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What Do Economists Have to Say about the Clean Air Act 50 Years after the Establishment of the Environmental Protection Agency?

Janet Currie and Reed Walker

Air quality in the United States has improved dramatically over the past 50 years. Since 1980, ambient levels of "criteria" air pollutants—those pollutants that are most consistently monitored by the Environmental Protection Agency (EPA) because they are known to be harmful for human health—have fallen substantially, as shown in Figure 1. Some pollutants, such as lead in gasoline, were banned outright. This decline in pollution has occurred even while primary sources of air pollution such as electricity generation, transportation, and industrial activity have continued to expand. How can air quality have improved so dramatically when the underlying sources of pollution have continued to grow? One important reason is the introduction of the Clean Air Act and the creation of the EPA to enforce it, almost 50 years ago.

The 1970 Clean Air Act, combined with significant amendments in 1977 and 1990 and more recent changes that reflect the evolution of scientific consensus, has had an expansive reach. Indeed, some researchers and policymakers have described the Clean Air Act as one of the most significant federal interventions into markets in the postwar period (Greenstone 2002). How large are the costs that the Clean Air Act imposes on producers and consumers, both in absolute terms and per additional unit of pollution reduction? And how do the costs compare with the benefits? Economists and policymakers have attempted to provide answers to these questions since the Clean Air Act was first proposed.

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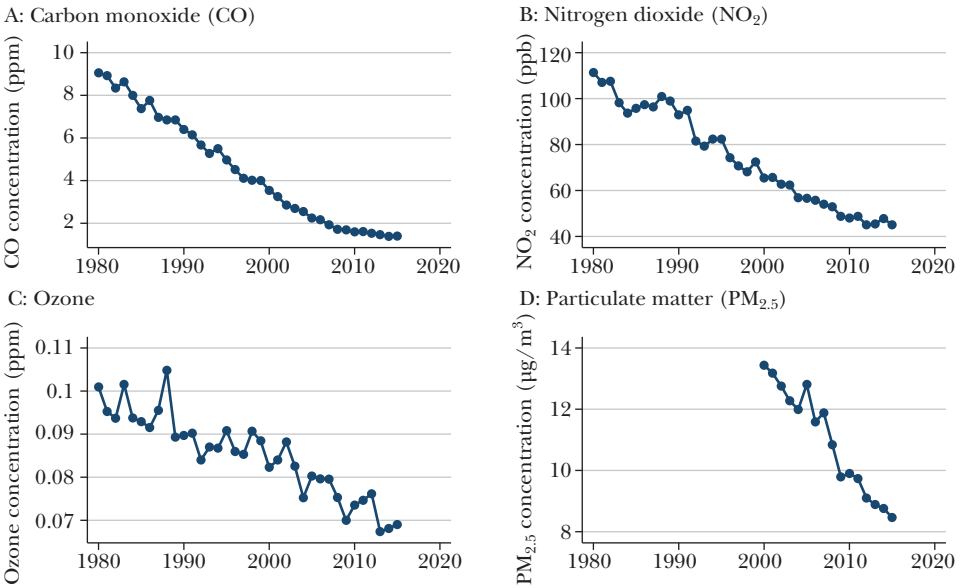
Figure 1
Trends in Air Pollution in the United States, 1980 to 2015



Source: Authors, using data from the Environmental Protection Agency's Air Quality System.
Note: Each annual average is computed based on the criteria set under the National Ambient Air Quality Standards. Carbon monoxide is measured as the second-highest eight-hour average. Nitrogen dioxide is measured as the ninety-eighth percentile of daily maximum one-hour average. Ozone is measured as the fourth-highest daily maximum eight-hour concentration. $PM_{2.5}$ is measured as an annual average. Abbreviations: ppm is parts per million; ppb is parts per billion; $\mu g/m^3$ is micrograms per cubic meter.

This article is a reflection on the 50-year anniversary of the creation of the Environmental Protection Agency and the passage of the 1970 Clean Air Act, describing what researchers and policymakers know about the ways in which the Clean Air Act has shaped our society in terms of costs, benefits, and important distributional concerns. We begin with a short overview of how the legislation has evolved. We then discuss how the Clean Air Act has affected ambient air quality in the United States, before turning to what the literature suggests about how to value these benefits. In the case of economic costs, we focus both on positive and normative findings—attempting to take stock of what we know about the effects of the Clean Air Act and also about how the Clean Air Act could be made more efficient or cost effective. We conclude with a discussion of how recent changes to both policy and technology present new opportunities for researchers in this area.

Background

The federal Clean Air Act was first implemented in 1963, but the original legislation provided only limited federal oversight of state efforts and led to disappointing

results. In response, Congress enacted the Clean Air Act amendments of 1970 and established the Environmental Protection Agency, vastly increasing federal power to address the problem of air pollution.

The Clean Air Act of 1970 initially relied exclusively on "command-and-control" regulations that were set using criteria that focused on the health benefits of cleaner air without regard to the economic costs of cleanup. The law also gave sweeping powers to a new federal government agency, the Environmental Protection Agency, to mandate specific mitigation measures. The legislation focused on common, dangerous air pollutants known as "criteria air pollutants." Today the criteria pollutants include sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, particulates, and ozone. National ambient air quality standards set the maximum allowable ambient pollution levels, and these standards are enforced locally on an annual basis.

Each year in July, the Environmental Protection Agency determines the set of counties that are in "nonattainment" of a particular standard. State governments must develop a pollutant-specific "State Implementation Plan" describing how these nonattainment counties will be brought into compliance. If a state fails to act or develops an inadequate plan, the EPA can withhold federal funding for the state air pollution control program, highway construction, and the construction of sewage treatment plants. The EPA can also ban permits for construction of major new and/or modified sources of a pollutant. In addition, the EPA can impose its own federal plan on nonattainment counties if it deems a state's plan to be insufficient. The EPA sets industry-specific emissions standards for new or modified sources of pollution in nonattainment counties, whereby affected facilities are required to adopt "lowest achievable emissions rate" technologies.[1] In addition, the EPA regulates mobile sources including most motor vehicles under the Clean Air Act, wielding the power to impose testing and certification requirements for engines and to require specific fuel formulations and additives. Thus, the Clean Air Act gives the EPA sweeping powers. These powers are sufficiently broad that even the threat of regulatory action has been associated with reductions in pollution (Keohane, Mansur, and Voynov 2009).

Since 1970, there have been two major amendments to the Clean Air Act, one in 1977 and one in 1990. These amendments largely maintained and extended the command-and-control approach to regulation, but the latter also introduced some more market-based approaches into the regulatory mix. The 1977 amendments introduced "New Source Review," a policy designed to regulate major new or modified sources of pollution in *attainment* counties, whereas facilities in those counties had not previously faced much regulatory scrutiny. In nonattainment areas, regulations were tightened such that any new stationary source of air pollution was required to offset its emissions by finding a counterpart in the same area willing to reduce its emissions one for one. These amendments also established major permit review requirements to ensure compliance with the air quality standards.

[1] Existing facilities in nonattainment areas are grandfathered in the sense that they are required only to install "reasonably available control technologies," which is a considerably less stringent standard.

The 1990 amendments updated national ambient air quality standards and continued to broaden the Environmental Protection Agency's enforcement powers, as well as creating important new market-based mechanisms, including the sulfur dioxide allowance-trading program to address the threat of acid rain. In a far-reaching development, the amendments mandated lead-free gasoline (as of 1995), established new auto gasoline reformulation requirements designed to produce cleaner-burning gasoline, set standards to control evaporative emissions from gasoline, and mandated that new gasoline formulations be sold from May to September in many states in an effort to reduce ozone. The amendments also required automobile manufacturers to further reduce tailpipe emissions from new vehicle fleets.

In another notable development extending the regulatory authority of the Environmental Protection Agency under the Clean Air Act, the 1990 amendments began regulating "toxic" air pollutants, identifying 189 hazardous air pollutants and requiring that the EPA establish emission standards that provide for "an ample margin of safety to protect public health" by minimizing the amount of toxic pollution released into the air to the extent that technology allows.

Air quality rules have continued to evolve to reflect scientific consensus. For example, in 1997, standards were tightened for ozone, and particles less than 2.5 micrometers in diameter were regulated for the first time. The fine-particle standard was revised downward in 2006 and 2012. Ozone regulations were further tightened in 2008 and 2015. In 2000, the Environmental Protection Agency finalized a rule requiring additional reductions in automobile emissions along with requirements (called "Tier 2 standards") for cleaner automotive fuels. Beginning in the 2000s, the EPA also adopted provisions to prevent upwind areas from polluting downwind areas, particularly in the case of ozone. These regional policies started with the NO_x Budget Trading Program (2003–2008), which evolved into the Clean Air Interstate Rule (2010–2015), which subsequently evolved into the Cross-State Air Pollution Rule, governing ozone precursors and SO_2 emissions in the northeastern United States.

To summarize, the Clean Air Act has given the federal Environmental Protection Agency sweeping powers to regulate virtually all industrial activities in the United States. These powers have been extended over time through the 1977 and 1990 amendments as well as subsequent smaller regulatory changes. The existing regulatory framework is extraordinarily complex, potentially creating substantial regulatory burden for affected firms. These regulations have also led to substantial improvements in air quality and associated public health. We discuss each in more detail below.

In discussing this body of work, it is useful to remind ourselves what economic theory suggests as the key parameters that govern the efficiency or cost effectiveness of environmental policy. The optimal level of pollution in society occurs where the marginal costs of reducing emissions by one unit are exactly equal to the marginal social benefit of that same reduction in air emissions. Thus, understanding and estimating marginal abatement costs and/or marginal social benefits would allow researchers and policymakers to have a better understanding as to which of the existing regulatory instruments are most cost effective and which we should

reconsider. It would also allow us to have a better understanding of whether existing regulations are too lax or too stringent. Economists are still far from being able to accomplish that goal for every regulatory component of the Clean Air Act, but it is useful to keep it in mind as we discuss existing studies that may be stepping-stones on that path.

Benefits of the Clean Air Act: Falling Pollution, Improved Health

Estimates of the benefits of clean air legislation are built on three foundational questions: How much did the legislation reduce pollution? How much does a reduction in pollution affect human health? How do we place a monetary value on these health effects, so that they can be compared with costs? Because the existing regulations affect certain areas more than others, economists have used this regulatory variation to construct a variety of counterfactuals for what air quality would be in the absence of the policy. For example, polluting firms in nonattainment counties are more heavily regulated than similar firms in other counties, attainment is based on whether a county is above or below a sharp cutoff for each pollutant, only some counties are in nonattainment in any given year, and counties move in and out of attainment status according to their pollution levels each year. Moreover, county attainment status is only partially in the control of county-level actors, because some air pollution can blow in from neighboring counties. This temporal and spatial variation facilitates air quality comparisons of affected and unaffected counties through the use of research designs such as regression discontinuity, difference-in-difference, and/or instrumental variables. Such research has provided compelling evidence as to the ways in which the Clean Air Act has shaped both air quality and population health over the past 50 years.

Effects of the Clean Air Act on Air Quality

How much of the dramatic reduction in air pollution over the past 50 years can be attributed to the Clean Air Act? Henderson (1996) was the first to recognize that the regulatory variation embedded into the Clean Air Act lends itself to exploring the causal effects of the policy. He examines the effect of ozone regulations between 1977 and 1987, comparing changes in air quality in newly designated nonattainment counties with changes in air quality in counties that were in compliance with the ozone standard. He finds that a switch to nonattainment status reduced ozone concentrations by 3 to 8 percent, depending on the measure.

Considerable research has followed along similar lines. For example, Chay and Greenstone (2003) explore the extent to which the original nonattainment designations in 1970 for total suspended particulates are associated with improved air quality in affected regions. They found a 10 percent improvement in air quality in the years after the regulations went into place in affected counties. Auffhammer, Bento, and Lowe (2009) examine the impact of changes following the 1990 Clean Air Act amendments, and they find that nonattainment designation led to air

quality improvements (11–14 percent), but primarily in the set of communities directly adjacent to the violating air quality monitor. More recent work has explored the air quality improvements associated with the 1997 tightening of fine particulate standards, with Bishop, Ketcham, and Kuminoff (2018) and Currie, Voorheis, and Walker (2019) finding statistically significant improvements in air quality of around 10 percent below baseline levels. In summary, there is a range of compelling evidence that nonattainment designations improve local air quality on average, and especially in areas where pollution is initially most severe.

Other research has focused on the regional air quality programs under the Clean Air Act, such as the NO_x Budget Trading Program (Deschênes, Greenstone, and Shapiro 2017), the SO_2 Acid Rain Program (Barreca, Neidell, and Sanders 2017; H. Chan et al. 2018), and the Clean Air Interstate Rule (Murphy 2017). The NO_x Budget Trading Program operated a cap-and-trade system for over 2,500 electricity-generating units and industrial boilers in the eastern and midwestern United States between 2003 and 2008. Using a difference-in-differences design, Deschênes, Greenstone, and Shapiro (2017) find a 40 percent decline in NO_x emissions leading to a 6 percent reduction in ozone concentrations, with most of the benefits at the upper end of the pollution distribution (for example, the number of days with ozone above 65 parts per billion fell by 35 percent).

One potential issue with permit trading of pollution emissions is that the incremental damages from pollution may differ across locations, but most market-based regulations penalize emissions at the same tax rate or permit price regardless of location. These "undifferentiated" policies can have significant distributional consequences and have led to contentious debates. For example, H. Chan et al. (2018) argue that by allowing permits to be traded between relatively less populous areas with low abatement costs and relatively densely populated areas with high abatement costs, the SO_2 Acid Rain Program achieved lower gains in health than a counterfactual program that would have simply mandated equal reductions across areas.[2] In another example, Fowlie (2010) studies the introduction of the NO_x budget program and the way that it interacted with electricity market deregulation and the restructuring of regional electricity markets that was occurring at that time. The harm from NO_x is localized, so the distribution of pollution sources matters. Fowlie points out that under existing cost-plus utility regulation, electricity producers faced a known return on investing in costly pollution abatement equipment and had stronger incentives to invest in abatement. In the set of electricity markets that were eventually deregulated, uncertain returns discouraged some low-abatement-cost producers from investing in abatement, offsetting some of the possible efficiency gains of the emissions trading program. In the end, pollution abatement under this particular permit program was not concentrated in the highest-marginal-harm locations.

[2]Fowlie, Holland, and Mansur (2012) explore the distributional implications of the Regional Clean Air Incentives Market (RECLAIM) in Southern California. RECLAIM was also the subject of litigation claiming that it exacerbated inequalities in environmental exposures, although Fowlie, Holland, and Mansur (2012) find no evidence that this was the case.

Looking forward, efficient policy design for pollutants with strongly local impacts requires a nuanced understanding of location-specific heterogeneity in damages as well as abatement costs. The considerable uncertainties associated with both damage and cost estimates also have direct implications for the optimal design of these policies. For example, Fowlie and Muller (2013) explore whether market-based policies can be designed to deal with pollutants like NO_x that are not "uniformly mixed." They show that when damages or abatement costs are uncertain, undifferentiated emissions trading policies can be better than differentiated policies that impose higher costs in more polluted areas.

Even though automobile emissions have historically accounted for a large fraction of criteria emissions, there has been comparatively less research on the efficacy of various mobile emissions standards for overall air quality improvements. Overall, automobile emissions have clearly declined. For example, on-road vehicle emissions accounted for 70 percent of carbon monoxide emissions in 1970 and 31 percent in 2017. Similarly, on-road vehicle emissions accounted for 49 percent of volatile organic compound emissions (an ozone precursor) in 1970 and 11 percent in 2017, according to the National Emissions Inventory data (available at https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data; accessed January 15, 2019). However, relatively little research has sought to isolate the causal effect of mobile emissions standards on overall air quality improvements. The limited existing research generally describes model-year trends before and after a standards change using a cross section of vehicles (Kahn 1996), or describes data on abatement technologies (but not emissions levels) for different vehicle types (Bresnahan and Yao 1985). Part of the difficulty may be that emissions standards apply to the entire vehicle fleet in a given year, making it challenging for researchers to separate changes in tailpipe standards from other secular trends affecting ambient air quality.

The 1990 amendments to the Clean Air Act required the elimination of lead from gasoline. The available evidence suggests that the elimination of leaded gasoline reduced children's blood lead levels dramatically in a short period of time (Aizer and Currie forthcoming). The amendments also included provisions about reformulated gasoline that were intended to reduce ozone precursors (such as volatile organic compounds) from mobile sources. Reformulated gasoline is federally mandated in areas that are in severe nonattainment of the ozone standard. Less polluted areas that do not meet the ozone standard may opt into federal standards for reformulated gasoline as part of their plan to reach attainment. Auffhammer and Kellogg (2011) find limited evidence of air quality improvements in affected regions despite the fact that consumers must pay for the more expensive reformulated gasoline.

Finally, the Clean Air Act has promulgated a significant number of emissions standards for hazardous air pollutants through its air toxics regulatory program. As mentioned, these regulations require the Environmental Protection Agency to develop maximum achievable control technology standards for over 180 toxic pollutants. While these standards are wide-reaching, the large number of regulated pollutants has precluded comprehensive analysis by economists. Currie et al. (2015) use data from hazardous air pollution monitors to show the relationship

between a subset of these regulated, toxic chemicals and distance from emitting facilities. They then use the openings and closings of these emitting facilities to better understand the ways in which these hazardous air pollutants affect local air quality and population health. They find significant effects of these plant openings/closings on measures of hazardous air quality, and ultimately population health, in the surrounding communities.

The Benefits of Pollution Reduction

Even if academics and policymakers understood perfectly how the Clean Air Act has affected air quality, it is unclear how we should value these improvements. A first step in understanding the value of air quality improvements is developing a better understanding of the various ways in which air pollution can affect societal outcomes. The next step, and one that is currently missing from the literature, is to translate these various impacts into a pollutant-specific damage function that can be used for policy analysis and valuation.[3]

Economists have examined the effects of pollution on health, housing prices, and worker productivity, asking whether observed correlations are causal or whether they may be better explained by an omitted "third factor" such as low income. Researchers have developed a range of solutions to the problem of identifying causal effects, including using natural experiments and/or instrumental variables research designs to break the correlation between pollution exposure and omitted variables that might be correlated with both pollution and outcomes.

Work on the health effects of pollution has often focused on infants and young children, as well as the elderly. This focus is partly because these groups are thought to be particularly vulnerable to air pollution. In one of the first economic studies of this question, Chay and Greenstone (2003) use the county-year variation in regulation, stemming from the initial implementation of the National Ambient Air Quality Standards, to compare the incidence of low birth weight and infant mortality in counties just above the nonattainment threshold and those just below when the law was introduced. They found that a regulation-induced, one-unit decline in total suspended particulates led to 5 to 8 fewer infant deaths per 100,000 live births, relative to attainment counties. Almond, Currie, and Duque (2018) review the recent literature on the effects of air pollution on young children.

A number of studies have explored contemporaneous relationships between air pollution spikes and hospital admissions for respiratory disease. Ransom and Pope (1995) look at the effects of intermittent shutdowns of a large steel mill on children in the surrounding areas. Schlenker and Walker (2016) explore daily changes in pollution levels in areas around California airports. Daily spikes in air pollution do cause increases in admissions for asthma and respiratory illnesses, with large effects for both children and the elderly.

[3]We discuss concentration-response functions relating pollution to mortality below, but these do not encompass other potential impacts of pollution, nor do they reflect a welfare measure of social costs.

Deryugina et al. (forthcoming) also explore the relationships between daily changes in pollution exposure and population health, exploiting changes in regional wind direction that drive daily pollution levels. They use claims data from Medicare, which covers all Americans over 65, and ask how daily spikes in atmospheric particulate matter less than 2.5 micrometers in diameter affect mortality. An innovative feature of their study is that they not only look at the number of deaths, but also estimate the number of life years lost as a result of pollution. They do this by predicting individual life expectancy using each person's health history. They find that a reduction in fine particles of approximately 4 micrograms per cubic meter between 1999 and 2011 resulted in a gain of a little over a month of life per elderly person. While these studies of pollution spikes and daily changes provide compelling evidence of harmful effects of pollution, they necessarily ignore some of the longer-run implications of pollution on health outcomes.

A smaller but growing literature explores how increased pollution levels are likely to affect outcomes apart from direct health measures, including labor productivity, cognition (as measured by test scores), educational attainment, and even crime; see Graff Zivin and Neidell (2013) for a comprehensive review of this literature.

Several studies examine the impact of short-term variations in pollution on labor supply and worker productivity. In an early paper on this topic, Graff Zivin and Neidell (2012) examine piece-rate workers in California and find that variations in ozone have significant effects on both hours worked and productivity: an increase of 10 parts per billion (on a mean of 48 parts per billion) decreases worker hours by 20 minutes and reduces productivity by 0.12 standard deviations.

Isen, Rossin-Slater, and Walker (2017) build on the Chay and Greenstone (2003) study by following the cohorts who were born just before and just after the passage of the 1970 Clean Air Act into adulthood. Cohorts who were born before 1970, and exposed to relatively high air pollution, look different on a range of outcomes, measured at age 30, compared with cohorts born after the relative improvements in air quality. They find that a decrease of 10 micrograms per cubic meter in total suspended particulates in the air breathed during gestation and early childhood was associated with a 1 percent increase in annual earnings at age 29 to 31, which works out to a lifetime income gain of $4,300 (in 2008 dollars) per affected person. Most of this effect comes from increased labor force participation rather than changes in on-the-job earnings, suggesting that reductions in disability may be an important pathway.

Declines in airborne lead, due to the elimination of lead from gasoline, are also likely to have had far-reaching effects. Aizer et al. (2018) link preschool children's blood lead levels to their future test scores and disciplinary records and find that declines in lead increased children's test scores and reduced behavior problems and delinquency. Aizer and Currie (forthcoming) focus specifically on lead from gasoline and show that individuals affected by the deleading of gasoline were less likely to be delinquent or to commit crime, a finding that echoes earlier work using cohort-level analyses (for example, Reyes 2007).

Monetizing Benefits

The studies discussed so far establish that the Clean Air Act reduced pollution, and that pollution reductions have positive effects on health and well-being, as well as areas like worker productivity. But a benefit-cost analysis requires an additional step: putting a monetary value on the benefits. Attempts to put a dollar benefit on health improvements have typically involved two key ingredients: (1) estimates of the value of a "statistical life" and (2) a concentration-response function relating pollution exposure and mortality risk.

The value of a statistical life is an estimate of how much people are willing to pay for small reductions in the risk of death. The Environmental Protection Agency recommends that analysts use an estimate of $7.4 million (in 2006 dollars) to quantify mortality risk reduction benefits, which is approximately the middle of the range of available estimates (for a review, see Viscusi and Aldy 2003). This "one-size-fits-all" estimate is potentially problematic given that pollution disproportionately affects the health of the very young and the very old, and willingness to pay for reductions in mortality risk may vary by age. Indeed, some researchers have begun using quality-adjusted life years (QALYs) in place of a single value of a statistical life measure (for example, Deschênes and Greenstone 2011; Deryugina et al. forthcoming).

Concentration-response functions describe how changes in air quality affect mortality risks or other measures of health and well-being. For example, the Environmental Protection Agency uses two key studies to evaluate the benefits of proposed and existing reductions in atmospheric particulate matter less than 2.5 micrometers in diameter (Krewski et al. 2009; Lepeule et al. 2012). Researchers face a number of significant difficulties when estimating concentration-response functions for air pollution. First, the existing concentration-response estimates used by the EPA are unlikely to represent causal relationships. They are based on cross-sectional data (like cross-city comparisons) that control for some observable confounders, but there may be many other correlated, but unobserved, factors that impact both mortality and pollution. Second, significant biases may arise due to the difficulty of measuring an individual's air pollution exposure. Third, these studies focus primarily on mortality, ignoring other pernicious effects of air pollution. Fourth, pollutants are often highly correlated, and it is difficult to say empirically which of the pollutants is responsible for the observed damages. Fifth, concentration-response functions potentially vary for different groups in the population. Sixth, the more compelling studies of concentration-response functions rely on high-frequency, short-run variations in pollution levels—on the days when air pollution rises in a given city, we can observe a corresponding change in mortality or morbidity rates. However, from a policy perspective, we are often most interested in how long-run changes in pollution map onto population health and well-being.

Finally, if people take actions to avoid pollution exposure, then estimates of the effects of pollution that do not take such defensive, avoidance behavior into account will have a downward bias. For example, Moretti and Neidell (2011) show

that taking account of the avoidance behavior generated by ozone alerts greatly increases the estimated effect of ozone emissions from the Port of Los Angeles on emergency room visits and hospitalizations for respiratory problems. An additional consideration is that avoiding pollution is itself costly, and any reduction in avoidance costs should be counted as a benefit of pollution reduction.

For all of these reasons, monetizing the marginal benefits of pollution control remains challenging. Some researchers have tried to monetize health impacts using hospital costs for respiratory or cardiac admissions (for example, Schlenker and Walker 2016). However, hospital reimbursement costs are poor measures of willingness to pay to avoid harm, which is ultimately what should enter into a proper concentration-response or damage function.

In a quest for a more encompassing welfare measure of air quality benefits, researchers have attempted to measure willingness to pay for air quality by using other methods such as those from stated or revealed preference studies. Stated preference methods, such as asking agents directly how much they value air quality ("contingent valuation"), have been criticized on a number of different grounds (Hausman 2012), except in cases of "passive use valuation" (Carson 2012). On the other hand, there has been an explosion of recent work on revealed preference measures to estimate willingness to pay for air quality. The most influential revealed preference approaches have come from hedonic housing value analyses—researchers have shown how agents trading off housing prices with housing amenities, including air quality, can provide information on willingness to pay for these amenities (Rosen 1974).

Starting with the groundbreaking work of Chay and Greenstone (2003), researchers have combined hedonic theory with causal methods to deliver a range of estimates of individual willingness to pay for air quality. For example, Chay and Greenstone (2005) use the national ambient air quality standards as an instrumental variable for air quality changes. Their instrumental variable estimates are much larger than ordinary least squares estimates and imply that each one-unit reduction in total suspended particulates increased home values by 0.7 to 1.5 percent. This translates into an estimated aggregate benefit of $4.5 billion per unit of total suspended particulate improvement for affected counties. There has been a subsequent growth of the hedonic valuation literature, providing willingness-to-pay estimates for many different aspects of Clean Air Act regulatory improvements.

These revealed preference approaches all find that people value cleaner air and are willing to pay for it in terms of housing prices, though there is less consensus about how much. Moreover, there are legitimate concerns about these approaches. The assumption that environmental factors are capitalized into housing prices, while convenient, requires that people are fully aware of both the pollution levels and the effects of pollution. This is certainly truer in some contexts than in others. If there are few housing sales in an area, it may not be possible to track the underlying value of housing capital with any precision. People may not always be able to move in response to shifts in pollution, if, for example, they are

credit constrained. Developing robust and generalizable approaches for recovering empirical measures of the welfare benefits associated with pollution control remains a high research priority.

A number of researchers have explored the monetary benefits of a specific component of the Clean Air Act, but there have been few serious efforts to estimate the total benefits associated with the combined policies—the Environmental Protection Agency (2011) study notwithstanding. For example, Chay and Greenstone (2005) suggest that regulation of total suspended particulates in the 1970s was associated with a $45 billion aggregate increase in housing values in nonattainment counties (relative to their attainment counterparts). Barreca, Neidell, and Sanders (2017) focus on the long-term effects of the SO_2 permit trading program introduced after the 1990 amendments to the Clean Air Act. Their design involves comparing adult mortality rates within a 100-mile radius of affected power plants to those in similar, unaffected counties. They estimate that the annual value of lives saved reached $134 billion per year by 2005, compared with program costs of approximately $3 billion per year.

The estimated benefits of cleaner air have been demonstrated to be large and significant. Yet key questions need further research: How much of the overall improvement in ambient pollution concentrations can be traced back to the Clean Air Act? In turn, how much of the reduction in infant mortality and of the overall increase in life expectancy can be attributed to the Clean Air Act rather than to improvements in medical care, living standards, and other factors? And have the benefits been uniform, or have some groups benefited substantially more than others from clearing the air? Last, and perhaps most important, what does the damage function look like for each regulated pollutant, and what are the marginal social benefits of improving air quality further?

Regulatory Costs of the Clean Air Act

From a social welfare perspective, the correct theoretical measure of the costs of environmental regulation is the (monetized) change in social welfare due to the reallocation of resources from the production of goods and services to pollution abatement activities (Hazilla and Kopp 1990). For this reason, private expenditures on compliance costs or engineering cost estimates are insufficient measures of economic costs, especially if there are significant general equilibrium impacts that extend beyond the directly regulated sector. Estimates of total costs should also include monitoring and enforcement.

Understanding the direct and indirect costs of the Clean Air Act is exceedingly difficult. It is hard to think of a credible counterfactual for what the US economy would look like if clean air legislation had never been enacted! Thus, the existing estimates of the economic costs of regulation have relied on a range of sources and methods that can broadly be classified into three categories: papers that seek to identify causal effects that the Clean Air Act has had on a range of different outcomes, using methods similar to those used in papers on the effects of pollution and health

described above; empirical industrial organization studies of a single industry that are used to estimate counterfactuals with and without regulation; and computable general equilibrium models of the entire economy, which are used to conduct counterfactual analyses of costs/output under different regulatory regimes. Each of these approaches has strengths and weaknesses.[4] An overall takeaway is that while we do not have a complete and accurate measurement of the total cost of the Clean Air Act, the current estimates suggest that the overall costs are likely to have been substantially less than the estimated benefits in terms of health and other outcomes.

Estimating Compliance Costs Based on Regulatory Variation in the Clean Air Act

Features of regulatory roll-out or design can be used to form counterfactuals for what regulated industries would have looked like in the absence of the program. For example, a number of different researchers have used the county-industry-year variation embedded in changes in air quality standards to estimate effects on a range of economic outcomes. Henderson (1996) shows that polluting industries in nonattainment counties exhibit lower growth rates, and that these effects are partly driven by the reallocation of industry to attainment counties. Kahn and Mansur (2013) similarly find that polluting firms tend to locate in areas not subject to the nonattainment designations of the Clean Air Act. One county's loss may be another county's gain in terms of jobs and production, so that focusing only on short-run losses in nonattainment counties relative to attainment counties may be a misleading way to infer economic impacts, a point to which we will return.

Similarly, Becker and Henderson (2000) use plant-level data to examine the effects of ozone nonattainment status. From 1963 to 1992, they find a 25 to 45 percent drop in the number of new plant openings in polluting industries in nonattainment counties, relative to polluting industries in attainment counties. Focusing on two industries that are large emitters, they find that total plant operating costs are higher in ozone nonattainment counties. For example, plants in the industrial organic chemicals industry had 17 percent higher total operating costs in ozone nonattainment areas compared with similar plants in attainment areas. To summarize, there is wide-ranging evidence that these regulations have led to relative shifts in production away from nonattainment counties.

A series of papers have explored the extent to which these same regulations affect input demand for productive inputs like capital or labor. Greenstone (2002) makes an early attempt to shed light on this question. He uses data from the 1967 to 1987 Census of Manufacturers to examine the extent to which Clean Air Act nonattainment designations affected plant input and output decisions. He estimates that in the first 15 years in which the Clean Air Act was in force (1972–1987),

[4]One could also try to quantify the costs of compliance by asking business owners about them, as was done in the Pollution Abatement Costs and Expenditures (PACE) survey. However, Jaffe et al. (1995) argue that the PACE data are "notoriously unreliable" (see also Becker and Henderson 2000). Due to budget constraints and the inherent problems of the survey, the Census Bureau stopped conducting the PACE survey in 2005.

nonattainment counties (relative to attainment ones) lost approximately 590,000 jobs, $37 billion in capital stock, and $75 billion of output in pollution-intensive industries (1987 dollars).

From a social welfare perspective, the overall effect of "jobs lost," plant exit, or output losses in an area is unclear. If a worker loses a job due to a new regulation, but finds a job tomorrow at the exact same wage, these costs may be minimal. In contrast, if a worker is unemployed for long periods of time and/or cannot find a comparable paying job in future years, these transitional costs of reallocating production may be quite large. There may also be capital adjustment costs and other allocative inefficiencies associated with reallocation. Walker (2013) investigates the transitional costs of the 1990 Clean Air Act amendments for manufacturing workers by combining the county-pollutant-year regulatory variation of the changes in air quality standards with longitudinal data on workers before and after a change in county-level attainment status. He finds that workers in newly regulated plants lost $5.4 billion (in 1990 dollars) in earnings due to the amendments and that these costs were mostly accounted for by a combination of delay in finding a new job elsewhere and lower earnings in future jobs. These losses are substantial, but also quite small relative to the estimated health benefits of the 1990 amendments.

Other researchers have tried to estimate the economic costs associated with this regulation-induced reallocation of production. For example, Greenstone, List, and Syverson (2012) examine the effects of the Clean Air Act on manufacturing total factor productivity. They explore how total factor productivity of polluting establishments in nonattainment counties changes relative to the productivity of polluting firms in attainment counties. They then convert these estimates into foregone output or losses to social welfare. Their estimated loss of total factor productivity in nonattainment counties corresponds to an annual economic cost from the regulation of manufacturing plants of roughly $21 billion, or about 9 percent of manufacturing sector profits in this period. One potential limitation of this study is that it ignores pollution as a factor of production. This may lead to bias when measuring total factor productivity; if a regulation induces firms to use less pollution (that is, fewer unmeasured inputs), then it may look like total factor productivity declines when in fact the "true" regulation-induced productivity change remains elusive.

There are clear trade-offs that researchers face when relying on "program evaluation" methods to answer questions pertaining to the costs of policy. For example, if economic activity is being reallocated from more regulated to less regulated areas, then economic activity in attainment areas will serve as a poor counterfactual for nonattainment areas. One potential solution to these problems comes from the growing literature in macroeconomics and international economics that considers problems of how to aggregate difference-in-difference estimates that rely on relative comparisons between potentially linked economic units (for example, see Nakamura and Steinsson 2018; Adão, Arkolakis, and Esposito 2019).

A more fundamental problem is that the answers obtained from many of these studies are often divorced from economic ideas of efficiency costs or welfare. For example, it is not clear how to interpret findings that plant entry decreases and

plant exit increases in response to tighter air quality standards. Other fields within economics may be able to provide useful insights. For example, papers in public finance have considered the welfare and incidence of changes in state corporate tax rates, recognizing that firms may move in response to tax changes. Suárez-Serrato and Zidar (2016) relate changes in firm entry/exit elasticities to welfare metrics that could prove fruitful in the welfare analysis of clean air regulations. Similarly, the idea that the Clean Air Act distorts production decisions is well appreciated, but researchers have almost no understanding of the allocative efficiency losses associated with these distortions. Fajgelbaum et al. (2019) propose methods to understand how variation in state corporate taxes may lead to allocative inefficiencies in production and economic costs to society, and the same technology may be well suited to shed light on the allocative inefficiencies associated with the Clean Air Act.

Relatedly, more work estimating the effects of the Clean Air Act on outcomes connected to welfare and incidence (for example, via prices, markups, and marginal costs) would be of tremendous value, as would work that more carefully considers input-output linkages, since the latter are likely to affect the overall cost of the Clean Air Act.[5]

Estimating Compliance Costs Based on Structural Models of Single Industries

A second approach to estimating the compliance costs of the Clean Air Act comes from the "New Empirical Industrial Organization" industry-based studies. These studies focus on a single industry and devote careful attention to institutional details, measurement of key variables, and econometric identification issues. This approach aims to get inside the black box of Clean Air Act regulations to understand the mechanisms underlying how they work. The hope is that the research community can learn generalizable insights starting from a relatively narrow focus. However, intra-industry linkages, which may be a significant component of the overall costs, are often willfully ignored in this approach.

As one example of this style of research, Ryan (2012) focuses on how the Clean Air Act affected the Portland cement industry. Some relevant features of the industry are high transportation costs and large fixed costs of entry, leading to the possibility of local monopoly. By increasing entry costs, the Clean Air Act can exacerbate monopoly power, potentially harming consumers. Using a dynamic oligopoly model, Ryan (2012) estimates that the entry costs created by the Clean Air Act led to multibillion-dollar losses of consumer surplus in this single industry. Clearly, evaluations of the welfare costs of the Clean Air Act should consider possible anticompetitive implications of the policy.

Empirical methods meant to model the specific details of a single industry have proven particularly useful for understanding how subcomponents of the Clean Air Act, such as the Acid Rain Program, have affected the US electricity generation

[5] Ganapati, Shapiro, and Walker (forthcoming) explore the effects of energy prices on prices, markups, and marginal costs, and the methods in their paper are well suited to understanding the changes in welfare and incidence associated with Clean Air Act regulatory changes.

industry. By constructing a detailed model of electricity markets, researchers have explored the cost implications of tradable permit markets—either relative to a no-regulation counterfactual or compared with conventional command-and-control benchmarks (for example, Ellerman et al. 2000; Fowlie 2010; Fowlie and Muller 2013; H. Chan et al. 2018). H. Chan et al. (2018) use this approach to estimate the cost savings under Phase II of the Acid Rain Program, finding that cost savings from emissions trading are $210–$240 million (in 1995 dollars) per year. In a review of various analyses, G. Chan et al. (2012) suggest that sulfur dioxide allowance trading under the Acid Rain Program contributed to cost savings of between 15 and 90 percent compared with conventional performance standards.

While single-industry studies are increasingly being used to understand the regulatory implications of the Clean Air Act for consumers and producers, results may not generalize to other industries/markets. Moreover, most of these models are necessarily partial equilibrium in nature, so that they do not account for effects on other sectors through forward and backward input-output linkages. Busse and Keohane (2007) offer an interesting example of how these linkages can matter, by showing that railways transporting coal to electricity-generating plants that were subject to Clean Air Act requirements to reduce sulfur dioxide emissions were able to exert market power and increase prices. Lastly, these models have been criticized for relying on strong modeling and equilibrium assumptions that can obscure the link between the underlying data and the estimates.

Estimating Compliance Costs Based on Computable General Equilibrium Models

Computable general equilibrium models offer a third way to investigate the compliance costs of the Clean Air Act. These models capture three types of costs that are typically omitted from other models: substitution effects that result from the price changes associated with environmental regulations (for example, the substitution of "clean" for "dirty" goods in consumption, or the substitution of leisure for labor as goods become more expensive), investment effects, and effects on productivity growth. These models also have the advantage that they can be used to estimate a wide variety of counterfactuals (both prospective and retrospective). Ho, Morgenstern, and Shih (2008) review more than a dozen prior US and European analyses based on computable general equilibrium models. As one example, Jorgenson and Wilcoxen (1990) use an intertemporal general equilibrium model to estimate that between 1974 and 1985 the mandated abatement costs of the Clean Air Act reduced the real growth rate of GNP by 0.2 percentage points per year, mostly through an increase in the cost of capital. Of course, GNP is not a welfare measure, and thus additional work is necessary to think about the welfare cost associated with this estimate.

The main drawback of these computable general equilibrium models is that they are not transparent and require many untestable assumptions. For example, the intergenerational general equilibrium model (Goettle et al. 2007) that has been used extensively by the Environmental Protection Agency and other organizations features over 2,000 equations that jointly define an equilibrium in each period. The complexity arises because these models must fully specify both the demand side and

the supply side of the economy, with a full set of demand elasticities and cross-price elasticities for each industry. In practice, these elasticities—which are often key to the results of the welfare analysis—are imputed or calibrated based on a range of difficult-to-test assumptions. These models often assume full employment, which assumes away regulation-induced unemployment and transition costs. Also, these models have a difficult time incorporating regulation-induced technological change.

While there are obvious potential advantages to using an equilibrium model to explore counterfactual policies, there may be room to improve on the existing work in this area. International trade, a field with a strong intellectual tradition of general equilibrium modeling, has made a number of quantitative advances recently emphasizing both model parsimony and empirical tractability (for example, see Caliendo and Parro 2015; Eaton et al. 2016; Redding 2016). Some of the methods from this literature may prove useful for understanding the economic costs of environmental policy. Shapiro and Walker (2018) borrow insights from this literature to try to better understand the role of environmental policy in explaining the substantial decline in pollution emissions from manufacturing since 1990. They find that virtually all of the observed reduction in pollution emissions can be explained by environmental policy rather than, for example, increases in trade exposure and production offshoring.

Predicted versus Actual Costs of the Clean Air Act

One defining feature of the research on the costs of the Clean Air Act is that predicted costs of the regulations are often higher than the costs that actually occur. Morgenstern (2018) provides an overview of the ways in which prospective and retrospective analyses have differed for nine separate environmental policies. There are at least four reasons why this pattern may arise.

First, firms are creative, while models are often parsimonious. It may be difficult to capture the full range of compliance opportunities available to firms in a prospective analysis.

Second, and relatedly, unforeseen changes in the economic environment may lead to substantial cost savings. A well-known example is the deregulation of the railroad industry and the sudden opening of access to low-sulfur coal in eastern states (Ellerman et al. 2000). This access to cheap, low-sulfur coal was a much more cost-effective compliance strategy for electricity-generating units under the Acid Rain Program than purchasing emissions permits and/or installing scrubbers. This is one possible reason why the actual costs of the Acid Rain Program were substantially lower than initially anticipated.

Third, regulations may increase the return to innovation in abatement, so that the resulting endogenous technical change drives abatement costs lower than earlier forecasts. Popp, Newell, and Jaffe (2010) provide an overview of empirical studies linking pollution abatement costs and expenditures with bursts of innovation as measured by environmental patents. However, credible, causal estimates of induced innovation are difficult to come by. A number of other factors such as greater trade openness and the availability of cheaper imports are also plausible candidates for the observed improvements in compliance technology costs over time.

Fourth, predicted costs of pollution abatement have sometimes failed to anticipate important interactions with existing policies and regulatory regimes. For example, Fowlie (2010) shows how a tradable permit program can be hindered by other regulations that prevent the permit market from reaching the least-cost solution for pollution abatement.

Although we have emphasized that forecasters have often overestimated the costs of environmental policies, researchers have also sometimes underestimated the benefits. For example, the primary rationale for the Acid Rain Program was the acidification of lakes in the Northeast. The primary anticipated benefit was therefore ecological. However, in the years following the initiation of the program, a new scientific consensus emerged about the harmful impacts of particulate matter on human health. The Acid Rain Program reduced particulate matter along with the targeted SO_2 reductions. Ultimately, over 95 percent of the benefits of the Acid Rain Program were associated with the human health impacts of reduced levels of particulate matter.

Distributional Effects

Even if overall costs and benefits balanced precisely, a law with the pervasive scope of the Clean Air Act is likely to have profound distributional effects depending on who benefits and who bears the costs. There is a body of evidence showing that poor and minority households are exposed to higher levels of air pollution on average, and these patterns have existed for as far back as measurement has been possible. This fact has inspired a great deal of research on "environmental justice," which is ably surveyed by Banzhaf, Ma, and Timmins (2019) in this journal.

If poor and minority persons are more likely to be exposed to pollution, then they may also have benefited disproportionately from antipollution policy. However, the evidence on the distribution of benefits of the Clean Air Act has been somewhat indirect, as researchers have much less information on the spatial distribution of air quality given the sparse pollution monitoring network. For example, fewer than 20 percent of US counties contain a single Environmental Protection Agency particulate monitor used to measure compliance with the Clean Air Act (Fowlie, Rubin, and Walker 2019). Researchers have shown that the 1990 Clean Air Act amendments improved air quality the most in the neighborhoods that surround a violating monitor (Auffhammer et al. 2009), and this has led the benefits of the air quality standards to be progressive in nature (Bento, Freedman, and Lang 2015). However, the evidence is necessarily incomplete given the limitations of the existing pollution monitoring network.

Recent improvements in satellite-based measurements of air quality have the potential to relax these existing research constraints. For example, Currie, Voorheis, and Walker (2019) use satellite-based measurements of particulate matter from 2000 to 2015, connected to Census demographic data, to show that recent changes to the Clean Air Act's particulate standard have contributed to disproportionate

improvements in air quality for African Americans over this time period. Other parts of the Clean Air Act, such as the elimination of lead in gasoline, have had a disproportionately positive effect on the test scores of minority children (Aizer et al. 2018).

In addition to being more likely to suffer exposure to pollution, poor and minority households may also suffer greater harm conditional on exposure. For example, the effects of air pollution may depend on underlying health; children are more likely to take up lead if they are nutritionally deficient in iron or zinc. The same potential exposure (in terms of, for example, outdoor ambient air quality) could also have a greater impact if disadvantaged people are less able to evade actual exposure; for instance, it may be harder to escape outdoor particulates in a drafty house than in a well-insulated one.

All of these arguments suggest that poor and minority households may have gained the most in terms of health from the targeted nature of the Clean Air Act enforcement; cleaning up the dirtiest regions first disproportionately improved air quality in low-income and minority communities.

While we believe improvements in health are first order, affecting many aspects of day-to-day life, there are additional, possibly second-order, distributional issues to be considered. Fullerton and Muehlegger (2017) suggest a number of reasons why the costs of environmental regulation may also be disproportionately borne by disadvantaged households. First, regulation may raise consumer prices and transportation costs, burdening poorer families, although robust empirical evidence on this point is lacking. Second, regulation of air pollution may induce firms to substitute to more capital-intensive technologies, thereby reducing demand for unskilled workers (Vona et al. 2018). Third, those who do not own homes or capital will miss out on the economic rents created by higher property values when pollution is reduced (Grainger 2012). Fourth, if cleaner areas gentrify, then lower-income residents, who are more likely to be renters than owners, may end up being pushed out by rising property values.

To summarize, the Clean Air Act is incredibly multifaceted and has most certainly led to significant benefits and costs to different stakeholders over time and across specific policies. To date, the evidence as to these distributional impacts is limited relative to the many possible impacts and mechanisms mentioned above. Going forward, understanding the distribution of the costs and benefits of environmental policy is crucial for policy design and welfare analysis and may also help shed light on the political economy of pollution control—an area that seems ripe for further study but has attracted relatively little research attention (for discussion of some exceptions, see Oates and Portney 2003).

Concluding Thoughts

The Clean Air Act is one of the most far-reaching pieces of regulatory legislation ever passed in the United States. Arguably, it affects just about all aspects of daily life, either directly through the air we breathe and the cars we drive or

indirectly by altering prices and the location of jobs and industries. The Clean Air Act is also incredibly complex, with many moving parts as well as both major alterations (especially the amendments of 1977 and 1990) and continual smaller revisions that may nonetheless have had important effects.

The research literature in this area suggests several broad conclusions. First, the Clean Air Act successfully reduced concentrations of regulated pollutions, although we do not know exactly how much of the spectacular reduction in pollution concentrations in the United States over the past 50 years can be attributed solely to the Clean Air Act. This reduction in pollution has had tangible benefits in terms of people's health and well-being, and people value those benefits. Second, the law has imposed substantial costs, and the costs are considerably greater than direct compliance costs alone. There has been a trend in regulatory policy toward flexible market mechanisms (like permit trading) to achieve compliance while minimizing costs. There are many virtues to these market-based approaches, not the least of which are strong static and dynamic incentives to achieve further emissions reductions that can be lacking in more prescriptive regulatory approaches. Third, there seems to be a general consensus that the benefits of clean air legislation over the past 50 years are likely to have greatly exceeded the costs. That said, it is simply not possible on the basis of the currently available evidence to add up the total benefits and/or the total costs, although the Environmental Protection Agency has tried (Environmental Protection Agency 2011). One step in that direction would be for researchers to contribute parameter estimates that facilitate "apples-to-apples" comparisons of benefits or costs across studies (for example, dollar per ton of pollution reduction). Finally, it seems that the benefits could have been achieved at far lower cost through more efficient policy choices.

In looking ahead at the near and medium term, here are at least four sets of developments that bear particular attention.

First, the Clean Air Act is struggling to come to grips with issues of greenhouse gas emissions. In *Massachusetts v. Environmental Protection Agency* (549 US 497 [2007]), the US Supreme Court had ruled that the EPA has the authority to regulate greenhouse gases. During the Obama administration, the EPA started a process to begin regulating emissions of greenhouse gases under the Clean Air Act. This decision led to various proposed rules: tighter emission standards for light-duty motor vehicles and certain larger "new and/or modified" stationary sources, as well as a national standard for greenhouse gas emissions from power plants. However, some of these plans were stayed by the Supreme Court in 2016, while others have been halted by the current administration. The Trump administration has replaced the Clean Power Plan of the Obama administration with its own, less-stringent Affordable Clean Energy rule, which focuses on making existing coal power plants more energy efficient.

Second, the Trump administration has rolled back more than ten regulations designed to protect air quality under the Clean Air Act, with an additional 14 currently being considered. Time will tell as to whether courts agree with the executive branch interpretation of how the law is written. Whatever the outcome

may be, these many changes present unique opportunities for empirically minded researchers to learn more about the ways in which these policies have led to measurable gains or losses to society.

Third, there have been dramatic improvements in technology for measuring air quality in recent years. For example, recent advances in satellite technology, combined with advances in prediction techniques—via machine learning—have allowed researchers to predict ground-level concentrations of particle matter less than 2.5 micrometers in diameter at fine spatial and temporal resolutions. For example, Di et al. (2016) provide daily pollution data on a one-kilometer grid. There are also hundreds of new, low-cost pollution monitors being offered to consumers in efforts to "crowdsource" measurement from the ground up. These monitors provide measures in real time and with considerable spatial coverage (for example, Fowlie 2019). These new ways to measure air pollution with unprecedented speed and granularity have considerable promise both for the design and implementation of Clean Air Act regulation, as well as for research on its consequences.

Finally, while the total benefits of the Clean Air Act appear much greater than the total costs, that does not inform us about the costs and benefits of an additional marginal unit of reduction in air pollution. Said differently, are we currently regulating pollutants in a way that maximizes social welfare—where the marginal benefit of a unit reduction in pollution emissions is equal to the marginal costs of abatement for that same unit of emissions reduction? This is one of the central questions in environmental policy, and the answer remains elusive. Our understanding of the benefits of improving air quality are changing rapidly with continued scientific discovery. Estimates of compliance costs are dropping due to ongoing innovations and technological breakthroughs in pollution abatement. These developments offer some exciting starting points for future research.

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References

Adão, Rodrigo, Costas Arkolakis, and Federico Esposito. 2019. "Spatial Linkages, Global Shocks, and Local Labor Markets: Theory and Evidence." NBER Working Paper 25544.

Aizer, Anna, and Janet Currie. Forthcoming. "Lead and Juvenile Delinquency: New Evidence from Linked Birth, School and Juvenile Detention Records." *Review of Economics and Statistics.*

Aizer, Anna, Janet Currie, Peter Simon, and Patrick Vivier. 2018. "Do Low Levels of Blood Lead Reduce Children's Future Test Scores?" *American Economic Journal: Applied Economics* 10 (1): 307–41.

Almond, Douglas, Janet Currie, and Valentina Duque. 2018. "Childhood Circumstances and Adult

Outcomes: Act II." *Journal of Economic Literature* 56 (4): 1360–446.

Auffhammer, Maximilian, Antonio M. Bento, and Scott E. Lowe. 2009. "Measuring the Effects of the Clean Air Act Amendments on Ambient PM_{10} Concentrations: The Critical Importance of a Spatially Disaggregated Analysis." *Journal of Environmental Economics and Management* 58 (1): 15–26.

Auffhammer, Maximilian, and Ryan Kellogg. 2011. "Clearing the Air? The Effects of Gasoline Content Regulation on Air Quality." *American Economic Review* 101 (6): 2687–722.

Banzhaf, Spencer, Lala Ma, and Christopher Timmins. 2019. "Environmental Justice: The Economics of Race, Place, and Pollution." *Journal of Economic Perspectives* 33 (1): 185–208.

Barreca, Alan I., Matthew Neidell, and Nicholas J. Sanders. 2017. "Long-Run Pollution Exposure and Adult Mortality: Evidence from the Acid Rain Program." NBER Working Paper 23524.

Becker, Randy, and Vernon Henderson. 2000. "Effects of Air Quality Regulation on Polluting Industries." *Journal of Political Economy* 108 (2): 379–421.

Bento, Antonio, Matthew Freedman, and Corey Lang. 2015. "Who Benefits from Environmental Regulation? Evidence from the Clean Air Act Amendments." *Review of Economics and Statistics* 97 (3): 610–22.

Bishop, Kelly C., Jonathan D. Ketcham, and Nicolai V. Kuminoff. 2018. "Hazed and Confused: The Effect of Air Pollution on Dementia." NBER Working Paper 24970.

Bresnahan, Timothy F., and Dennis A. Yao. 1985. "The Nonpecuniary Costs of Automobile Emissions Standards." *RAND Journal of Economics* 16 (4): 437–55.

Busse, Meghan R., and Nathaniel O. Keohane. 2007. "Market Effects of Environmental Regulation: Coal, Railroads, and the 1990 Clean Air Act." *RAND Journal of Economics* 38 (4): 1159–79.

Caliendo, Lorenzo, and Fernando Parro. 2015. "Estimates of the Trade and Welfare Effects of NAFTA." *Review of Economic Studies* 82 (1): 1–44.

Carson, Richard T. 2012. "Contingent Valuation: A Practical Alternative When Prices Aren't Available." *Journal of Economic Perspectives* 26 (4): 27–42.

Chan, Gabriel, Robert Stavins, Robert Stowe, and Richard Sweeney. 2012. "The SO_2 Allowance-Trading System and the Clean Air Act Amendments of 1990: Reflections on 20 Years of Policy Innovation." *National Tax Journal* 65 (2): 419–52.

Chan, H. Ron, B. Andrew Chupp, Maureen L. Cropper, and Nicholas Z. Muller. 2018. "The Impact of Trading on the Costs and Benefits of the Acid Rain Program." *Journal of Environmental Economics and Management* 88 (1): 180–209.

Chay, Kenneth Y., and Michael Greenstone. 2003. "Air Quality, Infant Mortality, and the Clean Air Act of 1970." NBER Working Paper 10053.

Chay, Kenneth Y., and Michael Greenstone. 2005. "Does Air Quality Matter? Evidence from the Housing Market." *Journal of Political Economy* 113 (2): 376–424.

Currie, Janet, Lucas Davis, Michael Greenstone, and Reed Walker. 2015. "Environmental Health Risks and Housing Values: Evidence from 1,600 Toxic Plant Openings and Closings." *American Economic Review* 105 (2): 678–709.

Currie, Janet, John Voorheis, and W. Reed Walker. 2019. "Racial Inequality in Pollution Exposure: New Evidence from Satellite Data and the Implementation of Stricter Standards for $PM_{2.5}$." Unpublished.

Deryugina, Tatyana, Garth Heutel, Nolan H. Miller, David Molitor, and Julian Reif. Forthcoming. "The Mortality and Medical Costs of Air Pollution: Evidence from Changes in Wind Direction." *American Economic Review*.

Deschênes, Olivier, and Michael Greenstone. 2011. "Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US." *American Economic Journal: Applied Economics* 3 (4): 152–85.

Deschênes, Olivier, Michael Greenstone, and Joseph S. Shapiro. 2017. "Defensive Investments and the Demand for Air Quality: Evidence from the NOx Budget Program." *American Economic Review* 107 (10): 2958–89.

Di, Qian, Itai Kloog, Petros Koutrakis, Alexei Lyapustin, Yujie Wang, and Joel Schwartz. 2016. "Assessing $PM_{2.5}$ Exposures with High Spatiotemporal Resolution across the Continental United States." *Environmental Science and Technology* 50 (9): 4712–21.

Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis. 2016. "Trade and the Global Recession." *American Economic Review* 106 (11): 3401–38.

Ellerman, A. Danny, Paul L. Joskow, Richard Schmalensee, Juan-Pablo Montero, and Elizabeth M. Bailey, eds. 2000. *Markets for Clean Air: The U.S. Acid Rain Program*. Cambridge: Cambridge University Press.

Environmental Protection Agency. 2011. "Benefits and Costs of the Clean Air Act from 1990 to 2020." Final Report, Rev. A, April 2011. https://www.epa.gov/sites/production/files/2015-07/documents/fullreport_rev_a.pdf.

Fajgelbaum, Pablo D., Eduardo Morales, Juan Carlos Suárez-Serrato, and Owen Zidar. 2019. "State Taxes and Spatial Misallocation." *Review of Economic Studies* 86 (1): 333–76.

Fowlie, Meredith. 2010. "Emissions Trading, Electricity Restructuring, and Investment in Pollution Abatement." *American Economic Review* 100 (3): 837–69.

Fowlie, Meredith. 2019. "My New Pollution Monitor: Gimmick or Game Changer?" *Energy Institute Blog*, University of California, Berkeley. January 2, 2019. https://energyathaas.wordpress.com/2019/01/02/my-new-pollution-monitor-gimmick-or-game-changer/.

Fowlie, Meredith, Stephen P. Holland, and Erin T. Mansur. 2012. "What Do Emissions Markets Deliver and to Whom? Evidence from Southern California's NO_x Trading Program." *American Economic Review* 102 (2): 965–93.

Fowlie, Meredith, and Nicholas Muller. 2013. "Market-Based Emissions Regulation When Damages Vary across Sources: What Are the Gains from Differentiation?" NBER Working Paper 18801.

Fowlie, Meredith, Edward Rubin, and Reed Walker. 2019. "Bringing Satellite-Based Air Quality Estimates Down to Earth." *AEA Papers and Proceedings* 109 (1): 283–88.

Fullerton, Don, and Erich Muehlegger. 2017. "Who Bears the Economic Costs of Environmental Regulations?" NBER Working Paper 23677.

Ganapati, Sharat, Joseph Shapiro, and Reed Walker. Forthcoming. "The Incidence of Carbon Taxes in U.S. Manufacturing: Lessons from Energy Cost Pass-Through." *American Economic Journal: Applied Economics*.

Goettle, Richard J., Mun S. Ho, Dale W. Jorgenson, Daniel T. Slesnick, and Peter J. Wilcoxen. 2007. "IGEM, an Inter-temporal General Equilibrium Model of the U.S. Economy with Emphasis on Growth, Energy and the Environment." Report for the Environmental Protection Agency Office of Atmospheric Programs, Climate Change Division, EPA Contract EP-W-05-035.

Graff Zivin, Joshua, and Matthew Neidell. 2012. "The Impact of Pollution on Worker Productivity." *American Economic Review* 102 (7): 3652–73.

Graff Zivin, Joshua, and Matthew Neidell. 2013. "Environment, Health, and Human Capital." *Journal of Economic Literature* 51 (3): 689–730.

Grainger, Corbett A. 2012. "The Distributional Effects of Pollution Regulations: Do Renters Fully Pay for Cleaner Air?" *Journal of Public Economics* 96 (9–10): 840–52.

Greenstone, Michael. 2002. "The Impacts of Environmental Regulations on Industrial Activity: Evidence from the 1970 and 1977 Clean Air Act Amendments and the Census of Manufacturers." *Journal of Political Economy* 110 (6): 1175–219.

Greenstone, Michael, John A. List, and Chad Syverson. 2012. "The Effects of Environmental Regulation on the Competitiveness of U.S. Manufacturing." NBER Working Paper 18392.

Hausman, Jerry. 2012. "Contingent Valuation: From Dubious to Hopeless." *Journal of Economic Perspectives* 26 (4): 43–56.

Hazilla, Michael, and Raymond J. Kopp. 1990. "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis." *Journal of Political Economy* 98 (4): 853–73.

Henderson, J. Vernon. 1996. "Effects of Air Quality Regulation." *American Economic Review* 86 (4): 789–813.

Ho, Mun, Richard D. Morgenstern, and Jhih-Shyang Shih. 2008. "Impact of Carbon Price Policies on U.S. Industry." Resources for the Future Discussion Paper 08-37.

Isen, Adam, Maya Rossin-Slater, and W. Reed Walker. 2017. "Every Breath You Take—Every Dollar You'll Make: The Long Term Consequences of the Clean Air Act of 1970." *Journal of Political Economy* 125 (3): 848–902.

Jaffe, Adam B., Steven R. Peterson, Paul R. Portney, and Robert N. Stavins. 1995. "Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?" *Journal of Economic Literature* 33 (1): 132–63.

Jorgenson, Dale W., and Peter J. Wilcoxen. 1990. "Environmental Regulation and U.S. Economic Growth." *RAND Journal of Economics* 21 (2): 314–40.

Kahn, Matthew. 1996. "Evidence on the Benefits of Vehicle Emissions Testing." *Economic Letters* 51 (1): 363–69.

Kahn, Matthew E., and Erin T. Mansur. 2013. "Do Local Energy Prices and Regulation Affect the Geographic Concentration of Employment?" *Journal of Public Economics* 101 (1): 105–14.

Keohane, Nathanial O., Erin T. Mansur, and Andrey Voynov. 2009. "Averting Regulatory Enforcement: Evidence from New Source Review." *Journal of Economics and Management Strategy* 18 (1): 75–104.

Krewski, Daniel, Michael Jerrett, Richard T. Burnett, Renjun Ma, Edward Hughes, Yuanli Shi, Michelle C. Turner, et al. 2009. "Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality." Health Effects Institute Research Report 140.

Lepeule, Johanna, Francine Laden, Douglas Dockery, and Joel Schwartz. 2012. "Chronic Exposure to Fine Particles and Mortality: An Extended Follow-Up of the Harvard Six Cities Study from 1974 to 2009." *Environmental Health Perspectives* 120 (7): 965–70.

Moretti, Enrico, and Matthew Neidell. 2011. "Pollution, Health, and Avoidance Behavior: Evidence from the Ports of Los Angeles." *Journal of Human Resources* 46 (1): 154–75.

Morgenstern, Richard. 2018. "Retrospective Analysis of U.S. Federal Environmental Regulation." *Journal of Benefit-Cost Analysis* 9 (2): 285–304.

Murphy, Joshua. 2017. "The Value of Reducing Power Plant Emissions: New Evidence from the Clean Air Interstate Rule." University of Toronto Working Paper.

Nakamura, Emi, and Jón Steinsson. 2018. "Identification in Macroeconomics." *Journal of Economic Perspectives* 32 (3): 59–86.

Oates, Wallace E., and Paul R. Portney. 2003. "The Political Economy of Environmental Policy." In *Handbook of Environmental Economics*, edited by Karl-Göran Mäler and Jeffrey R. Vincent, 1:325–54. Amsterdam: Elsevier.

Popp, David, Richard G. Newell, and Adam B. Jaffe. 2010. "Energy, the Environment, and Technological Change." In *Handbook of the Economics of Innovation*, edited by Bronwyn H. Hall and Nathan Rosenberg, 2:873–937. Amsterdam: North Holland.

Ransom, Michael R., and C. Arden Pope III. 1995. "External Health Costs of a Steel Mill." *Contemporary Economic Policy* 13 (2): 86–97.

Redding, Stephen J. 2016. "Goods Trade, Factor Mobility and Welfare." *Journal of International Economics* 101 (1): 148–67.

Reyes, Jessica Wolpaw. 2007. "Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime." *BE Journal of Economic Analysis and Policy* 7 (1). https://doi.org/10.2202/1935-1682.1796.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82 (1): 34–55.

Ryan, Stephen P. 2012. "The Costs of Environmental Regulation in a Concentrated Industry." *Econometrica* 80 (3): 1019–61.

Schlenker, Wolfram, and W. Reed Walker. 2016. "Airports, Air Pollution, and Contemporaneous Health." *Review of Economic Students* 83 (2): 768–809.

Shapiro, Joseph S., and Reed Walker. 2018. "Why Is Pollution from U.S. Manufacturing Declining? The Roles of Environmental Regulation, Productivity, and Trade." NBER Working Paper 20879.

Suárez-Serrato, Juan Carlos, and Owen Zidar. 2016. "Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms." *American Economic Review* 106 (9): 2582–624.

Viscusi, W. Kip, and Joseph E. Aldy. 2003. "The Value of a Statistical Life: A Critical Review of Market Estimates throughout the World." *Journal of Risk and Uncertainty* 27 (1): 5–76.

Vona, Francesco, Giovanni Marin, Davide Consoli, and David Popp. 2018. "Environmental Regulation and Green Skills: An Empirical Exploration." *Journal of the Association of Environmental and Resource Economists* 5 (4): 713–53.

Walker, W. Reed. 2013. "The Transitional Costs of Sectoral Reallocation: Evidence from the Clean Air Act and the Workforce." *Quarterly Journal of Economics* 128 (4): 1787–835.

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Policy Evolution under the Clean Air Act

Richard Schmalensee and Robert N. Stavins

Nearly half a century has elapsed since 1970, when the first Earth Day was celebrated, the US Environmental Protection Agency (EPA) was established, and the US Clean Air Act passed with unanimous bipartisan support in the Senate and only a single negative vote in the House of Representatives. It was not the first federal law to deal with air pollution—that was the Air Pollution Control Act of 1955—and it was technically only an amendment to the original Clean Air Act of 1963 (Stern 1982). But the 1970 Clean Air Act established the basic architecture of the US air pollution control system, it was the first environmental law to give the federal government a serious regulatory role, and it became a model for many subsequent environmental laws in the United States and abroad. In this article, we describe the evolution of air pollution control policy under this legislation with particular attention to the types of policy instruments used.

While the Clean Air Act evolved over time, so too did the area of scholarship that came to be known as "environmental economics." For almost a half century after Pigou (1920) advanced the abstract notion of taxing pollution, economists paid very little attention to environmental protection. In the late 1960s, Crocker

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(1966), Dales (1968), Ayres and Kneese (1969), and a few others began serious study of environmental policy, but economists were not engaged in the design of the US Clean Air Act. The *Journal of Environmental Economics and Management* was launched in 1974, and environmental protection received increasing attention from economists throughout the late 1970s and 1980s, leading to the area's emergence as a distinct field during the 1990s. The National Bureau of Economic Research held its first Conference on Economics of the Environment in 1991, and in 2007 it launched its Environment and Energy Economics Program.

We begin our analysis by outlining the key provisions of the 1970 act and its main changes over time. We then turn to our main focus, which is to trace and assess the historical evolution of the policy instruments used by the Environmental Protection Agency in its clean air regulations. This evolution has been driven at various times by the emergence on the policy agenda of new air quality problems, by innovation and experimentation by the agency, and by changes in the Clean Air Act itself. Until roughly 2000, EPA made increasing use of market-based instruments, enabled in part by major amendments to the Clean Air Act in 1977 and 1990 that passed with overwhelming bipartisan support. In recent years, however, environmental policy has become a partisan battleground. So far, it has not been possible to provide an efficient response to climate change or to address other new and evolving air quality problems.

The Evolution of the Clean Air Act: 1970–1990

The 1970 Clean Air Act was a national-level response to environmental concerns. For environmental activists, this national approach addressed the fears that states would compete by lowering their environmental standards. For industries operating across states, it addressed the fear of facing a multitude of state-level mandates. This law, only 24 pages in length, gave the Environmental Protection Agency considerable discretion and authority to set and change regulations and to enforce compliance. Under the Administrative Procedure Act of 1946 (Pub. L. 79-404, 60 Stat. 237), EPA is required to publish proposals for major changes in regulation and to take public comments into account in the final versions. Its compliance with provisions of the Clean Air Act and the Administrative Procedure Act can be reviewed by federal courts. In addition, because EPA is an Executive Branch agency, since the Reagan administration its major regulatory proposals have been required to pass a benefit-cost test administered by the Office of Management and Budget (for discussion, see Copeland 2009). A key part of the process is submission of a Regulatory Impact Analysis that compares the benefits and costs of the proposal.

The 1970 law contained four key provisions. First, the Environmental Protection Agency was charged with identifying pollutants that are produced by numerous or diverse sources and have "an adverse effect on public health or welfare" and with promulgating a system of National Ambient Air Quality Standards for these "criteria air pollutants" to protect public health and welfare. The six criteria air pollutants

are carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide.

Second, states were tasked with developing State Implementation Plans, to which the Environmental Protection Agency could require modification, to bring areas under their jurisdiction into attainment with the National Ambient Air Quality Standards.

Third, the Environmental Protection Agency was to develop national New Source Performance Standards for power plants and other stationary pollution sources, and emissions standards for new motor vehicles. It was empowered, but not required, to regulate motor vehicle fuels. Imposing requirements only on *new* stationary and mobile sources had the perverse effect of encouraging firms to retain their existing capital stock, slowing turnover of the capital stock and thereby retarding environmental progress (Stavins 2006). However, states retained the authority to regulate existing stationary sources if necessary to bring areas into attainment with air quality standards.

Fourth, the Environmental Protection Agency was to develop National Emission Standards for Hazardous Air Pollutants, also known as air toxics, to protect public health. These air toxics, such as benzene, are mainly produced by manufacturing plants and other isolated sources and have localized effects.

The first major set of amendments to the Clean Air Act, 112 pages in length, passed in 1977 by a voice vote in the Senate and a vote of 273–109 in the House of Representatives. A regime of Prevention of Significant Deterioration was established, which limited the worsening of air quality in areas that were already in compliance with the National Ambient Air Quality Standards. This regime permitted new stationary sources of air pollution to be built in nonattainment areas if, through modifications of existing sources, overall emissions were reduced. This regime enabled the Environmental Protection Agency to extend its experiments with emissions trading, which began in 1974 (and are discussed below). Also, EPA was empowered to issue technology-based control standards for air toxics instead of emission or performance standards, where the latter were deemed impractical. Finally, EPA was given authority to regulate substances likely to deplete stratospheric ozone.

Unsurprisingly, the 1977 legislation included some politically driven provisions. For example, one stipulation was that the New Source Performance Standards for sulfur dioxide from coal-fired power plants must require that some of the sulfur in the coal burned be removed from the plants' flue gas. This "scrubber" requirement was a political victory for producers of high-sulfur Eastern coal (Ackerman and Hassler 1981) over the producers of low-sulfur Western coal, which would otherwise have been favored for meeting standards for reduced sulfur emissions.

In the 1980s, acid rain caused by emissions of sulfur dioxide (SO_2) from coal-fired power plants emerged as a significant problem. In 1988, the United States ratified the Montreal Protocol to protect the ozone layer. In response to these developments and others, Congress passed the 314-page 1990 amendments, which included four main provisions: (1) the establishment of the path-breaking sulfur

dioxide cap-and-trade program, intended to cut acid rain to half of 1980 levels (discussed in this journal in Schmalensee et al. 1998; Stavins 1998; Schmalensee and Stavins 2013); (2) regulation of a number of aspects of motor vehicle fuels, including volatility (that is, how easily a fuel vaporizes);[1] (3) authority for the Environmental Protection Agency to ensure that the United States would meet its obligations under the Montreal Protocol, and direction to use a cap-and-trade system to do so; and (4) instructions to EPA to issue technology standards for each of 189 listed air toxics, providing the maximum degree of emissions reduction, taking into account costs and non-air-quality effects. Economists inside and outside the administration were engaged in the design of the acid rain program (G. Chan et al. 2012). This final provision reflected the fact that developing harm-based standards for air toxics had proven to be unworkable: only seven such standards had been issued since 1970. The 1990 amendments were passed by large bipartisan majorities: over 90 percent of Democrats voted in favor in both houses of Congress, as did 87 percent of Republicans.

Beginning in the late 1980s, climate change emerged as a significant issue. Then-candidate George H. W. Bush promised in 1988 to use the "White House Effect" to address the emerging problem of the greenhouse effect, and the Senate ratified the UN Framework Convention on Climate Change in October 1992 without a roll-call vote. By the time legislation to deal with climate change received serious consideration in 2009, however, environmental policy had become a partisan issue, and polarization between the parties had increased.

In June 2009, the House of Representatives passed legislation (the American Clean Energy and Security Act of 2009, also known as the Waxman–Markey bill) that included an economy-wide emissions trading system to cut carbon dioxide (CO_2) emissions linked with global climate change. Despite bipartisan support for emissions trading in the 1990 amendments, many Republicans and some coal-state Democrats attacked the proposed emissions trading system as "cap-and-tax." The legislation passed the House by a vote of 219–212, with support from 83 percent of Democrats but only 4 percent of Republicans. Five of the eight Republicans who supported the legislation were from heavily Democratic states, where a "nay" vote would have been highly visible and attracted opposition, and 25 of the 44 Democrats who did not support it were from heavily Republican states. The legislation would have had its greatest impact on coal, the most carbon-intensive fossil fuel, and 25 of the 44 Democrats who opposed the legislation were from states in which more than half of electricity was generated from coal. In July 2010, the Senate abandoned its attempt to pass companion legislation.

This polarization between the two political parties in regard to environmental policy—well documented by political scientists (for example, Shipan and Lowry 2001)—was part of a gradually widening gulf between the parties on virtually all

[1] The volatility standard was explicitly relaxed if corn-based ethanol was used. The Senate minority leader in 1990, Robert Dole (R-Kansas), represented a large, corn-producing state.

issues (Fleisher and Bond 2004).[2] The Clean Air Act, and federal air pollution legislation generally, ceased to evolve after 1990, although regulatory actions authorized by existing legislation and judicial oversight continued.

Policy Instruments Used under the Clean Air Act

Three major types of policy instruments have been employed under the authority of the Clean Air Act: technology standards, which specify the equipment or process to be used for compliance; performance standards, which specify the maximum quantity of emissions (typically in rate-based units, such as grams of pollutant per mile driven) or maximum atmospheric concentrations that are allowed; and emissions trading systems, either in the form of emissions-reduction credit (offset) systems or cap-and-trade. In addition, taxes have sometimes been employed, although their use under the Clean Air Act has been peripheral.[3]

As panel A of Table 1 indicates, three types of instruments have been used for the control of criteria air pollutants. Hazardous air pollutants have been controlled only by standards; emissions trading and taxes have been used to address the protection of stratospheric ozone; and cap-and-trade has been employed to reduce SO_2 emissions as a precursor of acid rain. As we discuss below, the Obama administration proposed a hybrid standard/trading regulation under the Clean Air Act to reduce CO_2 emissions in the electricity sector, but the Trump administration has proposed replacing it with a standards regime.

Panel B of Table 1 examines the use of the four types of policy instruments across regulated sectors of the economy: electricity generation, other stationary sources, and mobile sources. The command-and-control mainstays of the original 1970 act—technology standards and performance standards—have been used in all domains, while emissions trading has been applied only to stationary sources.

Most economists would agree that economic efficiency—achieved when the difference between benefits and costs is maximized—ought to be a fundamental criterion for evaluating environmental protection efforts (Pareto 1896; Hicks 1939; Kaldor 1939).[4] However, discussions in the environmental policy realm have frequently employed the criterion of cost effectiveness—that is, minimizing

[2]Polarization, and a corresponding gradual disappearance of moderates, has been taking place for decades (Lowry and Shipan 2002; Theriault 2008). It has shown up in studies by political scientists employing a diverse set of measures (Poole and Rosenthal 1997, 2007). The rise of the Tea Party movement within the Republican Party and the nomination and election in 2016 of Donald Trump are only the most recent episodes in a much longer story.

[3]The 1990 amendments to the Clean Air Act allowed states to tax regulated air pollutants to recover administrative costs of state programs, and allowed areas in extreme noncompliance to charge higher rates. Under this structure, the South Coast Air Quality Management District in Los Angeles implemented the highest permit fees in the country (US Congress, Office of Technology Assessment 1995). As we discuss below, Congress imposed a tax, outside the Clean Air Act, on ozone-depleting chemicals that took effect in 1990.

[4]This criterion is considered in the companion article by Janet Currie and Reed Walker in this issue.

Table 1
Major Categories of Pollutants and Sectors Regulated by the Clean Air Act

	Policy instrument used			
	Technology standards	*Performance standards*	*Emissions trading*	*Taxes*
A: Pollutant categories				
Criteria pollutants	*	*	*	
Toxic/hazardous pollutants	*	*		
Stratospheric ozone depletion			*	*
Acid rain			*	
Greenhouse gases		Proposed	Proposed	
B: Regulated sectors				
Electricity generation	*	*	*	
Other stationary sources	*	*	*	*
Mobile sources	*	*		

the costs of reducing emissions to a specified level. Of course, cost effectiveness is not the same as economic efficiency, but measuring the benefits of environmental protection is challenging. Reducing emissions to a level determined by noneconomic considerations, but at the lowest cost, offers an empirically easier alternative. Using this approach (and assuming equal effectiveness of enforcement), performance standards for reduced emissions are at least as cost effective as technology standards in meeting a given emissions standard, because they provide greater flexibility to minimize compliance costs.

When emissions from multiple sources are *well mixed*, so that emissions from all sources produce the same damages per unit of pollution, cost effectiveness requires that all sources that exercise some degree of emissions control experience the same marginal abatement cost (Baumol and Oates 1988). In principle, governments could employ nonuniform performance standards to bring about the cost-effective allocation of control responsibility among emissions sources with heterogeneous control costs, but to develop such a set of standards, the government would need to know the marginal abatement cost functions of all sources. Costs are generally heterogeneous, and the government rarely, if ever, knows the relevant cost functions of pollution sources. As a consequence, such detailed command-and-control methods are rarely, if ever, cost effective.

In principle, government has two methods for achieving the cost-effective reduction of pollution across sources when it lacks detailed information about source-level control costs: a tax on pollutant emissions and an emissions trading system. In theory, the tax on each unit of pollution should equal the marginal social damages at the efficient level of control (Pigou 1920). Even if damages cannot be measured, imposing the same tax rate on all sources will lead them to reduce emissions to the point where their marginal abatement costs are equal to the common

tax rate, thereby satisfying the necessary condition for cost effectiveness. But such pollution taxes have never been implemented under the Clean Air Act.

Why have Pigouvian taxes not been much used, despite their theoretical advantages (Kneese and Schultz 1975)? First, it is difficult to identify the appropriate tax rate. Although for efficiency the tax should be set equal to the marginal benefits of cleanup at the efficient level of cleanup, policymakers are much more likely to focus on a desired level of cleanup, and there is uncertainty about how firms will respond to a given level of taxation. A more important political problem is that tax systems are likely to be more costly for regulated firms than command and control, because firms both incur abatement costs and pay taxes on their residual emissions (Buchanan and Tullock 1975). In practice, some of these costs will be passed on to consumers, but many firms may still be worse off under a tax.

The work of Coase (1960) pointed to an alternative way that the government could achieve its pollution-control targets cost effectively, without the abatement uncertainty inherent in the tax approach, and without the tax burden on regulated firms. Coase described the issue of how to address pollution as a problem of poorly defined property rights. If resources such as clean air could be recognized as a form of property, with corresponding rights that could be traded in a market, private actors could allocate the use of this property in a cost-effective way.

Not long after Coase's work appeared, Crocker (1966) and Dales (1968) proposed emissions trading systems based on property rights. Such systems are of two basic types: credit programs and cap-and-trade systems. Under credit programs, credits are assigned (or created) when a source reduces emissions below the level required by existing, source-specific limits; these credits can enable the same or another firm to meet its control target. Under a cap-and-trade system, an allowable overall level of pollution is established and allocated among firms in the form of allowances. Firms that keep their emissions below their allotted level may sell their surplus allowances to other firms or, in many systems, bank them for later use. Each source has an incentive to abate emissions up to the point where its marginal control costs are equal to the market-determined price of tradable allowances. Hence, the environmental constraint is satisfied, and marginal abatement costs are equated across sources, satisfying the condition for cost effectiveness. Although the specified overall level of pollution abatement is certain under cap-and-trade regimes, the price at which pollution allowances will be traded is not assured in advance.

Under a cap-and-trade system, the unique cost-effective equilibrium can usually be achieved independent of the initial allocation of allowances (Montgomery 1972; Hahn and Stavins 2011). This independence property is a key reason why cap-and-trade systems have been preferred to pollution tax systems in representative democracies. The government can set the overall emissions cap and then allocate the available (and valuable) allowances among regulated sources to maximize support for the initiative, without either reducing the system's environmental performance or driving up its cost. In some cap-and-trade systems, most allowances are auctioned off, notably in the Regional Greenhouse Gas Initiative in the northeastern United States (Burtraw, Kahn, and Palmer 2006) and the California cap-and-trade program

(California Legislative Analyst's Office 2017), but auctioning of allowances has not played an important role under the Clean Air Act.

Even when the assumption that emissions are well mixed is only approximately correct, taxes or emissions trading may be more cost effective than command and control if marginal abatement costs differ substantially across sources. If source-specific damages differ too much, however, command and control may be superior. If sources are relatively isolated, trading may produce "hot spots," areas of unacceptably high concentrations, without further policy protections. Further, neither taxes nor emissions trading has been used to regulate mobile sources, although tradable performance standards have been employed, as we discuss below.

The Evolution of Air Quality Policy Instruments

Under the original 1970 Clean Air Act, all federal air pollution regulation involved either technology standards or performance standards. At that time, some environmental advocates argued that implementing greater flexibility through tradable rights to emit pollution would inappropriately legitimize environmental degradation, while others questioned the feasibility of such an approach (Mazmanian and Kraft 2009). But over time, as the Clean Air Act was amended and as the interpretation of its provisions by the Environmental Protection Agency evolved, air pollution regulation evolved from sole reliance on conventional, command-and-control regulations to greater use of emissions trading.[5] This evolution has come to a halt in the past decade.

First Experiments with Emissions Trading in the 1970s

Beginning in 1974, the Environmental Protection Agency experimented with emissions trading among stationary sources through four programs: netting, bubbles, offsets, and banking. Under netting or bubbles, firms that reduced emissions below the level required by law received credits usable against higher emissions elsewhere within the firm, so long as total, combined emissions did not exceed an aggregate limit (Tietenberg 1985; Hahn 1989; Foster and Hahn 1995). Bubbles allowed firms to treat multiple sources within a plant as a single source, whereas netting extended the practice to multiple firms. These may be thought of as basic forms of intrafirm and interfirm emissions trading, respectively. By the mid-1980s, EPA had approved more than 50 bubbles, and states had authorized many more under EPA's framework rules. Estimated compliance cost savings from these bubble programs exceeded $430 million (Korb 1998). The offset program, as explicitly authorized by the 1977 amendments, allowed trades between firms. Firms wishing to establish new sources in areas that were not in compliance with National Ambient

[5] A report from the Environmental Protection Agency (2001) provides a comprehensive discussion of the use of economic incentives in all US environmental protection programs through 2000, but command-and-control regulations were still the norm (Hahn 2000).

Air Quality Standards could offset their new emissions by reducing existing emissions through internal sources or through agreements with other firms. Finally, under the banking program, firms could store earned emission credits for future use, allowing for either internal expansion or sale of credits to other firms.

The Environmental Protection Agency codified all four programs in its Emissions Trading Program in 1986, but the programs were not widely used. States were not required to use the programs, and uncertainties about their future course may have made firms reluctant to participate (Liroff 1986). In addition, individual trades between firms were subject to administrative approval, and trades were required to produce significant net emissions reductions, all of which raised transactions costs. Nevertheless, companies such as Armco, DuPont, USX, and 3M did trade emissions credits, and a market for transfers developed. Even this limited degree of participation in EPA's post-1974 trading programs may have saved between $5 billion and $12 billion over the life of the programs (Hahn and Hester 1989).

The Leaded Gasoline Phasedown in the 1980s

Starting in 1975, new US car models were required to be built with catalytic converters to reduce emissions of carbon monoxide and hydrocarbons. However, lead in gasoline fouls catalytic converters, so the Environmental Protection Agency required that only unleaded gasoline could be used in new cars.

There was also concern about the threat of lead emissions to human health, and the Environmental Protection Agency began to set rules for reducing the quantity of lead in gasoline beginning in 1979. However, smaller refineries found it difficult to meet the requirements, even though the rules for reducing lead were less stringent for smaller operations (Newell and Rogers 2007). In late 1982, EPA launched a lead emissions trading program aimed at reducing the burden of the phasedown on the smaller refineries. Unlike a textbook cap-and-trade program, in which a fixed quantity of allowances is given or sold to potential emitters, there was no explicit allocation of allowances (Hahn 1989). Instead, if a refiner produced gasoline with a total lead content that was lower than the amount allowed, it earned lead "credits" that EPA allowed it to trade. This structure is sometimes called a "tradable performance standard." In 1985, EPA promulgated rules for an accelerated phaseout of lead. These new rules included a "banking" provision, so that lead credits could be saved for later use. This created an incentive for refineries to make early reductions in lead content, which in turn would help them meet the lower limits that took effect over time.

Taken together, these tradable and bankable lead "credits" resulted in leaded gasoline being removed from the market faster than anticipated (Anderson, Hofmann, and Rusin 1990; Newell and Rogers 2007). In each year of the program before it was terminated in 1987, more than 60 percent of the lead added to gasoline was associated with traded lead credits (Hahn and Hester 1989). This high level of trading far surpassed levels observed earlier under the Emissions Trading Program in the 1970s. The level of trading and the rate at which the production of leaded gasoline was reduced suggest that the program was relatively cost effective

(Kerr and Maré 1997; Nichols 1997). The program resulted in savings of approximately 20 percent relative to approaches that did not include trading (Environmental Protection Agency 1985). In addition, the program provided significant incentives for diffusion of cost-saving technology (Kerr and Newell 2003). By 1988, when uniform performance standards were imposed for reductions in lead at oil refineries of all sizes, very little leaded gasoline was produced in the United States. The 1990 amendments to the Clean Air Act banned all leaded gasoline beginning in 1996.

The phasedown of leaded gasoline was the first environmental program in which trading played a central role, and it demonstrated that a trading system could reduce emissions in an economically cost-effective manner. Moreover, it demonstrated that transaction costs in such a system could be low enough to permit substantial trade. The lack of a prior approval requirement, as had existed in the preceding Emissions Trading Program, was an important factor in the success of lead trading (Hahn and Hester 1989). Also, the ability to bank credits enabled significant cost savings and early reductions.

Stratospheric Ozone Protection

Following US ratification of the Montreal Protocol in 1988, Congress imposed an excise tax on chemicals that deplete stratospheric ozone that took effect in 1990 (Omnibus Budget Reconciliation Act of 1989, Pub. L. 101-239, 103 Stat. 2106, § 7506 [1989]). Beginning in 1989, the Environmental Protection Agency set up an emissions trading system for ozone-depleting chemicals, which was then expanded after the 1990 amendments (Hahn and McGartland 1989). Limits were placed on both the production and the use of ozone-depleting chemicals by issuing allowances to producers. Different types of ozone-depleting chemicals have different effects on ozone depletion, and each ozone-depleting chemical was assigned a weight on the basis of its depletion potential. Through mid-1991, there were 34 participants in the market and 80 trades, but we are not aware of any studies that estimate cost savings.

The timetable for the phaseout of ozone-depleting chemicals was subsequently accelerated, and the tax on ozone-depleting chemicals was raised over time (Reitze 2001). It effectively served as a windfall-profits tax, to prevent firms that held emissions permits benefitting from higher prices created by the quantity restrictions (Merrill and Rousso 1990; Environmental Protection Agency 2001). There was considerable debate regarding the extent to which the pollution taxes or the emissions trading system should be credited with the ultimately successful reduction in the use of ozone-depleting chemicals, for which US production ceased in 1995 (Cook 1996).

Sulfur Dioxide Allowance Trading

There was concern starting in the early 1980s (for example, see Glass et al. 1982) that emissions of SO_2 from coal-fired power plants leading to greater acidity in precipitation was damaging forests and aquatic ecosystems. Because costs of reducing these emissions differed dramatically across sources, command-and-control instruments for specifying levels of emissions failed to attract congressional support.

However, the path-breaking 1990 amendments to the Clean Air Act required the Environmental Protection Agency to launch the SO_2 allowance trading program, eventually covering all nontrivial power plants with a declining cap achieving a 50 percent reduction below 1980 levels (Ellerman et al. 2000).

The government allocated allowances to power plants to emit specific quantities of SO_2 at zero cost, based primarily on actual fuel use during the 1985–1987 period. In addition, because of concerns about barriers to entry for new generating plants, the statute required the Environmental Protection Agency to withhold about 2.8 percent of all allowance allocations each year, sell them at an annual auction, and return the proceeds to firms from which allowances had been withheld (Ellerman et al. 2000). If annual emissions at a regulated facility exceeded its allowance allocation, the owner could comply by buying additional allowances or reducing emissions—which in turn could be accomplished by installing pollution controls, shifting to a fuel mix with less sulfur, or reducing production. If emissions at a regulated facility were below its allowance allocation, the facility owner could sell the extra allowances or bank them for future use.

Although government auctioning of allowances would have generated revenue that could have been used—in principle—to reduce distortionary taxes, thereby reducing the program's social cost (Goulder 1995), this efficiency argument was not advanced at the time. Because the entire investor-owned electric utility industry was subject to cost-of-service regulation in 1990, it was assumed that the value of free allowances would be passed on to consumers and thus not generate windfall profits for utilities. Just as important, the ability to allocate *free* allowances helped to build significant political support for the program (Joskow and Schmalensee 1998). Because of the independence property associated with cap-and-trade systems, the initial allocation of allowances could be designed to maximize political support without compromising the system's environmental performance or increasing its cost.

The program performed well, with SO_2 emissions from electric power plants decreasing 36 percent between 1990 and 2004 (Environmental Protection Agency 2011), even though electricity generation from coal-fired power plants *increased* 25 percent over the same period (Table 8.2a in Energy Information Administration 2012). The program delivered emissions reductions more quickly than expected, as utilities made substantial use of the ability to bank allowances for future use. Although the program's costs, at least initially, were likely not as low as they ideally could have been (Schmalensee and Stavins 2013), cost savings overall were eventually at least 15 percent and perhaps as great as 90 percent of the costs of various alternative command-and-control policies (Carlson et al. 2000; Ellerman et al. 2000; Keohane 2003).

The SO_2 reductions achieved benefits that were a substantial multiple of the program's costs (Burtraw et al. 1998; Chestnut and Mills 2005), although these benefits were due mainly to what have been termed "co-benefits"—in this case, human health impacts of decreased local SO_2 and small particulate concentrations—rather than primarily arising from the ecological benefits of reduced acid deposition that motivated the program's establishment (Schmalensee and Stavins 2013).

One concern was that trading might produce "hot spots" of unacceptably high SO_2 concentrations. However, computer models had predicted that plants that had the most impact on ecosystems had the lowest costs of reducing emissions. The pattern of emissions reductions was broadly consistent with those predictions, and no significant hot spots emerged (Ellerman et al. 2000; Swift 2004).[6]

In retrospect, there are number of reasons this program worked so well. First, a key feature was putting final rules in place well before the beginning of the first compliance period, which provided regulated entities with some degree of certainty, thereby facilitating their planning and limiting allowance price volatility in early years (Schmalensee and Stavins 2017). Second, as with the lead trading program, the absence of requirements for prior approval of trades contributed to low transaction costs and substantial trading (Rico 1995). Third, banking of allowances was again important, accounting for more than half of the program's cost savings (Carlson et al. 2000; Ellerman et al. 2000). Fourth, the program may have reduced costs over time by providing incentives for technology innovation (Ellerman et al. 2000; Popp 2003; Bellas and Lange 2011). Fifth, the emissions reduction goals were achieved with less litigation (and thus less uncertainty) than was typical for environmental programs, because firms that found it particularly costly to reduce emissions had the option to buy allowances instead. Sixth, with continuous emissions monitoring and a $2,000 per ton statutory fine for any excess emissions, enforcement was stringent and compliance was nearly perfect (Burtraw and Szambelan 2010).

Finally, the cost of the SO_2 reduction program was significantly reduced by an external factor: the substantial deregulation of railroads in 1980, which caused rail rates to fall and thus reduced the cost of burning low-sulfur Western coal in the East (Ellerman and Montero 1998; Keohane 2003; Schmalensee and Stavins 2013). A command-and-control policy that required the use of certain technologies to reduce sulfur dioxide emissions would not have provided the flexibility to take advantage of the fall in rail rates (Schmalensee and Stavins 2017).

Although subsequent regulatory actions, court decisions, and regulatory responses led to the virtual elimination of the SO_2 allowance market by 2010 (Schmalensee and Stavins 2013), the SO_2 trading program is widely regarded as a success story of cost-effective environmental regulation.

Regional Programs under Clean Air Act Authority

Two other market-oriented environmental programs that merit attention were regional programs executed under the authority of the Environmental Protection Agency and the Clean Air Act: the Regional Clean Air Incentives Market in the Los Angeles area, and NO_x trading among eastern states.[7]

[6] H. Chan et al. (2018) argue that the actual SO_2 emissions had worse health impacts than emissions under a hypothetical uniform performance standard with the same total emissions. Of course, given very heterogeneous costs of compliance, that hypothetical program had been a political nonstarter.

[7] A systematic study of the evolution of environmental policy instrument use at the state level is beyond the scope of this article. It is worth noting, however, that some states have made significant use

The Regional Clean Air Incentives Market (RECLAIM) was launched in 1993 by the South Coast Air Quality Management District, which is responsible for controlling emissions in a four-county area of Southern California. It sought to replace command-and-control regulations and find a more cost-effective way of reducing emissions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) from 350 sources, including power plants and industrial sources in the Los Angeles area. RECLAIM Trading Credits were allocated for free, with the NO_x and SO_2 caps declining annually until 2003, when the market reached its overall goal of a 70 percent reduction in emissions (Ellerman, Joskow, and Harrison 2003). Banking of unused credits from one year to the next was not allowed. A unique aspect of this program's design was that trades were not permitted from downwind to upwind sources, reflecting differences in marginal source-specific damages.

The program was predicted to achieve significant cost savings via trade (Johnson and Pekelney 1996; Anderson 1997). By June 1996, 353 program participants had traded more than 100,000 tons of credits, with a value of over $10 million (South Coast Air Quality Management District 2018). Emissions at facilities covered by the program were some 20 percent lower than at facilities regulated with parallel command-and-control regulations, hot spots did not appear, and substantial cost savings were achieved (Burtraw and Szambelan 2010; Fowlie, Holland, and Mansur 2012).

In the program's early years, allowance prices remained in the expected range of $500 to $1,000 per ton of NO_x. During California's electricity crisis in 2000–2001, however, some sources of electricity were taken offline, which required dramatic increases in generation at some RECLAIM facilities. This caused emissions to exceed permit allocations at those facilities, and, in the absence of a pool of banked allowances, it resulted in a dramatic spike in allowance prices—to more than $60,000 per ton in 2001 (Fowlie, Holland, and Mansur 2012). The program was temporarily suspended. Prices returned to normal levels (about $2,000 per ton) by 2002, with all sources rejoining the program by 2007. As of July 2018, the twelve-month moving average of NO_x prices was $2,530 per ton (South Coast Air Quality Management District 2018).

Another regional program of particular interest is NO_x trading in the eastern United States, which was enabled by the 1990 Clean Air Act amendments. In 1999, eleven northeastern states and the District of Columbia developed and implemented the NO_x Budget Program, a regional NO_x cap-and-trade system. The goal of the program was to reduce summertime ground-level ozone—that is, smog formed by the interaction of NO_x and volatile organic compounds in the presence of sunlight—by more than 50 percent relative to 1990 levels (Environmental Protection Agency 2004). Some 1,000 electric generating and industrial units were required to demonstrate compliance each year during the summer ozone season.

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of market-based instruments. The California cap-and-trade system for greenhouse gases is a notable example (Borenstein et al. 2018).

The region covered by the program was divided into upwind and downwind zones, reflecting differences in source-specific damages, and allowances were given to states to distribute to in-state sources. Sources could buy, sell, and bank allowances within limits reflecting the seasonal nature of the ozone problem. Upwind states were given less generous allowance allocations. However, trading across zones was permitted on a one-for-one basis, and the upwind and downwind zones made similar reductions from baseline emissions levels (Ozone Transport Commission 2003).

At the outset, the NO_x Budget Program market was characterized by uncertainty because some trading rules were not in place when trading commenced. This resulted in high price volatility during the program's first year, although prices stabilized by the program's second year (Farrell 2000). For the 1999–2003 period, abatement cost savings were estimated at 40 to 47 percent relative to conventional regulation that did not include trading or banking (Farrell 2000).

In 1998, the Environmental Protection Agency had issued a call for State Implementation Plans, which required 21 eastern states to submit plans to reduce their NO_x emissions from more than 2,500 sources. The result was an interstate cap-and-trade program, known as the NO_x Budget Trading Program, which went into effect in 2003, replacing the earlier NO_x Budget Program. Overall, under the NO_x Budget Program and the NO_x Budget Trading Program, NO_x emissions declined from about 1.9 million tons in 1990 to less than 500,000 tons by 2006, with 99 percent compliance (Butler et al. 2011; Deschenes, Greenstone, and Shapiro 2017).

Overall, this experience demonstrated that in order to avoid unnecessary price volatility, all of the components of an emissions trading program should be in place well before the program takes effect, and that a well-designed multistate process with federal guidance could be effective in coordinating what were legally state-level goals.

In 2005, the NO_x Budget Trading Program was effectively replaced by the Clean Air Interstate Rule, which reduced allowance allocations under the acid rain program. In July 2008, however, an appeals court ruled that the Clean Air Act did not give authority to the Environmental Protection Agency to amend the acid rain program (*North Carolina v. Environmental Protection Agency*, No. 05-1244), while an appellate court decision in December of the same year left the policy in place while EPA developed a new approach. In 2015, the Clean Air Interstate Rule was replaced by the Cross State Air Pollution Rule, which does not allow interstate trading.

Climate Change Policies

The single greatest air pollutant emissions issue facing the United States and the world is the emissions of greenhouse gases. For a time, it was unclear whether this topic fell under the purview of the Clean Air Act. Early in the 2000s, the Environmental Protection Agency considered whether it had the authority to regulate emissions of carbon dioxide and other greenhouse gases, noting that during the

major amendments to the Clean Air Act in 1990, Congress had not specified that such emissions should be treated as a pollutant.

Obama Administration Climate Policies

In response to a lawsuit brought by twelve states and several cities, the US Supreme Court ruled in *Massachusetts et al. v. Environmental Protection Agency et al.* (549 US 497 [2007]) that if the Environmental Protection Agency was to find that emissions of greenhouse gases endanger public health or welfare, it would be obligated (on the basis of authority in the 1970 act) to regulate those emissions. In December 2009, the Obama administration EPA issued an "Endangerment Finding," which found that current and projected levels of six greenhouse gases endangered public health and welfare. When attempts to address climate change via new legislation (the American Clean Energy and Security Act of 2009, commonly known as the Waxman–Markey bill) failed in 2010, the focus of addressing greenhouse gas emissions thus turned to the possibility of regulatory approaches under existing authority of the Clean Air Act. EPA proceeded to issue regulations covering greenhouse gas emissions from mobile and then stationary sources. Treating CO_2 as a criteria air pollutant under the Clean Air Act may have been cumbersome and represented a "stretch," but it was a stretch the administration was essentially required to make by the 2007 Supreme Court decision combined with the administration's 2009 Endangerment Finding.

In September 2009, the Obama administration finalized a rule with two main steps: to increase fuel efficiency under the Corporate Average Fuel Economy (CAFE) program and to establish national greenhouse gas emissions standards under the Clean Air Act (Broder 2009). The rule increased the required average fuel efficiency in model year 2016 to 35.5 miles per gallon, with a second phase announced in 2012 increasing the standard to 54.5 miles per gallon for model year 2025. Notably, this rule enabled manufacturers for the first time to earn, bank, and trade credits for exceeding these performance standards (Leard and McConnell 2017).

The second part of the Obama administration's regulatory action on climate change began quietly in 2013, with a proposal for New Source Performance Standards to limit CO_2 emissions from all new coal and natural gas power plants built in the United States. The proposed rule would essentially have made it impossible to build new traditional coal plants, but since there were no new coal plants planned or likely to be built, due to the relative prices of coal and natural gas, the rule had no real impacts and was not particularly controversial.

However, a subsequent rule—the Clean Power Plan—announced in June 2014 had considerably more bite. This rule sought to reduce CO_2 emissions from existing sources in the electricity-generating sector. The proposal listed specific targets for each state but gave the states many ways to meet their targets: increasing the efficiency of fossil fuel power plants, switching electricity generation from coal-fired plants to natural gas–fired plants, developing new low-emissions generation (including renewable and nuclear generation), fostering more efficient end-use of electricity, and others. States were also given flexibility to employ any of a wide

variety of policy instruments, including market-based trading systems. Furthermore, states could work together to submit multistate plans. The regulation was to be finalized in June 2015 and implemented in 2020.

The state-by-state approach in the Clean Power Plan did not guarantee cost effectiveness, because marginal abatement costs would vary greatly across states. However, encouragement was given to states to employ cap-and-trade systems, and the Environmental Protection Agency emphasized its willingness to consider and facilitate multistate implementation plans. EPA was not guaranteeing cost effectiveness, but it was allowing for it and, indeed, attempting to facilitate it.

A difficult challenge for climate change policies is that global damages are unaffected by the location of emissions. Thus, any jurisdiction taking action will incur the direct costs of its actions, but the direct climate benefits will be distributed globally. Hence, the direct climate benefits a jurisdiction reaps from its actions will almost certainly be less than the costs it incurs, even if global climate benefits from emissions reductions are much greater than global costs. Despite this logic, the central estimate of annual net benefits (benefits minus costs) of the Clean Power Plan in 2030 in the Environmental Protection Agency's Regulatory Impact Analysis submitted to the Office of Management and Budget was $67 billion (Environmental Protection Agency 2014). How could this be?

Table 2 emphasizes two key underlying assumptions. First, the estimate of climate benefits was not limited to benefits received by the United States, but rather was an estimate of global climate benefits. Second, the estimate of benefits included (the much larger) benefits of human health impacts associated with reductions in correlated air pollutants that were not themselves greenhouse gases.

It would certainly be inappropriate to use a global measure of benefits in analysis of all US regulations (Gayer and Viscusi 2016). Doing so could imply that a labor policy that increased US employment, but led to lower employment in competitor economies, would have zero benefits! On the other hand, it can be argued that counting only domestic benefits is not appropriate for a global commons problem (National Academy of Sciences 2017). In a global commons problem, every jurisdiction will find itself in a situation where the benefits of its actions spill over to other jurisdictions, and the direct climate benefits it reaps from reducing greenhouse gas emissions within its own jurisdiction will be less than the costs it incurs. One can also imagine trying to argue that a US climate policy would increase the probability of other countries taking similar actions, but trying to quantify this effect would be speculative at best.

In addition to counting climate benefits outside the United States, the Environmental Protection Agency under President Obama counted health benefits from reductions of other pollutants, the emissions of which are correlated with those of CO_2. For example, the Clean Power Plan was expected to reduce the burning of coal, leading to decreased emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter, and mercury. These pollutants—especially particulate matter less than 2.5 microns across—have very significant human health impacts; indeed, the estimated benefits from reducing their emissions dwarf the domestic climate

Table 2

Estimated Benefits and Costs of Clean Power Plan Rule in 2030

(Environmental Protection Agency's Regulatory Impact Analysis, midpoint estimates, billions of dollars)

	Climate change impacts from CO_2		*Domestic health impacts from correlated pollutants plus . . .*	
	Domestic	*Global*	*Domestic climate impacts*	*Global climate impacts*
Climate change benefits	3	31	3	31
Health co-benefits	–	–	45	45
Total benefits	3	31	48	76
Total compliance costs	9	9	9	9
Net benefits (benefits minus costs)	–6	22	39	67

Source: Authors' calculations, based on table ES-7 (p. ES-19) and table ES-10 (p. ES-23) of June 2014 Regulatory Impact Analysis of proposed Clean Power Plan Rule (Environmental Protection Agency 2014), adopting midpoint estimates, using 3 percent discount rate, and domestic shares of global climate benefits from the Interagency Working Group on Social Cost of Carbon (2010).

benefits. According to the Regulatory Impact Analysis, whereas the US climate change benefits from CO_2 reductions due to the proposed rule in 2030 would probably be less than $3 billion per year,[8] the domestic health benefits from reduced concentrations of correlated non–greenhouse gas air pollutants would amount to some $45 billion per year! Thus, 94 percent of estimated domestic benefits of this climate policy were due to reductions of non–greenhouse gas air pollutants. In turn, these estimates of health benefits are driven heavily by predicted reductions in morbidity and mortality, and those in turn are driven by the dose-response assumptions EPA employs.

The inclusion of these human health co-benefits is the key argument that climate policies provide a near-term or medium-term increase in US welfare. If the global estimate of climate benefits ($31 billion per year) is employed instead, then the Clean Power Plan Rule looks even better, with total annual benefits of $76 billion, leading to the Environmental Protection Agency's bottom-line estimate of positive net benefits of $67 billion per year in 2030. The Obama administration's proposed Clean Power Plan thus offered the flexibility to be cost effective, and if one accepts the estimates of benefits and costs, it could also have been welfare enhancing.

[8] Suppose a domestic US climate benefits number were used in this analysis, rather than a global number. EPA estimated global climate benefits of the rule in 2030 using a midrange 3 percent discount rate to be $31 billion. According to the Obama administration's Interagency Working Group on Social Cost of Carbon (2010), US benefits from reducing greenhouse gas emissions would be, on average, about 7 to 10 percent of global benefits. If benefits within the United States were thus 8.5 percent of global benefits, they would amount to about $2.6 billion, considerably less than the $8.8 billion in total annual compliance costs estimated by the Regulatory Impact Analysis.

Trump Administration Climate Policies

Both of the main Obama administration climate change regulatory initiatives—the Corporate Auto Fuel Economy standards for motor vehicles and the Clean Power Plan for the electricity sector—were reversed by the Trump administration. In August 2018, the Environmental Protection Agency and the National Highway Traffic Safety Administration proposed a rule that would have the federal government freeze the motor vehicle standards at their 2020 levels going forward (Environmental Protection Agency 2018a).

When the final version of the Clean Power Plan was published in October 2015 (40 C.F.R. 60), it immediately faced lawsuits from a number of states. They argued, among other things, that the Clean Air Act gave authority to the Environmental Protection Agency only to issue technical and performance standards for power plants (some argued that only the states could regulate *existing* plants), and that by allowing flexibility, the Clean Power Plan went well beyond that authority. In February 2016, the US Supreme Court issued a stay in the implementation of the Clean Power Plan while that litigation proceeded (Liptak and Davenport 2016).

In August 2018, with implementation of the Clean Power Plan still suspended, the Trump administration announced the Affordable Clean Energy Rule as a replacement for the Clean Power Plan Rule (Friedman 2018; Environmental Protection Agency 2018c). The new rule instructs the states to set standards for efficiency improvements in existing coal-fired power plants, subject to guidance from the Environmental Protection Agency regarding technologies to be used as well as EPA approval. (It seems that states could require no improvements at all, if EPA agreed.) It also changes the rules on what constitutes a new source, subject to very strict standards, so that old plants can increase efficiency without becoming subject to new source standards. It does not provide incentives for changing the mix of methods used for generating electricity or even allow such methods for compliance. Without such flexibility, there is no possibility of cost effectiveness in reducing air pollution. However, it is interesting to note that by issuing the revised regulation, the Trump administration implicitly accepted the 2009 finding by EPA that greenhouse gas emissions do cause harm (Friedman 2018).

The Regulatory Impact Analysis for the Affordable Clean Energy Rule compares it with the Clean Power Plan and finds it superior (Environmental Protection Agency 2018d), although the same report estimates that it would have lower costs, greater coal use, greater greenhouse gas emissions, and greater adverse health effects.[9] The different conclusion is based on different underlying assumptions. This Regulatory Impact Analysis uses a US-only social cost of carbon to value those emissions increases. Whereas, with a 3 percent discount rate, the global social cost of carbon

[9] It is not clear how fully this analysis of the Affordable Clean Energy Rule takes into account the so-called rebound effect: if coal-fired power plants are made more efficient, their marginal costs will be reduced, and it will be economic to use them more intensively. The impact of this effect on human health may be substantial (Keyes et al. 2019).

in 2030 used by the Obama administration was $50 per ton, the US-only cost used by the Trump administration was $7 per ton. With a 7 percent discount rate, the US-only social cost for a ton of carbon emissions was $1 per ton.

The same US-only social cost of carbon was also used in the Regulatory Impact Analysis for the Trump Administration's revised CAFE standards. In several tables that take the loss of health benefits into account, the Affordable Clean Energy Rule is found to have lower net benefits than the Clean Power Plan. But the presentation in the Regulatory Impact Analysis de-emphasizes these health co-benefits and focuses on "net benefits associated with the targeted pollutant (CO_2)." On that metric, and considering only domestic climate benefits, the cost savings from moving from the Clean Power Plan to the Affordable Clean Energy Rule outweigh the foregone benefits.

Conclusions

The supporters of the 1970 Clean Air Act no doubt hoped that it would produce major environmental benefits. They would surely be pleased that despite the fact that real US GDP more than tripled between 1970 and 2017, aggregate emissions of the six criteria pollutants declined by 73 percent (Environmental Protection Agency 2018a). On the other hand, the original supporters of the 1970 Clean Air Act might well be surprised by some of the twists and turns of clean air regulation since then. For example, it is difficult to imagine that any of the supporters of the 24-page 1970 act imagined how complex air pollution regulation would become over the subsequent half century. In addition, we suspect that the evolution toward more intensive use of market-based environmental policy would also have been a surprise to those involved in passage of the 1970 act.

But those involved in the strongly bipartisan passage of the 1970 Clean Air Act would surely be disappointed that environmental policy has become a partisan battleground. It has seemingly become impossible to amend the Clean Air Act or to pass other legislation to address climate change in a serious and economically efficient manner. Regulation under the Clean Air Act has not ceased, but addressing new problems such as climate change has become exceedingly difficult, partly because the existing legislation provides no simple vehicle for doing so. The climate effects of CO_2 emissions are predicted to last for many centuries (Stocker et al. 2013). If US inaction slows global reductions of greenhouse gas emissions, the environmental damage is likely to be both profound and long lasting.

A great deal has been learned over the 50 years since the Clean Air Act was signed into law in 1970. The 1977 and 1990 amendments reflect some of that learning, including the practical difficulty of regulating a myriad of air toxics. Much has also been learned about the design and implementation of emissions trading systems (Schmalensee and Stavins 2017). Most importantly, we now know from experience that cap-and-trade systems can be environmentally effective and economically cost effective. Provisions for the banking of permits have proven to be

very important for achieving maximum gains from trade, and the absence of such provisions has led to price spikes and market collapses.

Another implication of these five decades of experience may be that policies to address climate change and other new environmental problems should be designed to make them more acceptable in the real world of politics. This could mean, for example, giving greater attention to suboptimal, second-best designs of carbon-pricing regimes (Stavins 2019). Examples might include earmarking revenues from taxes or allowance auctions to finance additional climate mitigation, rather than optimizing the system via cuts in distortionary taxes, and/or using such revenues for fairness purposes, such as with lump-sum rebates or rebates targeted to low-income and other particularly burdened constituencies (Goulder and Hafstead 2017; Stavins 2019). Economists might also be more effective by sometimes working to catch up with the political world by examining better design of second-best nonpricing climate policy instruments, such as clean energy standards, subsidies for green technologies, and other approaches. At some point the politics may change, of course, which is why ongoing economic research on climate policy instruments of all kinds is important.

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References

Ackerman, Bruce A., and William T. Hassler. 1981. *Clean Coal/Dirty Air.* New Haven, CT: Yale University Press.

Anderson, Robert C., and Andrew Q. Lohof. 1997. "The United States Experience with Economic Incentives in Environmental Pollution Control Policy." Environmental Protection Agency Paper EE-0126A.

Anderson, Robert C., Lisa A. Hofmann, and Michael Rusin. 1990. "The Use of Economic Incentive Mechanisms in Environmental Management." American Petroleum Institute Research Paper 51.

Ayres, Robert U., and Allen V. Kneese. 1969. "Production, Consumption, and Externalities." *American Economic Review* 59 (3): 282–97.

Baumol, William J., and Wallace E. Oates. 1988. *The Theory of Environmental Policy.* Cambridge: Cambridge University Press.

Bellas, Allen S., and Ian Lange. 2011. "Evidence of Innovation and Diffusion under Tradable Permit Programs." *International Review of Environmental and Resource Economics* 5 (1): 1–22.

Borenstein, Severin, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins. 2018. "Expecting the Unexpected: Emissions Uncertainty and Environmental Market Design." University of California, Berkeley, Energy Institute at Haas Working Paper 274.

Broder, John. 2009. "Obama to Toughen Rules on Emissions and Mileage." *New York Times,* May 18, 2009, A1.

Buchanan, James M., and Gordon Tullock. 1975. "Polluters' Profits and Political Response: Direct Controls versus Taxes." *American Economic Review* 65 (1): 139–47.

Burtraw, Dallas, Danny Kahn, and Karen Palmer. 2006. "CO_2 Allowance Allocation in the Regional Greenhouse Gas Initiative and the Effect on Electricity Investors." *Electricity Journal* 19 (2): 79–90.

Burtraw, Dallas, Alan Krupnick, Erin Mansur, David Austin, and Dierdre Farrell. 1998. "Costs and Benefits of Reducing Air Pollution Related to Acid Rain." *Contemporary Economic Policy* 16 (4): 379–400.

Burtraw, Dallas, and Sarah Jo Szambelan. 2010. "US Emissions Trading Markets for SO_2 and NO_x." In *Permit Trading in Different Applications*, edited by Bernd Hansjürgens, Ralf Antes, and Marianne Strunz, 15–45. New York: Routledge.

Butler, Thomas J., Francoise M. Vermeylen, Melissa Rury, Gene E. Likens, Brian Lee, George E. Bowker, and Lance McCluney. 2011. "Response of Ozone and Nitrate to Stationary Source NO_x Emission Reductions in the Eastern USA." *Atmospheric Environment* 455 (5): 1084–94.

California Legislative Analyst's Office. 2017. "The 2017–18 Budget: Cap-and-Trade." https://lao.ca.gov/reports/2017/3553/cap-and-trade-021317.pdf.

Carlson, Curtis, Dallas Burtraw, Maureen Cropper, and Karen L. Palmer. 2000. "Sulfur Dioxide Control by Electric Utilities: What Are the Gains from Trade?" *Journal of Political Economy* 108 (6): 1292–326.

Chan, Gabriel, Robert Stavins, Robert Stowe, and Richard Sweeney. 2012. "The SO_2 Allowance-Trading System and the Clean Air Act Amendments of 1990: Reflections on 20 Years of Policy Innovation." *National Tax Journal* 65 (2): 419–52.

Chan, H. Ron, B. Andrew Chupp, Maureen L. Cropper, and Nicholas Z. Muller. 2018. "The Impact of Trading on the Costs and Benefits of the Acid Rain Program." *Journal of Environmental Economics and Management* 88 (1): 180–209.

Chestnut, Lauraine G., and David M. Mills. 2005. "A Fresh Look at the Benefits and Costs of the US Acid Rain Program." *Journal of Environmental Management* 77 (3): 252–66.

Coase, Ronald. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3 (1): 1–44.

Cook, Elizabeth, ed. 1996. *Ozone Protection in the United States: Elements of Success*. Washington, DC: World Resources Institute.

Copeland, Curtis W. 2009. "Federal Rulemaking: The Role of the Office of Information and Regulatory Affairs." Congressional Research Service Report for Congress RL32397.

Crocker, Thomas D. 1966. "The Structuring of Atmospheric Pollution Control Systems." In *The Economics of Air Pollution*, edited by Harold Wolozin, 61–86. New York: W. W. Norton.

Dales, J. H. 1968. "Land, Water, Ownership." *Canadian Journal of Economics* 1 (4): 791–804.

Deschenes, Olivier, Michael Greenstone, and Joseph S. Shapiro. 2017. "Defensive Investments and the Demand for Air Quality: Evidence from the NO_x Budget Program." *American Economic Review* 107 (10): 2958–89.

Ellerman, A. Denny, Paul L. Joskow, and David Harrison Jr. 2003. "Emissions Trading in the U.S.: Experience, Lessons, and Considerations for Greenhouse Gases." Prepared for the Pew Center on Global Climate Change. http://web.mit.edu/globalchange/www/PewCtr_MIT_Rpt_Ellerman.pdf.

Ellerman, A. Denny, Paul L. Joskow, Richard Schmalensee, Juan-Pablo Montero, and Elizabeth M. Bailey. 2000. *Markets for Clean Air: The U.S. Acid Rain Program*. Cambridge: Cambridge University Press.

Ellerman, A. Denny, and Juan-Pablo Montero. 1998. "The Declining Trend in Sulfur Dioxide Emissions: Implications for Allowance Prices." *Journal of Environmental Economics and Management* 36 (1): 26–45.

Energy Information Administration. 2012. *Annual Energy Review 2011*. Washington, DC: Energy Information Administration.

Environmental Protection Agency. 1985. *Costs and Benefits of Reducing Lead in Gasoline: Final Regulatory Impact Analysis*. Washington, DC: Office of Policy Analysis, Environmental Protection Agency.

Environmental Protection Agency. 2001. "The United States Experience with Economic Incentives for Protecting the Environment." National Center for Environmental Economics Report EPA-240-R-01-001.

Environmental Protection Agency. 2004. "Evaluating Ozone Control Programs in the Eastern United States: Focus on the NO_x Budget Trading Program, 2004." Environmental Protection Agency Report EPA454-K-05-001.

Environmental Protection Agency. 2011. *National Emissions Inventory (NEI) Air Pollutant Emissions Trends Data: 1970–2011*. Washington, DC: Environmental Protection Agency.

Environmental Protection Agency. 2014. "Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants." Environmental Protection Agency Report EPA-452/R-14-002.

Environmental Protection Agency. 2018a. "Air Pollution Trends Show Cleaner Air, Growing Economy." News Release, July 31, 2018. https://www.epa.gov/newsreleases/air-pollution-trends-show-cleaner-air-growing-economy.

Environmental Protection Agency. 2018b. "The Safer and Affordable Fuel Efficient (SAFE) Vehicles Proposed Rule for Model Years 2021–2026." https://www.epa.gov/regulations-emissions-vehicles-and-engines/safer-and-affordable-fuel-efficient-vehicles-proposed.

Environmental Protection Agency. 2018c. "Proposal: Affordable Clean Energy (ACE) Rule." https://www.epa.gov/stationary-sources-air-pollution/proposal-affordable-clean-energy-ace-rule.

Environmental Protection Agency. 2018d. "Regulatory Impact Analysis for the Proposed Emissions Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program." Environmental Protection Agency Report EPA-453/R-18-006.

Farrell, Alex. 2000. "The NO_x Budget: A Look at the First Year." *Electricity Journal* 13 (2): 83–93.

Fleisher, Richard, and John R. Bond. 2004. "The Shrinking Middle in the US Congress." *British Journal of Political Science* 34 (3): 429–51.

Foster, Vivien, and Robert W. Hahn. 1995. "Designing More Efficient Markets: Lessons from Los Angeles Smog Control." *Journal of Law and Economics* 38 (1): 19–48.

Fowlie, Meredith, Stephen P. Holland, and Erin T. Mansur. 2012. "What Do Emissions Markets Deliver and to Whom? Evidence from Southern California's NO_x Trading Program." *American Economic Review* 102 (2): 965–93.

Friedman, Lisa. 2018. "Trump's Plan for Coal Emissions: Let Coal States Regulate Them." *New York Times*, August 18, 2018, 1A.

Gayer, Ted, and W. Kip Viscusi. 2016. "Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic versus Global Approaches." *Review of Environmental Economics and Policy* 10 (2): 245–63.

Glass, Norman R., Dean E. Arnold, James N. Galloway, George R. Hendrey, Jeffrey J. Lee, William W. McFee, Stephen A. Norton, Charles F. Powers, Danny L. Rambo, and Carl L. Schofield. 1982. "Effects of Acid Precipitation." *Environmental Science and Technology* 16 (3): 162A–169A.

Goulder, Lawrence H. 1995. "Environmental Taxation and the Double Dividend: A Reader's Guide." *International Tax and Public Finance* 2 (2): 157–83.

Goulder, Lawrence H., and Mark A. C. Hafstead. 2017. *Confronting the Climate Challenge: U.S. Policy Options.* New York: Columbia University Press.

Hahn, Robert W. 1989. "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders." *Journal of Economic Perspectives* 3 (2): 95–114.

Hahn, Robert W. 2000. "The Impact of Economics on Environmental Policy." *Journal of Environmental Economics and Management* 39 (3): 375–99.

Hahn, Robert W., and Gordon L. Hester. 1989. "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program." *Yale Journal on Regulation* 6 (1): 109–53.

Hahn, Robert W., and Albert M. McGartland. 1989. "The Political Economy of Instrument Choice: An Examination of the U.S. Role in Implementing the Montreal Protocol." *Northwestern University Law Review* 83 (3): 592–611.

Hahn, Robert W., and Robert N. Stavins. 2011. "The Effect of Allowance Allocations on Cap-and-Trade System Performance." *Journal of Law and Economics* 54 (4): S267–94.

Hicks, John R. 1939. "The Foundations of Welfare Economics." *Economic Journal* 49 (196): 696–712.

Interagency Working Group on Social Cost of Carbon. 2010. "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866." https://www.epa.gov/sites/production/files/2016-12/documents/scc_tsd_2010.pdf.

Johnson, Scott Lee, and David M. Pekelney. 1996. "Economic Assessment of the Regional Clean Air Incentives Market: A New Emissions Trading Program for Los Angeles." *Land Economics* 72 (3): 277–97.

Joskow, Paul L., and Richard Schmalensee. 1998. "The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program." *Journal of Law and Economics* 41 (1): 37–83.

Kaldor, Nicholas. 1939. "Welfare Propositions of Economics and Interpersonal Comparisons of Utility." *Economic Journal* 49 (195): 549–52.

Keohane, Nathaniel O. 2003. "What Did the Market Buy? Cost Savings under the U.S. Tradeable Permits Program for Sulfur Dioxide." Yale Center for Environmental Law and Policy Working Paper YCELP-01-11-2003.

Kerr, Suzi, and David Maré. 1997. "Efficient Regulation through Tradeable Permit Markets: The United States Lead Phasedown." Department of Agricultural and Resource Economics, University of Maryland, College Park, Working Paper 96-06.

Kerr, Suzi, and Richard G. Newell. 2003. "Policy-Induced Technology Adoption: Evidence from the U.S. Lead

Phasedown." *Journal of Industrial Economics* 51 (3): 317–43.

Keyes, Amelia T., Kathleen F. Lambert, Dallas Burtraw, Jonathan J. Buonocore, Johathan I. Levy, and Charles T. Driscoll. 2019. "The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions." *Environmental Research Letters* 14 (1): 044018.

Kneese, Allen V., and Charles L. Schultz. 1975. *Pollution, Prices, and Public Policy*. Washington, DC: The Brookings Institution.

Korb, Barry. 1998. "U.S. Experience with Economic Incentives for Emissions Trading." In *Applying Market-Based Instruments to Environmental Policies in China and OECD Countries*, 99–115. Paris: Organisation for Economic Cooperation and Development.

Leard, Benjamin, and Virginia McConnell. 2017. "New Markets for Credit Trading under US Automobile Greenhouse Gas and Fuel Economy Standards." Resources for the Future Report.

Liptak, Adam, and Coral Davenport. 2016. "Supreme Court Deals Blow to Obama's Efforts to Regulate Coal Emissions." *New York Times*, February 10, 2016, A1.

Liroff, Richard A. 1986. *Reforming Air Pollution Regulations: The Toil and Trouble of EPA's Bubble*. Washington, DC: Conservation Foundation.

Lowry, William R., and Charles R. Shipan. 2002. "Party Differentiation in Congress." *Legislative Studies Quarterly* 27 (1): 33–60.

Mazmanian, Daniel A., and Michael E. Kraft. 2009. "The Three Epochs of the Environmental Movement." In *Toward Sustainable Communities: Transition and Transformations in Environmental Policy*, edited by Daniel A. Mazmanian and Michael E. Kraft, 3–32. Cambridge, MA: MIT Press.

Merrill, Peter R., and Ada S. Rousso. 1990. "Federal Environmental Taxation." In *Proceedings of the Annual Conference on Taxation Held under the Auspices of the National Tax Association–Tax Institute of America*, 83:191–98. Washington, DC: National Tax Association.

Montgomery, W. David. 1972. "Markets in Licenses and Efficient Pollution Control Programs." *Journal of Economic Theory* 5 (3): 395–418.

National Academy of Sciences. 2017. *Valuing Climate Damages*. Washington, DC: National Academies Press.

Newell, Richard G., and Kenneth Rogers. 2007. "The Market-Based Lead Phasedown." In *Moving to Markets in Environmental Regulation: Lessons from Twenty Years of Experience*, edited by Jody Freeman and Charles Kolstad, 173–93. Oxford: Oxford University Press.

Nichols, Albert L. 1997. "Lead in Gasoline." In *Economic Analyses at EPA: Assessing Regulatory Impact*, edited by Richard D. Morgenstern, 49–86. Washington, DC: Resources for the Future.

Ozone Transport Commission. 2003. "NO_x Budget Program: 1999–2002 Progress Report." http://www2.epa.gov/sites/production/files/2015-08/documents/otcreport.pdf.

Pareto, Vilfredo. 1896. *Cours d'économie politique*. Vol. 2. Lausanne: F. Rouge.

Pigou, Arthur C. 1920. *The Economics of Welfare*. London: Macmillan.

Poole, Keith T., and Howard Rosenthal. 1997. *Congress: A Political-Economic History of Roll Call Voting*. New York: Oxford University Press.

Poole, Keith T., and Howard Rosenthal. 2007. *Ideology and Congress*. New Brunswick, NJ: Transaction Publishers.

Popp, David. 2003. "Pollution Control Innovations and the Clean Air Act of 1990." *Journal of Policy Analysis and Management* 22 (4): 641–60.

Reitze, Arnold W. Jr. 2001. "Stratospheric Ozone." Chap. 13 in *Air Pollution Control Law: Compliance and Enforcement*. Washington, DC: Environmental Law Institute.

Rico, Renee. 1995. "The U.S. Allowance Trading System for Sulfur Dioxide: An Update on Market Experience." *Environmental and Resource Economics* 5 (2): 115–29.

Schmalensee, Richard, Paul L. Joskow, A. Denny Ellerman, Juan-Pablo Montero, and Elizabeth M. Bailey. 1998. "An Interim Evaluation of Sulfur Dioxide Emissions Trading." *Journal of Economic Perspectives* 12 (3): 53–68.

Schmalensee, Richard, and Robert N. Stavins. 2013. "The SO_2 Allowance Trading System: The Ironic History of a Grand Policy Experiment." *Journal of Economic Perspectives* 27 (1): 103–22.

Schmalensee, Richard, and Robert N. Stavins. 2017. "Lessons Learned from Three Decades of Experience with Cap and Trade." *Review of Environmental Economics and Policy* 11 (1): 59–79.

Shipan, Charles R., and William R. Lowry. 2001. "Environmental Policy and Party Divergence in Congress." *Political Research Quarterly* 54 (2): 245–63.

South Coast Air Quality Management District. 2018. "July 2018 Quarterly Report to Stationary Source Committee." http://www.aqmd.gov/docs/default-source/Agendas/ssc/ssc-agenda-7-20-18.pdf.

Stavins, Robert N. 1998. "What Can We Learn from the Grand Policy Experiment? Lessons from SO_2

Allowance Trading." *Journal of Economic Perspectives* 12 (3): 69–88.

Stavins, Robert N. 2006. "Vintage-Differentiated Environmental Regulation." *Stanford Environmental Law Journal* 25 (1): 29–63.

Stavins, Robert N. 2019. "The Future of U.S. Carbon-Pricing Policy." NBER Working Paper 25912.

Stern, Arthur C. 1982. "History of Air Pollution Legislation in the United States." *Journal of the Air Pollution Control Association* 32 (1): 44–61.

Stocker, Thomas F., Dahe Qin, Gian-Kasper Plattner, Melinda M. B. Tignor, Simon K. Allen, Judith Boschung, Alexander Nauels, Yu Xia, Vincent Bex, and Pauline M. Midgley, eds. 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge: Cambridge University Press.

Swift, Byron. 2004. "Emissions Trading and Hot Spots: A Review of the Major Programs." *Environment Reporter* 35(19): 1–16.

Theriault, Sean M. 2008. *Party Polarization in Congress.* New York: Cambridge University Press.

Tietenberg, Tom. 1985. *Emissions Trading: An Exercise in Reforming Pollution Policy.* Washington, DC: Resources for the Future.

US Congress, Office of Technology Assessment. 1995. "Environmental Policy Tools: A Users Guide." Office of Technology Assessment Report OTA-ENV-634.

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US Water Pollution Regulation over the Past Half Century: Burning Waters to Crystal Springs?

David A. Keiser and Joseph S. Shapiro

In 1969, the Cuyahoga River in Cleveland, Ohio, lit on fire. Historically, this fire was unremarkable—rivers in Baltimore, Detroit, Buffalo, Philadelphia, and elsewhere caught fire throughout the nineteenth and early twentieth centuries, and the Cuyahoga had lit on fire at least 13 previous times since 1868 (Adler 2002). But the event attracted enormous attention. A widely read *Time* magazine article (*Time* 1969) noted:

> The Potomac reaches the nation's capital as a pleasant stream, and leaves it stinking from the 240 million gallons of wastes that are flushed into it daily. Among other horrors, while Omaha's meat packers fill the Missouri River with animal grease balls as big as oranges, St. Louis takes its drinking water from the muddy lower Missouri because the Mississippi is far filthier. . . . Among the worst of them all is the 80-mile-long Cuyahoga . . . No Visible Life. Some river! Chocolate-brown, oily, bubbling with subsurface gases, it oozes rather than flows. "Anyone who falls into the Cuyahoga does not drown," Cleveland's citizens joke grimly. "He decays."

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Outrage at the 1969 fire is often listed as one reason behind the passage of US environmental laws in the early 1970s (Adler 2002; Dingell 2010).

The Cuyahoga has not burned since 1969 and today is home to 40 species of fish (National Park Service 2018). But water pollution issues are not just a part of history. Today, over half of US rivers and lakes violate environmental standards, and 4 to 28 percent of Americans in a typical year receive drinking water from systems that violate health-based standards (Allaire, Wu, and Lall 2018; Environmental Protection Agency 2018a). Flint, Michigan, recently exposed 100,000 residents to dangerous levels of lead in drinking water. Contaminated drinking water leads an estimated 16 million Americans to suffer from gastrointestinal illness annually (Messner et al. 2006).

Polls also suggest that water pollution has been Americans' top environmental concern for at least 30 years (Gallup 2018). Figure 1 shows the percentage of respondents to an annual US Gallup poll who say they are concerned a "great deal" about various environmental problems. Approximately 60 percent of Americans today list both drinking water pollution and river and lake pollution as a great concern. In every survey since 1989, the share concerned about each of these issues has substantially exceeded the shares expressing concern about air pollution, climate change, and other environmental problems (Gallup 2018).

The federal government sought to address these concerns with three actions: it created the Environmental Protection Agency (EPA) in 1970, the Clean Water Act in 1972, and the Safe Drinking Water Act in 1974. The Clean Water Act regulates "surface waters"—rivers, lakes, and some ocean areas. Whether the Clean Water Act regulates groundwater, which includes subsurface aquifers, is legally disputed (Brownhill and Rosen 2018). The Safe Drinking Water Act regulates drinking water, which includes groundwater or surface water that is purified by a drinking water treatment plant and then transported by pipe to households and businesses.

A half century later, these laws still manage US surface and drinking water. Since 1970, the United States has spent approximately $4.8 trillion (in 2017 dollars) to clean up surface water pollution and provide clean drinking water, or over $400 annually for every American.[1] In the average year, this accounts for 0.8 percent of GDP, making clean water arguably the most expensive environmental investment in US history. For comparison, the average American spends $60 annually on bottled water (Arthur 2018).

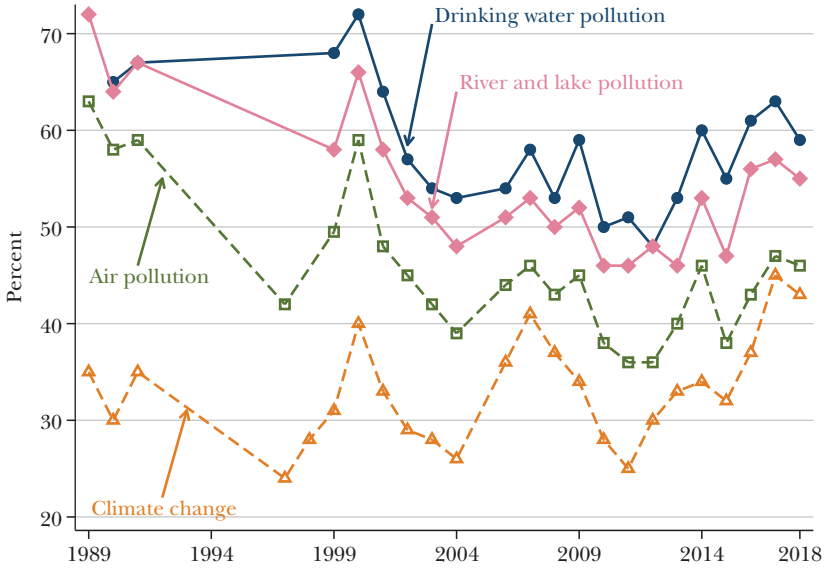
This article is structured around four main questions: What forces led to these laws? How do they regulate pollution? How effective and efficient have they been? Why has recent economic research focused relatively little on water pollution, and what can remedy this lack of research?[2] We will also illustrate that water pollution

[1] For the calculations behind this estimate, see online Appendix B, available with this article at the *Journal of Economic Perspectives* website.

[2] Other economic reviews of water pollution appear in Freeman (2000), Olmstead (2010), Griffiths et al. (2012), and Fisher-Vanden and Olmstead (2013).

Figure 1

Share of Americans Concerned "A Great Deal" about Various Environmental Issues, 1989–2018



Source: Gallup (2018).

Note: Each poll asks, "I'm going to read you a list of environmental problems. As I read each one, please tell me if you personally worry about this problem a great deal, a fair amount, only a little or not at all." The graph shows four issues to avoid too many lines obscuring the main patterns. Results for other issues, which are not surveyed in all years, include the following: loss of tropical rain forests (mean share 40 percent), extinction of plant and animal species (38 percent), contamination of soil and water by toxic waste (54 percent), damage to Earth's ozone layer (42 percent), acid rain (28 percent), loss of natural habitat for wildlife (51 percent), ocean and beach pollution (51 percent), maintenance of the nation's fresh water for household needs (48 percent), and contamination of soil and water by radioactivity from nuclear facilities (49 percent). Stated concern about drinking water and stated concern about river and lake pollution equal or exceed stated concern about each of these other issues in nearly every year of the survey.

provides an excellent setting to learn about externalities, cost-benefit analysis, local public goods, fiscal federalism, regulatory design, nonmarket valuation, and other classic economic issues. Indeed, water pollution is a textbook example of an externality—at least since Stigler (1952, 1966), introductory texts have used the example of a plant dumping waste in a river and causing people downstream to suffer to illustrate the concept of externalities.

We emphasize four conclusions. First, many measures of drinking and surface water pollution have fallen since the founding of the Environmental Protection Agency, due at least in part to the Clean Water Act and the Safe Drinking Water Act. The progress, however, is incomplete. As William Ruckelshaus, first head of the EPA, summarized: "Even if all of our waters are not swimmable or fishable, at least they are not flammable" (as quoted in Mehan 2010). Second, these large investments could be more cost effective—they could achieve the same aggregate pollution reduction at

lower cost, by better utilizing market-based instruments, regulating agriculture, and exploiting returns to scale in drinking water treatment. Third, most analyses estimate that the benefits of existing regulations of surface water quality are *less* than their costs, which is not the case for most government regulations. We highlight several reasons why existing studies may underestimate the true value of surface water quality. Fourth, relatively little economic research focuses on water pollution and its regulation, especially relative to research on air pollution. We suggest some reasons for this lack of research.

What Forces Led to the Clean Water Act and Safe Drinking Water Act?

Human health provided the most common historic rationale for public policy to improve water quality. Sanskrit texts from 4,000 years ago describe purification methods for drinking water that are still used today. Roman bureaucrats under Augustus Caesar sought to eliminate lead piping since it was "hurtful to the human system" (Raucher 1996). For centuries, typhoid and cholera caused a large number of deaths. John Snow's (1855) famed study of London, which provided early evidence that water transmitted cholera, is sometimes considered the founding of modern epidemiology and quasi-experimental research. In the early twentieth century, many cities began chlorinating and filtering drinking water, and cholera and typhoid rates plummeted (Cutler and Miller 2005; Alsan and Goldin 2019). By the 1950s, these investments had nearly eliminated US cholera and typhoid epidemics, and so weakened the health-based rationale for additional investment.

The federal government did create some drinking water standards in the early twentieth century, but before the 1970s, the federal government had largely left water quality up to cities and states. Their water pollution policies and enforcement were limited: as of 1969, only 59 percent of drinking water systems met the preexisting federal standards (Public Health Service 1970). For surface waters, the federal laws before the Clean Water Act of 1972 also had limited power. A 1948 law included regulations that Congress described as "almost unenforceable," and President Dwight Eisenhower called water pollution a "uniquely local blight." Regulators summarized, "The solution to pollution is dilution" (Milazzo 2006). After one of the earlier Cuyahoga River fires, for example, Cleveland prohibited refineries from discharging oil into the Cuyahoga, but violation of this ordinance was punished only with a rarely applied $10 fine (Adler 2002).

The environmental movement helped change this inattention to water pollution. Demonstrations for the first Earth Day in 1970 included 20 million people—among the largest demonstrations in US history.

Along with the 1969 Cuyahoga River fire, other proximate causes of the environmental movement include the production of many new industrial chemicals, photographs of Earth taken from space, and a major 1969 oil spill off the coast of Santa Barbara, California. In 1973, a study found dozens of chemicals, including

potential carcinogens, in the drinking water of New Orleans and Pittsburgh (Raucher 1996). New Orleans area residents at the time described drinking water supplies as smelling "oily-petrochemical" and fish from the nearby Mississippi River as unsalable due to "oily" or "chemical" tastes (Environmental Protection Agency 1972; Agee 1975). Deeper causes of the environmental movement at this time may have included broader social activism and rising national incomes.

Several aspects of politics from the 1950s and 1960s affected water pollution policy in the 1972 Clean Water Act and beyond. First, discussions of surface water pollution had little reference to health; indeed, the Clean Water Act is perhaps the only major environmental regulation of the 1970s and 1980s that does not have health as a main goal (Cropper and Oates 1992). Second, because industry opposed regulation of water pollution, policymakers focused on subsidies to wastewater treatment plants rather than industrial regulation. Third, to assuage concerns that southern states were attracting manufacturing with weak regulation, policymakers created uniform national standards. Finally, to ensure political support from rural representatives, investment in reducing water pollution disproportionately targeted small towns (Milazzo 2006). Water quality policy at that time also largely ignored agriculture.

How Do These Laws Regulate Pollution?

Clean Water Act

The general goals of the 1972 Clean Water Act were implausibly ambitious: eliminating discharge of *all* pollutants into navigable waters by 1985, making *all* water safe for fishing and swimming by 1983, and prohibiting *all* discharge of toxic amounts of toxic pollutants.[3] President Nixon vetoed the Clean Water Act, due to costs that he called "unconscionable" and "budget-wrecking," but bipartisan majorities voted to override the veto in the Senate (52–12, with 36 senators not voting) and the House (247–23, with 1 "present" and 160 abstentions) (*CQ Almanac* 1972).

The Clean Water Act had two main activities. The first provided grants to cities to improve wastewater treatment plants. In most cities, underground pipes transmit polluted water from homes and businesses to a plant that abates pollution before discharging treated wastes to surface waters. The United States has around 15,000 such plants. The federal government allocated grant funding across states according to formulas considering state population, forecast population, and wastewater treatment needs (Congressional Budget Office 1985). Within a state, grants were allocated according to an annual "priority list." These grants began in 1957 under predecessor laws to the Clean Water Act, but their scale increased after 1972. In total, the federal government provided around 35,000 grants. Projects funded by these grants between 1960 and 2005 cost about $870 billion over their lifetimes (in 2017 dollars)—about $230 billion in federal grant funds, $110 billion in municipal matching funds, and

[3] Technically the 1972 law was called the Federal Water Pollution Control Act Amendments of 1972. We follow common practice in referring to it as the Clean Water Act.

$530 billion in operation and maintenance costs.[4] In 1987, the grants program transitioned to a subsidized loan program, the Clean Water State Revolving Fund. The second main policy involved permits distributed to facilities discharging pollution from a fixed source (like a pipe) into navigable surface waters—the National Pollution Discharge Elimination System. Each permit describes the levels of pollution the plant may discharge. These permits focus on five conventional pollutants (for example, bacteria such as fecal coliform) and 126 "priority" toxic pollutants, though they may cover other water quality measures (Environmental Protection Agency 2010).

It may be informative to compare the Clean Water Act with water quality policies in other countries. Many countries have subsidized municipal investment in wastewater treatment plants, including Brazil, Canada, France, India, Japan, New Zealand, and South Korea, and many countries set standards to regulate industrial pollution emissions. Other aspects of regulation, however, differ substantially between countries. Canada's 1970 Canada Water Act focuses on supporting partnerships between Canada's federal and provincial governments, on product standards, and on research; the US Clean Water Act focuses less on these topics (Booth and Quinn 1995). The year 2000 EU Water Framework Directive has limited enforcement provisions but centralizes most regulatory decisions in the European Commission (whereas the Clean Water Act decentralizes many decisions to states) and regulates groundwater (Craig 2018). Agricultural runoff and non-point-source pollution remain top water quality problems in many industrialized countries, though farm management and training in some countries may help (Parris 2011).

The focus of the Clean Water Act on wastewater treatment and point-source emissions has led to less focus on other water pollution concerns. Here, we mention several such issues.

The Clean Water Act largely ignores agricultural pollution, which contributes to some of the worst surface water quality problems (Craig and Roberts 2015). These problems include a "Dead Zone" in the Gulf of Mexico where oxygen shortages kill much aquatic life. The Clean Water Act does regulate large and some medium-sized animal feedlots ("concentrated animal feeding operations"). Initially, the Clean Water Act ignored agricultural pollution because it was not perceived as an important issue and because it was more difficult to monitor abatement and emissions. Agricultural water pollution abatement typically involves management practices, such as the timing and method of applying fertilizer and its relationship to soil conditions. Agricultural pollution abatement also involves land use decisions, which the US federal system generally reserves as a power for states (Malik, Larson, and Ribaudo 1994). The federal government does operate some farm management programs pertinent to pollution, but these programs are voluntary and have low funding (Keiser, Kling, and Shapiro 2019).

Another challenge involves the language of the Clean Water Act protecting "Waters of the United States," which has led to legal debates over how this term

[4] For details, see online Appendix B.

applies to roughly half of US waters, primarily composed of wetlands, headwaters, and intermittent streams. Two Supreme Court decisions held that the Clean Water Act does not protect most of these waters (*Rapanos v. United States*, 547 US 715 [2006]; *Solid Waste Agency of Northern Cook County (SWANCC) v. US Army Corps of Engineers*, 531 US 159 [2001]). In 2015, the Obama administration issued the Waters of the United States Rule, which sought to reinstate these protections. However, in 2017, President Trump issued an executive order to rescind or revise this rule. The net benefits of these regulations have also become controversial (Boyle, Kotchen, and Smith 2017).

An additional challenge is the rise of fracking (more properly, hydraulic fracturing), which has increased US gas and oil production but has also raised concerns of contaminating groundwater and surface waters. Fracking extracts natural gas or crude oil from underground shale rock, typically by combining horizontal drilling with the high-pressure injection of water, chemicals, and sand. The corresponding concerns for water quality involve chemicals leaking from wells, improper cement casing around the well, and improper storage of fracking liquids in surface ponds (Olmstead et al. 2013; Mason, Muehlenbachs, and Olmstead 2015). The 2005 Energy Policy Act exempted fracking from a portion of the Safe Drinking Water Act that regulates underground injection of contaminants, but fracking remains subject to the Clean Water Act.

A short list of additional challenges involving the Clean Water Act includes "combined sewer systems" that dump raw sewage in rivers during heavy storms (primarily in small cities in the Northeast and industrial Midwest); power plants forced to shut off on hot days by their National Pollution Discharge Elimination System permits; the relatively few pollutants that are the focus of the Clean Water Act, whereas US industry manufactures, processes, or imports 33,000 chemical substances (Environmental Protection Agency 2019); air pollution abatement technologies that convert air pollution to surface water pollution; the "total maximum daily load requirements," a regulatory tool with 75,000 local pollution budgets promulgated since 1995 (Environmental Protection Agency 2018a); and the limited prevalence of cap-and-trade markets for water quality (as discussed in this journal in Fisher-Vanden and Olmstead 2013).

Safe Drinking Water Act

Broadly, the Safe Drinking Water Act seeks to protect health by limiting drinking water contamination. The law was popular at its passage—it passed with a voice vote in the Senate and 296–84 in the House (*CQ Almanac* 1974).

The Safe Drinking Water Act includes three main policy instruments. First, it provides a process for setting and enforcing drinking water standards. The Environmental Protection Agency sets an enforceable "maximum contaminant level" for 94 contaminants, including microorganisms such as *E. coli*, radionuclides such as uranium, organic chemicals such as glyphosate (a weed-killer), inorganic chemicals such as cyanide, and disinfectants such as chlorine and their by-products (Environmental Protection Agency 2015, 2018b). States can regulate additional contaminants

beyond the 94 on this list. For example, California, but not the EPA, enforces standards on perchlorate, a component of rocket fuel (California Water Boards 2019). The EPA also sets unenforceable "secondary standards" when contaminants create issues involving taste, color, and smell, which have primarily aesthetic importance. While the EPA designs standards, states enforce them, typically using administrative orders, modest civil penalties, or prison, and enforcement is incomplete (Tiemann 2017). A water system can violate these standards by exceeding contaminant limits, by failing to treat water appropriately, or by failing to report tests (Environmental Protection Agency 1999).

Second, the Safe Drinking Water Act authorizes actions to protect groundwater from contamination. This includes regulations of wells drilled for underground fluids (the Underground Injection Control Program); designation of some aquifers as primary drinking water sources, which then prevents any federal funds for purposes that could contaminate these aquifers (the Sole Source Aquifer Program); and protection of areas around groundwater wellheads (the Wellhead Protection Program).

The third main activity involves subsidies for cleaner drinking water. Some subsidies fund drinking water treatment, distribution networks, and related infrastructure, and others provide grants for data management.

The Safe Drinking Water Act regulates roughly 150,000 public and private water systems. About 50,000 of these ("community water systems") provide water to standard homes; the others supply water to sites such as schools, factories, and campgrounds. The largest 400 community water systems cover nearly half the US population, while the smallest 28,000 systems cover only 2 percent of the population (Tiemann 2017). The law does not regulate domestic wells, which serve about 45 million Americans, or bottled water, which the Food and Drug Administration regulates.

Fiscal federalism provides an interesting comparison between the Clean Water Act and the Safe Drinking Water Act. Because rivers flow between states, they provide a classic example of an interjurisdictional externality. Perhaps for this reason, the Clean Water Act provided federal subsidies for wastewater treatment. Drinking water treatment, by contrast, creates less of an externality between cities and jurisdictions, and accordingly, the Safe Drinking Water Act provides less federal funding.

Like the Clean Water Act, the Safe Drinking Water Act also faces some ongoing challenges and issues. Here, we briefly describe four of them.

First, the Safe Drinking Water Act regulates 94 contaminants, but many unregulated chemicals are believed to be toxic and are found in drinking water, including some pesticides and pharmaceuticals. No new contaminants have been regulated since 2006 (Sullivan, Agardy, and Clark 2005; Environmental Protection Agency 2015, 2018b). Concern about toxic chemicals in drinking water is long-standing and has been magnified at times by popular media, going back to Rachel Carson's 1961 book *Silent Spring* and movies such as *A Civil Action* (1998) and *Erin Brockovich* (2000). An example of a contaminant common in drinking water that is not currently regulated would be per- and polyfluoroalkyl substances, which are used to repel water and oil. These chemicals appear in nonstick cookware and pizza boxes, and some evidence

links them to cancer and infant health problems (Agency for Toxic Substances and Disease Registry 2018).

Second, lead is a toxic metal that retards brain development. It typically appears in drinking water due to plumbing materials that contain lead, including pipes or soldering. The Safe Drinking Water Act has used increasingly stringent provisions to remove lead from drinking water systems. Recent crises in Flint, Michigan, and elsewhere underscore its continuing challenge (SciLine 2019).

Third, some are concerned that fracking has allowed chemicals to penetrate groundwater, which then feeds into drinking water. Evidence on the prevalence of such pollution is mixed, though households appear willing to pay reasonable sums to avoid such potential contamination (Mason, Muehlenbachs, and Olmstead 2015; Muehlenbachs, Spiller, and Timmins 2015; Wrenn, Klaiber, and Jaenicke 2016).

Fourth, many abatement technologies have increasing returns to scale (Olmstead 2010) and thus are more expensive on a per unit basis for smaller drinking water systems. Water quality regulations are weaker for small or intermittent drinking water systems and nonexistent for rural wells.

How Effective Have These Laws Been?

The extent to which the Clean Water Act and Safe Drinking Water Act affect water pollution depends on how these laws alter enforcement and compliance behavior. For example, to what extent do standards require actual changes? To what extent do regulators test water, and then notify and punish violators? On the compliance side, what is the cost to decrease pollution? These compliance costs evolve on the basis of developments in abatement technologies, which can decrease through learning by doing, economies of scale, or innovation. Additionally, compliance depends on the ability of sources to circumvent these laws—for example, by relocating emissions or reclassifying economic activity.

Existing research does not speak to all of these individual channels of enforcement and compliance, but it does indicate aggregate changes in pollution. Surface water treatment has improved substantially since the early 1970s. In 1940, municipal wastewater treatment plants removed about 20 percent of a common measure of pollution ("biochemical oxygen demand"), and by 1996, they removed nearly 70 percent of it (Environmental Protection Agency 2000b). Industrial treatment has also expanded. In 1954, only 13 percent of water used in large US manufacturing plants had any treatment before discharge; by 1982, 30 percent did (Census Bureau 1971, 1986).[5]

Several studies find evidence of decreased surface water pollution. Some use small sets of monitoring sites (Smith, Alexander, and Wolman 1987; Environmental Protection Agency 2000b), though one finds no change for dissolved oxygen in a large sample

[5]The Survey of Water Use in Manufacturing, which provided these industrial data, was discontinued after the 1980s, though the Census Bureau has recently discussed starting it again.

of lakes (Smith and Wolloh 2012). A national water quality simulation model also suggests substantial decreases in ambient pollution due to observed changes in emissions (Environmental Protection Agency 2000a). More comprehensive evidence comes from 50 million pollution readings from 240,000 monitoring sites (Keiser and Shapiro 2019). That analysis finds that most pollutants have declined substantially, though agricultural pollutants such as nitrates have not. It also finds that the rate of decrease for most pollutants has slowed over time.

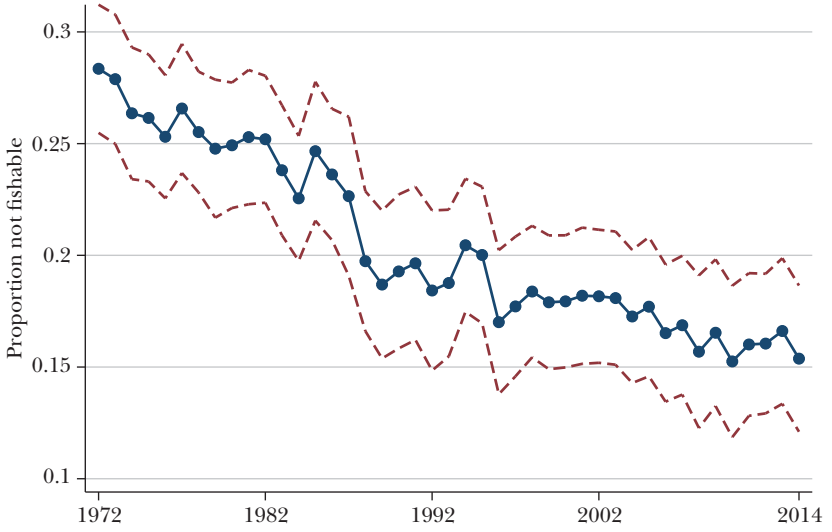
Figure 2 shows an example of this evidence of the substantial decrease in US surface water pollution. This graph summarizes 14.6 million pollution readings covering 265,000 monitoring sites over the period 1972–2014. It shows a common omnibus measure of water quality—whether waters are safe for fishing. This definition of "fishable" is widely used in research; it was developed by William Vaughan for Resources for the Future and reflects published water quality criteria and state water quality standards between 1966 and 1979. When the Clean Water Act passed in 1972, nearly 30 percent of water quality readings were unsafe for fishing. This share has trended steadily downward, and by 2014, only about 15 percent were unsafe.[6] Such decreases could in principle arise from a variety of sources: outsourcing dirty production, productivity growth, environmental lawsuits, or environmental regulation (Shapiro and Walker 2018).

Some studies estimate how much of the change in water pollution can be attributed to the Clean Water Act. Keiser and Shapiro (2019) use a triple-difference research design comparing areas upstream versus areas downstream of wastewater treatment plants and before versus after plants receive grants, across many plants. They find that Clean Water Act grants significantly decrease pollution for 25 miles downstream and for 30 years. Inspections and fines are generally implemented through the National Pollution Discharge Elimination System. Studies exploiting variation in inspections and fines over space and time find that they decrease pollution from wastewater treatment plants and pulp and paper manufacturing (Magat and Viscusi 1990; Laplante and Rilstone 1996; Helland 1998; Earnhart 2004; Glicksman and Earnhart 2007; Gray and Shimshack 2011). For example, Shimshack and Ward (2008) use difference-in-differences regressions for about 250 paper mills in 28 states over 14 years to find that fines on a plant, or on another plant in the same state, are associated with decreases in reported emissions of two common pollutants.

Evidence on trends in drinking water quality and treatment is less clear. Some evidence suggests that drinking water quality has improved, but unfortunately, rather than recording actual pollution concentrations, the best long-term national data record violations of standards, which are more complex to interpret because standards change frequently. The share of community water systems that treat water at all grew substantially between the 1970s and 1990s (Environmental Protection Agency 1999). In 1969, 40 percent of systems violated standards, while in 2015, only 10 percent

[6]Figure 1 in online Appendix A shows similar patterns for the four physical pollutants underlying this measure of whether waters are fishable. For the period 1962–2001, appendix table III of Keiser and Shapiro (2019) shows similar trends in many sensitivity analyses.

Figure 2
US Surface Water Pollution, 1972–2014



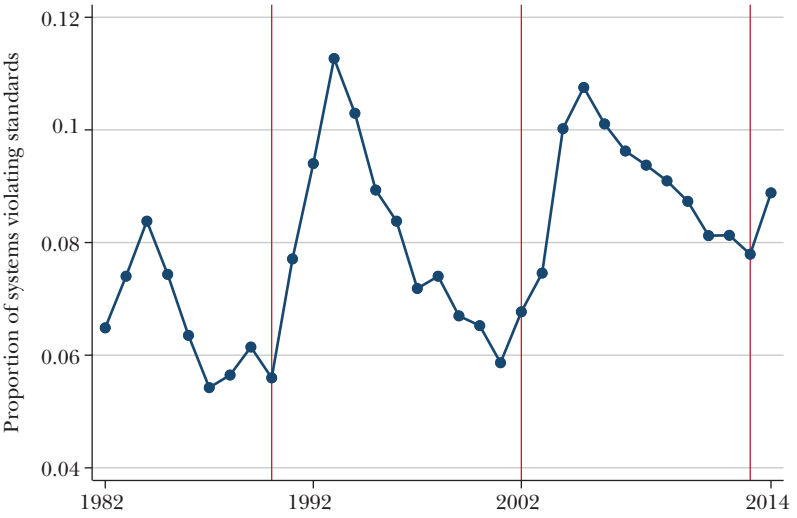
Source: The graph summarizes 14.6 million pollution readings from 265,000 monitoring sites from the Environmental Protection Agency's STORET ("STOrage and RETrieval") Legacy, Modern STORET, and the National Water Information System. See Keiser and Shapiro (2019) for details on the data cleaning procedure.
Note: The graph shows year fixed effects plus a constant from regressions that also control for monitoring site fixed effects, a day-of-year cubic polynomial, and an hour-of-day cubic polynomial. Each observation in the regression is an individual pollution reading at a specific monitoring site; the dependent variable in the regression takes the value one if it violates the fishable standard and zero otherwise. Connected dots show yearly values, dashed lines show 95 percent confidence interval, and 1972 is the reference category. Standard errors are clustered by watershed.

did, even as standards tightened (Public Health Service 1970; Allaire, Wu, and Lall 2018).[7] Figure 3 shows this pattern over the period 1982–2014. This graph shows that violations jump discretely each time the Safe Water Drinking Act incorporates tighter standards, and then the frequency of violations gradually declines as water systems become more likely to comply with the new rule (Allaire, Wu, and Lall 2018).

Some research directly analyzes the effects of the Safe Water Drinking Act and its subsequent amendments. Bennear and Olmstead (2008) exploit variation over time and across drinking water systems to find that the legal requirement for some systems to send annual water quality reports to customers decreased total and health-based water quality violations by more than one-third. Grooms (2016) shows that mean quarterly arsenic concentrations in Californian drinking water follow a linear trend through the early 2000s, then fall by 50 percent in exactly the fourth quarter of 2008, when arsenic standards were tightened. This analysis does not have a control group,

[7]These 1969 and 2015 statistics are not perfectly comparable—each takes a nonrandom sample of drinking water systems, and they focus on different measures of violations.

Figure 3
US Drinking Water Quality Violations, 1982–2014



Source: Data are from Allaire (2018) and cover a balanced panel of 17,900 community water systems.
Note: Vertical lines show years of the most important changes in standards (Total Coliform Rule in 1990, Stage 1 Drinking Water Byproducts Rule in 2002, and Stage 2 Drinking Water Byproducts Rule in 2013). Each point shows the share of community water systems violating health-based standards.

though it does find an abrupt change in a time series. Nigra et al. (2017) show that urinary arsenic concentrations in a national sample of 14,000 Americans had similar trends before the year 2008 for Americans who drank water from public systems versus for Americans who drank well water. After 2008, arsenic concentrations fell for individuals using public water systems but did not change for individuals drinking well water, which did not face new regulations.

How Efficient Has Regulation of Clean Water Been?

The analysis of gains or losses to social welfare from policies to reduce water pollution often involves assessment of three elements: the consumer surplus that people obtain from any decreases in pollution resulting from these policies (including gains due to health, recreation, and other channels), the lost producer surplus from firms due to complying with these regulations, and deadweight loss from taxation to raise revenue for pollution abatement subsidies.

Research has used various methods to investigate these questions. To measure the benefits of cleaner water, some studies use the "travel cost" method, based on changes in where people travel for boating, fishing, or swimming. Others use hedonic methods to analyze changes in home values, look at investments in defensive goods such as bottled water, or study health consequences. Still others use

Table 1
Benefits and Costs of Federal Regulations

	Surface water (1)	*Drinking water* (2)	*Air* (3)	*Greenhouse gases* (4)	*All other* (5)	*All* (6)
A: Total US expenditures (trillions of 2017 dollars)						
1970 to 2014	2.83	1.99	2.11	–	–	–
1973 to 1990	0.94	0.49	0.85	–	–	–
B: Estimated benefits and costs of regulations analyzed in years 1992–2017						
Total benefits / total costs	0.79	4.75	12.36	2.98	1.97	6.31
Mean benefits / mean costs	0.57	8.26	15.18	3.64	21.79	16.17
Share with benefits < costs	0.67	0.20	0.08	0.00	0.19	0.15

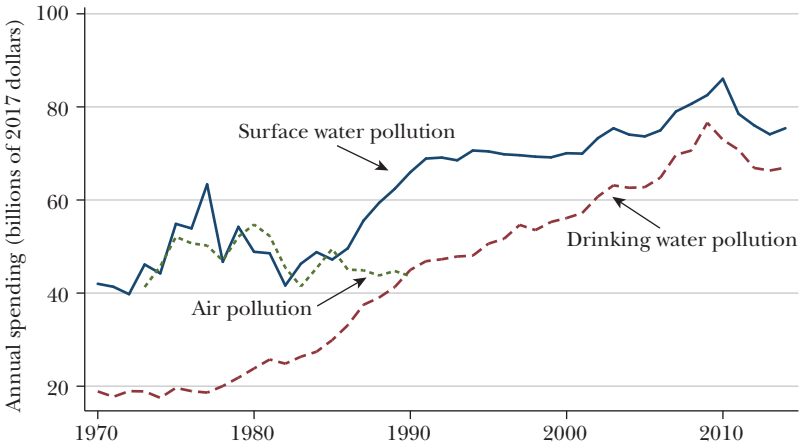
Source: Authors. For years after 2004, data are from table A-1 of the "Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities." For earlier years, data are from various tables of predecessor reports.
Note: Column 5 covers all regulations not in columns 1–4. For studies that estimate a lower bound and upper bound on costs or benefits, this table averages the two. When costs or benefits are estimated for multiple discount rates, this table uses values for a 3 percent discount rate. When studies present multiple estimates for other reasons, this table averages the multiple estimates. The table includes the few studies that report negative costs (that is, cost savings). It also includes studies that contain notes that their benefits or costs are incomplete in specific known ways. The table excludes regulations with unreported benefits or unreported costs, or regulations with benefits and costs not reported in monetary terms or reported in noncomparable monetary terms. The greenhouse gases column includes energy efficiency regulations. For studies listing only a bound (for example, benefits up to $10 million), this table uses the bound. Regulations affecting emissions from all media (as an example, regulating manufacture and disposal of polychlorinated biphenyls) are not listed as air or water policies. Total US expenditures reflect public and private investments (see online Appendix B) and are not readily available for greenhouse gases or all other regulations (columns 4–5).

"stated preference" methods, which include contingent valuation surveys that have been controversial (as discussed in this journal in Diamond and Hausman 1994; Hausman 2012; Kling, Phaneuf, and Zhao 2012). Health-based methods are the most common approach for estimating the value of drinking water quality. To measure the costs of providing clean water, some studies use accounting data from surveys of firm expenditures on pollution abatement, others use engineering estimates of the costs of abatement technology, and still others use reported government accounts.

Panel A of Table 1 shows estimates of the total cost of cleaning up surface water pollution, providing clean drinking water, and abating air pollution.[8] For federal expenditures, we use microdata from a federal accounting database, the Grants Information and Control System, and from annual reports of the Clean Water State Revolving Fund. For state and local expenditures, we use summaries from the Annual Survey of Governments and Annual Census of Governments. For industrial

[8] Online Appendix B describes how we construct these cost estimates in detail, but here we summarize.

Figure 4
Annual Investments to Clean Pollution in Surface Waters, Drinking Water, and Air, 1970–2010



Source: Authors. See sources and details in online Appendix B.
Note: Expenditures include public and private sources, industry, agriculture, transportation (for example, catalytic converters and reformulated gasoline), and all other sources with available data. Air pollution line shows only annual values for 1973 to 1990 because these are the years with the most reliable data; available air pollution expenditure estimates for other individual years require more imputation. All values are deflated to 2017 dollars using the Engineering News Record Construction Price Index.

expenditures, we primarily use data from a survey of manufacturing plants, the Pollution Abatement Costs and Expenditures Survey.

Over the period 1970 to 2014, we calculate total spending of $2.83 trillion to clean up surface water pollution, $1.99 trillion to provide clean drinking water, and $2.11 trillion to clean up air pollution (all converted to 2017 dollars). Total spending to clean up water pollution exceeded total spending to clean up air pollution by 70 to 130 percent.

Figure 4 shows these spending patterns by year. Between 1973 and 1987, annual spending to clean up surface waters was only slightly higher than spending to clean up air pollution, at $40 to $63 billion per year. Spending on drinking water treatment was lower, at $17 to $37 billion per year. Since 1987, spending to treat surface and drinking waters has steadily increased, which might reflect regulation of more toxic pollutants or maintenance of aging infrastructure.

Panel B of Table 1 summarizes benefit-cost analyses of 240 regulations the federal government implemented over the period 1992–2017. For years after 2004, data are from table A-1 of the annual "Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities," which is published by the Office of Information and Regulatory Affairs within the White House Office of Management and Budget. For earlier years, data are from various tables of predecessor reports. For many years, the federal government has completed a prospective evaluation (technically, a "Regulatory Impact Analysis")

for all major regulations. This evaluation typically estimates all quantifiable benefits and costs, where possible in monetary terms. The regulation may be implemented regardless of the result, though regulations with unfavorable benefit/cost ratios are more scrutinized. In Keiser, Kling, and Shapiro (2019), we review other studies by academics, which have similar patterns.

For concreteness, we describe one of the studies for surface water summarized in Table 1. In 2004, the Environmental Protection Agency considered requiring the meat and poultry products industry to decrease its water pollution emissions.[9] To evaluate this regulation, the EPA and its contractor Eastern Research Group completed a 1,200-page "Development Document" and a 250-page "Economic and Environmental Analysis." The analysis explains that this regulation would require plants to install abatement technologies such as biological treatment, nitrification, or disinfection. Based on a 350-firm survey and on the 1997 Economic Census, the analysis estimates that this would cost $42 million to $58 million annually. The analysis also estimates that this regulation would decrease emissions of nitrogen from this industry by 60 percent, sediment by 30 percent, and pathogens like *E. coli* by 80 percent. Using a national water quality simulation model (the National Water Pollution Control Assessment Model), the analysis estimates how these decreases in emissions would affect a water quality index from McClelland (1974), then uses stated preference estimates from Carson and Mitchell (1993) to calculate households' associated willingness to pay. The analysis finds that the decreased pollution emissions would lead to benefits of $2.6 million annually, with a range of $0 to $10 million (all figures in 2003 dollars). Given these estimated costs and benefits, this study implies an unfavorable estimated benefit/cost ratio of 0.052 (that is, the estimated benefits are about 5 percent of the estimated costs), with a range of 0.0 to 0.24. The EPA finalized the analysis in February 2004, the final rule was published in the *Federal Register* in September 2004, and the regulation took effect in October 2004.

Table 1 distinguishes five categories of regulations: surface water, drinking water, air pollution, greenhouse gases, and all other (including nonenvironmental). For four of these five categories of regulations, investments pass a benefit-cost test overall. For example, estimated total benefits from air pollution regulations exceed their estimated total costs by a factor of 12. For drinking water studies, total benefits are estimated to exceed total costs by a factor of 5. These are analyses of tightening existing regulation; the net benefits of maintaining existing drinking water treatment may be even greater, because basic drinking water treatment first got rid of typhoid and cholera. Surface water quality (including the meat and poultry regulation described in the previous paragraph) is the only one of these five categories of investment that fails a benefit-cost test—estimated total benefits are only 80 percent of estimated total costs. The next row in Table 1 describes the mean regulation—again all categories have a favorable benefit/cost ratio except surface waters, where

[9] Technically, this was a revision to the industry's Clean Water Act effluent guidelines. This rule finalized the first standards for poultry slaughterers or processors and revised standards for other meat product plants. See Environmental Protection Agency (2014).

the mean regulation has benefits that are 57 percent of its costs. The last row of Table 1 describes the share of regulations that are estimated to have benefits smaller than their costs. For surface water regulations, 67 percent of regulations fail a benefit-cost test; for drinking water regulations, only 20 percent do; and for air pollution regulations, only 8 percent do. Other studies using other samples of regulations reach a similar conclusion that many regulations to reduce surface water pollution fail a benefit-cost test, while most other regulations to reduce pollution pass such a test (Hahn 2000; Keiser, Kling, and Shapiro 2019).

Have investments to clean up US surface waters actually led to negative net benefits, or is existing research underestimating their benefits? Benefit estimates from existing studies may be biased downward for several reasons; investigation of these channels would be valuable for future research (Keiser, Kling, and Shapiro 2019; Keiser and Shapiro 2019). Many studies focus on recreation, amenity, or other types of "use" values that people derive from visiting surface waters. Other "nonuse" or "existence" values for clean water may also be important, though they are difficult to measure well. For example, some people may be willing to pay to decrease pollution in iconic waters such as the Great Lakes, Mississippi River, or San Francisco Bay, even if they never visit these water bodies. One assessment of the Clean Water Act did estimate that nonuse values are only one-sixth as large as use values (Environmental Protection Agency 2000a), but the standard difficulties in measuring nonuse and existence values apply equally well to this analysis.

Other potential benefits are also hard to measure and potentially understated in existing analyses. Many studies ignore health benefits, by assuming that drinking water treatment plants purify any pollution in rivers and lakes before that water reaches households for drinking. For example, in prevailing analyses, health accounts for little to none of the benefits of the Clean Water Act, but for most of the benefits of the Clean Air Act (Keiser, Kling, and Shapiro 2019). Many studies also use restrictive models of pollution transport, even though advances in hydrological routing models could allow more sophisticated analyses of pollution flows. Existing estimates abstract from changes in wages, which are one form in which improvements in market-level amenities such as water quality can be capitalized (Roback 1982). Existing estimates may also overlook changes in the equilibrium relationship of home prices to water pollution, which is another general equilibrium channel (Banzhaf 2018). More broadly, general equilibrium analyses of water pollution policy are limited. Existing estimates also abstract from benefits of reducing toxic and other nonconventional pollutants. Additionally, prevailing estimates generally assume that people have complete information about water pollution. While some newspapers print daily air pollution levels, anything close to this level of information is hard to obtain for water pollution. Furthermore, existing estimates abstract from ecological consequences such as loss of biodiversity and may miss benefits that accrue through groundwater and oceans.

Of course, existing studies may also inaccurately measure costs; the sign of this bias is ambiguous. Abatement costs represent market prices rather than surplus, abstract from market power and any associated loss to customers, ignore potentially

valuable by-products from abatement, can be difficult to distinguish from production or safety costs, can lead to learning by doing or innovation that decreases future abatement costs, and can increase the cost of consumer goods and thereby exacerbate distortions due to labor and capital taxes (Cremeans and Segal 1975; Bovenberg and Goulder 1996; Keiser, Kling, and Shapiro 2019).

One could diagnose inaccuracies of estimated benefits and costs for many types of regulation. Are net benefits more severely underestimated for surface water quality than for other goods? Our subjective perception is that cost estimates for water and other types of regulations have similar quality. But for benefits, the channels where environmental goods typically generate especially large benefits are either assumed in the case of water to be nonexistent (health) or hard to measure (nonuse or existence values) (Olmstead 2010). Most existing benefits of surface water quality are believed to come from recreation, but available data on recreation are often geographically limited (for example, one county, state, or lake) and often come from a single cross section. Hence, our subjective perception is that underestimation of benefits is more likely a concern for surface water quality regulation than for other regulations.

Even if current estimates understate the true benefits of investments in surface water quality, several reasons suggest why current and past regulation of surface water quality could produce smaller net benefits than other types of environmental investments (Keiser and Shapiro 2019). Surface water quality policy does not typically use market-based instruments such as cap-and-trade markets, pollution taxes, or hybrids of these two (such as a cap-and-trade market with a price floor). Such policies are generally more cost effective and tend to minimize the cost of pollution abatement. Fisher-Vanden and Olmstead (2013) identified 21 active and pilot programs with trading markets for water pollution permits: two recently created examples are the Chesapeake Bay Watershed Nutrient Credit Exchange and the Minnesota River Basin Trading market. Of course, one reason for the rarity of this approach to water pollution is the concern that it could create local areas of high pollution ("hot spots"). Another reason is that some watersheds have few polluters, and thin markets could lead to higher transaction costs.

Another inefficiency is that current policy ignores much of agriculture, which can make aggregate abatement more costly because current water pollution policy does not equate marginal abatement costs across all sources. Additionally, subsidizing abatement capital, which is primarily how the federal government addresses municipal wastewater treatment, can encourage too much investment in capital rather than in other factors of production such as labor.

Apart from specific policy choices, surface waters may be more substitutable than other environmental goods—changing the river where a person goes fishing or boating may be less costly than changing the air a person breathes (where the person lives or works) or the water a person drinks. Firms, which account for most air pollution abatement, may also find more cost-effective ways to abate water pollution than governments, which account for a large share of water pollution abatement.

Failing a cost-benefit test does not imply the United States should not invest in surface water quality. Apart from the fact that these analyses may underestimate true benefits, they also reflect the policy instruments and investments actually made. Using more cost-effective instruments, targeting investments to areas with greatest net benefits, and other reforms can achieve greater benefits for the same cost. Policymakers may also value other objectives, such as equity.

What is known about the efficiency of water pollution regulation elsewhere? Analysis of the main water quality policy of the European Union, the Water Framework Directive, is too preliminary to be meaningful. The main benefit-cost analysis the European Union's main commissioned report summarizes is for a single watershed in Bulgaria (Russi and Farmer 2018, 53). Some evidence finds that India's National River Conservation Plan has not significantly decreased water pollution (Greenstone and Hanna 2014). Exploiting local discontinuities in regulation, He, Wang, and Zhang (2018) find that reducing China's emissions of chemical oxygen demand, an omnibus measure of industrial pollution, by 10 percent would cost US$160 billion. They do not compare these costs to the associated benefits, though river pollution in China does appear to increase cancer mortality (Ebenstein 2012).

Why a Dearth of Economic Research on Water Pollution?

Given the importance of water quality and the strikingly low estimated benefit/cost ratios, surprisingly little economic research analyzes it. Table 2 describes several measures of research. Publications are perhaps the most relevant measure. Two to three times more JSTOR economics articles focus on the Clean Air Act than on the Clean Water Act or Safe Drinking Water Act. In the top five economics journals, 45 articles discuss the Clean Air Act but only two discuss the Clean Water Act or the Safe Drinking Water Act. Even in environmental and energy economics journals, more than twice as many papers discuss the Clean Air Act than the Clean Water Act or Safe Drinking Water Act. At National Bureau of Economic Research Summer Institute sessions on energy and environmental economics over the years 2009–2018, 21 papers discussed the Clean Air Act and only three discussed the Clean Water Act or Safe Drinking Water Act. We also reviewed eight leading graduate and undergraduate environmental economics textbooks. The mean book spent three times more pages discussing the Clean Air Act than the Clean Water Act. We also reviewed two undergraduate textbooks in public finance; they spent three to six pages discussing the Clean Air Act but did not discuss the Clean Water Act.[10]

Discussing why relatively little economics research has focused on water pollution and its regulation may help explain these surprising patterns and also provide a road map for scholars seeking to start working in this area. One challenge is the

[10] Table 1 in online Appendix A shows that relatively more papers mention water pollution than water pollution regulation. The table measures are less informative, however, since many of these papers focus on unrelated topics (for example, crime) but mention the phrase "water pollution" once.

Table 2
Prevalence of Economic Research on Air versus Water Pollution

	Regulation			*Ratio: air vs. water*	
	Clean Air Act (1)	*Clean Water Act (2)*	*Safe Drinking Water Act (3)*	*Air/ surface (4)*	*Air/ drinking (5)*
Economics journal articles					
All	902	400	87	2.3	10.4
Year 2000+	455	192	38	2.4	12.0
Top five journals	45	1	1	45.0	45.0
Environmental/energy economics	176	65	16	2.7	11.0
Agricultural economics	53	116	19	0.5	2.8
Noneconomics journal articles					
Environment	741	1,106	1,510	0.7	0.5
Health	647	261	581	2.5	1.1
Presentations					
NBER Summer Institute	21	1	2	21.0	7.0
ASSA meetings (AERE sessions)	41	14	3	2.9	2.4
Environmental economics textbooks, no. pages					
Mean	14	4	2	3.5	2.3
Median	11	3	0	3.7	3.7
Public finance textbooks, mean no. pages	4.5	0	0	–	–

Source: All journal articles are from JSTOR. Environmental textbooks include Chapman (2000), Goodstein (2001), Kolstad (2010), Berck and Helfand (2011), Callan and Thomas (2013), Anderson and Libecap (2014), Freeman, Herriges, and Kling (2014), Phaneuf and Requate (2017), and Tietenberg and Lewis (2018). Public finance textbooks include Rosen (2002) and Gruber (2010). The National Bureau of Economic Research (NBER) data cover 2009–2018 environmental/energy economics sessions, while the Allied Social Sciences Association (ASSA) data cover 2011–2019. The ASSA papers include all those in sessions contributed by the Association of Environmental and Resource Economists (AERE). See online Appendix C for additional details.

limited availability of data on surface or drinking water pollution. The Environmental Protection Agency does not operate a comprehensive national monitoring network for water pollution. Many air pollution monitors report values hourly, while the average water pollution monitoring site in one large dataset reports every four months (Keiser and Shapiro 2019). Because many organizations collect water pollution data, using a range of methods and devices, it can be complex to determine which water quality data are accurate, representative, and comparable. Keiser and Shapiro (2019, appendix B.3) describe several methods to address these issues.

One improvement in access to surface water quality data is the Water Quality Portal (http://www.waterqualitydata.us) managed by the Environmental Protection Agency. Fully introduced in June 2018, it streamlines access to a broad range of water quality data. The portal covers about 300 million water quality records, 2.4 million monitoring sites, and 450 monitoring organizations (Read et al. 2017). However, it excludes the largest and oldest federal data repository, the EPA's STORET ("STOrage and RETrieval") Legacy system, which includes 200 million water samples from 700,000 monitoring sites over roughly the years 1900–1998. STORET

Legacy is more difficult to parse, though the EPA plans to incorporate it eventually into the Water Quality Portal. Remote sensing (satellite) measures of water color and clarity are also becoming more common (Lee, Orne, and Schaeffer 2014), as are automatic water quality monitors that can frequently detect and automatically report ambient levels (Anvari et al. 2009). While remote sensing is becoming influential in air pollution research, its use in water pollution research in economics is nascent. For groundwater, one smaller repository, the National Ground-Water Monitoring Network, measures water quality in about 2,000 wells.

For data on drinking water quality, the most comprehensive source is the Tap Water Database, compiled by a nonprofit, the Environmental Working Group. Since 2010, this database has collected data from states. The Environmental Protection Agency also maintains several other records. The Safe Drinking Water Information System begins earlier than the Tap Water Database but reports only violations and not pollution concentrations. The Annual Water Quality Reports is a database of annual reports that water utilities send consumers. Finally, the National Occurrence Database maintains some records of regulated and unregulated water contaminants.

A third challenge for water pollution research involves assessing where and when steps to reduce water pollution have taken place. Some recent progress in data availability may help. The Clean Watershed Needs Survey provides a panel census of the roughly 15,000 wastewater treatment plants that receive household and some business waste in most US cities. The Grants Information and Control System provides data on over 35,000 grants the federal government gave cities through the Clean Water Act to improve wastewater treatment. The Environmental Protection Agency keeps records of inspections and enforcement actions against violators of the Clean Water Act—these data were formerly known as the Permit Compliance System, and a newer, improved version is the Integrated Compliance Information System. The Pollution Abatement Costs and Expenditures survey for many years collected information on firms' capital and operating costs to address pollution emissions. Many of these datasets have existed for decades, though they have gradually become more accessible.

A fourth challenge involves causal inference. Because water quality regulation is somewhat uniform across space, it has been difficult for economists to identify effects of regulation by comparing regulated against unregulated areas. This concern is arguably less pronounced for other environmental goods.

A fifth challenge involves spatial computation. For studying air pollution and climate change, geographic aggregates such as counties or states provide a reasonable unit of analysis. For water pollution, looking at spatial patterns determined by geography—such as upstream and downstream on an individual river segment—can be informative. A few advances have made this form of analysis more feasible. The National Hydrography Dataset provides a georeferenced atlas of every US water feature. Software and computing advances such as ArcGIS, QGIS, C++, and the National Hydrography Dataset have streamflow algorithms, and several papers now exploit the direction of streamflow (Ebenstein 2012; Olmstead et al. 2013;

Cicala 2017; Lipscomb and Mobarak 2017; Garg et al. 2018; Keiser and Shapiro 2019). Also, since 2000, the Watershed Boundary Database has a more spatially detailed watershed called a Hydrologic Unit Code. The most detailed twelve-digit Hydrologic Unit Codes distinguish 100,000 separate local water areas (US Department of Agriculture 2018).

A sixth challenge is the choice of which water pollutants should be the main focus. The surface water pollution repositories discussed above describe over 16,000 different measures of pollution, and it is unclear how to choose a few measures that matter most. Some studies focus on one or a few omnibus measures of water pollution, though the chosen measure varies by study. For example, Sigman (2002) and Lipscomb and Mobarak (2017) use biochemical oxygen demand; Duflo et al. (2013) use biochemical oxygen demand, chemical oxygen demand, and a few others; and Keiser and Shapiro (2019) focus on whether waters are safe for fishing and on "dissolved oxygen," which measures the capacity of water to support aquatic life.

Conclusion

In 1970, the United States created the Environmental Protection Agency, then passed two sweeping laws designed to improve water quality—the Clean Water Act and the Safe Drinking Water Act. The resulting investments in cleaner water have not been cheap, costing on average about 0.8 percent of US GDP per year. A half century later, many measures of drinking and surface water quality have improved, in part because of these laws. Industrial, sewage, and drinking water pollution have all decreased, though agricultural water pollution remains prevalent.

The investments in drinking water appear to create substantial health benefits that exceed their estimated costs. Perhaps surprisingly, however, existing evidence suggests that the estimated costs of most investments in cleaning up rivers, lakes, and oceans exceed their measured benefits. Many of these estimates note that they have difficulty quantifying several important channels of benefits and may be understating true benefits. Unfortunately, economic research on water pollution and its regulation has been limited. An important task for research is to assess which investments in surface water pollution create net benefits, along with ways to make these investments more effective.

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References

Adler, Jonathan H. 2002. "Fables of the Cuyahoga: Reconstructing a History of Environmental Protection." *Fordham Environmental Law Journal* 14 (1): 89–146.

Agee, James L. 1975. "Protecting America's Drinking Water: Our Responsibilities under the Safe Drinking Water Act." *EPA Journal* 1 (3): 2–5.

Agency for Toxic Substances and Disease Registry. 2018. "Per- and Polyfluoroalkyl Substances (PFAS) and Your Health." https://www.atsdr.cdc.gov/pfas/health-effects.html (accessed June 12, 2019).

Allaire, Maura. 2018. "Health-Based Violations of the Safe Drinking Water Act, 1982–2015." Harvard Dataverse, v1. https://doi.org/10.7910/DVN/IFV6SQ (accessed December 9, 2018).

Allaire, Maura, Haowei Wu, and Upmanu Lall. 2018. "National Trends in Drinking Water Quality Violations." *PNAS* 115 (9): 2078–83.

Alsan, Marcella, and Claudia Goldin. 2019. "Watersheds in Child Mortality: The Role of Effective Water and Sewerage Infrastructure, 1880–1920." *Journal of Political Economy* 127 (2): 586–638.

Anderson, Terry L., and Gary D. Libecap. 2014. *Environmental Markets: A Property Rights Approach.* New York: Cambridge University Press.

Anvari, Alex, Jenny Delos Reyes, Ehsan Esmaeilzadeh, Ali Jarvandi, Nicholas Langley, and Keyssi Rivera Navia. 2009. "Designing an Automated Water Quality Monitoring System for West and Rhode Rivers." In *2009 IEEE Systems and Information Engineering Design Symposium: Program and Author Index*, edited by Kenneth G. Crowther and Garrick E. Louis, 131–36. Charlottesville: University of Virginia.

Arthur, Rachel. 2018. "'Bottled Water is America's Favorite Drink!' Bottled Water Takes Top Spot in US." *Beverage Daily*, June 1, 2018. https://www.beveragedaily.com/Article/2018/06/01/Bottled-water-takes-top-spot-in-US-in-2017#.

Banzhaf, H. Spencer. 2018. "Difference-in-Differences Hedonics." Unpublished.

Bennear, Lori S., and Sheila M. Olmstead. 2008. "The Impacts of the 'Right to Know': Information Disclosure and the Violation of Drinking Water Standards." *Journal of Environmental Economics and Management* 56 (2): 117–30.

Berck, Peter, and Gloria Helfand. 2011. *The Economics of the Environment.* Boston, MA: Addison-Wesley.

Booth, Larry, and Frank Quinn. 1995. "Twenty-Five Years of the Canada Water Act." *Canadian Water Resources Journal* 20 (2): 65–90.

Bovenberg, A. Lans, and Lawrence H. Goulder. 1996. "Optimal Environmental Taxation in the Presence of Other Taxes: General-Equilibrium Analyses." *American Economic Review* 86 (4): 985–1000.

Boyle, Kevin J., Matthew J. Kotchen, and V. Kerry Smith. 2017. "Deciphering Dueling Analyses of Clean Water Regulations." *Science* 358 (6359): 49–50.

Brownhill, Stacy L., and Julie A. Rosen. 2018. "Clean Water Act Groundwater Pollution Liability in Limbo." *National Law Review*, October 4, 2018. https://www.natlawreview.com/article/clean-water-act-groundwater-pollution-liability-limbo.

California Water Boards. 2019. "Contaminants in Drinking Water." https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.html (accessed June 30, 2019).

Callan, Scott J., and Janet M. Thomas. 2013. *Environmental Economics and Management: Theory, Policy, and Applications.* Mason, OH: South-Western.

Carson, Richard T., and Robert Cameron Mitchell. 1993. "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." *Water Resources Research* 29 (7): 2445–54.

Census Bureau. 1971. *1967 Census of Manufactures: Water Use in Manufacturing.* Washington, DC: Census Bureau.

Census Bureau. 1986. *1982 Census of Manufactures: Water Use in Manufacturing.* Washington, DC: Census Bureau.

Chapman, Duane. 2000. *Environmental Economics: Theory, Application, and Policy.* Reading, MA: Addison-Wesley.

Cicala, Steve. 2017. "Imperfect Markets versus Imperfect Regulation in U.S. Electricity Generation." NBER Working Paper 23053.

Congressional Budget Office. 1985. "Efficient Investment in Wastewater Treatment Plants." Technical Report, Congressional Budget Office.

CQ Almanac. 1972. "Clean Water: Congress Overrides Presidential Veto." https://library.cqpress.com/cqalmanac/document.php?id=cqal72-1249049.

CQ Almanac. 1974. "Safe Drinking Water." https://library.cqpress.com/cqalmanac/document.php?id=cqal74-1225339.

Craig, Robin Kundis. 2018. "Water Quality Law in the US and EU: A Comparison of the Clean Water Act and Water Framework Directive." *EuropeNow*, December 10, 2018. https://www.europenowjournal.org/2018/12/10/water-quality-law-in-the-us-and-eu-a-comparison-of-the-clean-water-act-and-water-framework-directive/.

Craig, Robin Kundis, and Anna M. Roberts. 2015. "When Will Governments Regulate Nonpoint Source Pollution? A Comparative Perspective." *Boston College Environmental Affairs Law Review* 42 (1): 1–64.

Cremeans, John E., and Frank W. Segel. 1975. "National Expenditures for Pollution Abatement and Control, 1972." *Survey of Current Business* 55 (2): 8–11.

Cropper, Maureen L., and Wallace E. Oates. 1992. "Environmental Economics: A Survey." *Journal of Economic Literature* 30 (2): 675–740.

Cutler, David, and Grant Miller. 2005. "The Role of Public Health Improvements in Health Advances: The Twentieth-Century United States." *Demography* 42 (1): 1–22.

Diamond, Peter A., and Jerry A. Hausman. 1994. "Contingent Valuation: Is Some Number Better Than No Number?" *Journal of Economic Perspectives* 8 (4): 45–64.

Dingell, John D. 2010. "Preamble." In *Burning Rivers: Revival of Four Urban-Industrial Rivers That Caught on Fire*, by John H. Hartig. Brentwood, UK: Multi-Science Publishing.

Duflo, Esther, Michael Greenstone, Rohini Pande, and Nicholas Ryan. 2013. "Truth-Telling by Third-Party Auditors and the Response of Polluting Firms: Experimental Evidence from India." *Quarterly Journal of Economics* 128 (4): 1499–545.

Earnhart, Dietrich. 2004. "Panel Data Analysis of Regulatory Factors Shaping Environmental Performance." *Review of Economics and Statistics* 86 (1): 391–401.

Ebenstein, Avraham. 2012. "The Consequences of Industrialization: Evidence from Water Pollution and Digestive Cancers in China." *Review of Economics and Statistics* 94 (1): 186–201.

Environmental Protection Agency. 1972. *Industrial Pollution of the Lower Mississippi River in Louisiana*. Washington, DC: EPA.

Environmental Protection Agency. 1999. *25 Years of the Safe Drinking Water Act: History and Trends*. Washington, DC: EPA.

Environmental Protection Agency. 2000a. "A Benefits Assessment of Water Pollution Control Programs Since 1972: Part 1, The Benefits of Point Source Controls for Conventional Pollutants in Rivers and Streams: Final Report." Technical Report, EPA Contract 68-C6-0021, RTI Project 6600-4.

Environmental Protection Agency. 2000b. "Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment." EPA Report EPA-832-R-00-008.

Environmental Protection Agency. 2010. *NPDES Permit Writers' Manual*. Washington, DC: EPA.

Environmental Protection Agency. 2014. "Economic and Environmental Benefits Analysis of the Final Meat and Poultry Products Rule." EPA Report EPA-821-R-04-010.

Environmental Protection Agency. 2015. "Regulation Timeline: Contaminants Regulated under the Safe Drinking Water Act." https://www.epa.gov/sites/production/files/2015-10/documents/dw_regulation_timeline.pdf (accessed November 28, 2018).

Environmental Protection Agency. 2018a. "ATTAINS, National Summary of State Information." https://ofmpub.epa.gov/waters10/attains_nation_cy.control (accessed November 8, 2018).

Environmental Protection Agency. 2018b. "National Primary Drinking Water Regulations." https://www.epa.gov/sites/production/files/2016-06/documents/npwdr_complete_table.pdf (accessed November 28, 2018).

Environmental Protection Agency. 2019. "TSCA Chemical Substance Inventory." https://www.epa.gov/tsca-inventory/how-access-tsca-inventory (accessed June 12, 2019).

Fisher-Vanden, Karen, and Sheila Olmstead. 2013. "Moving Pollution Trading from Air to Water: Potential, Problems, and Prognosis." *Journal of Economic Perspectives* 27 (1): 147–72.

Freeman, A. Myrick III. 2000. "Water Pollution Policy." In *Public Policies for Environmental Protection*, edited by Paul R. Portney and Robert N. Stavins, 169–213. Washington, DC: Resources for the Future.

Freeman, A. Myrick III, Joseph A. Herriges, and Catherine L. Kling. 2014. *The Measurement of Environmental and Resource Values*. New York: Resources for the Future Press. 3rd ed.

Gallup. 2018. "Environment." https://news.gallup.com/poll/1615/environment.aspx (accessed November 9, 2018).

Garg, Teevrat, Stuart E. Hamilton, Jacob P. Hochard, Evan Plous Kresch, and John Talbot. 2018. "(Not So) Gently Down the Stream: River Pollution and Health in Indonesia." *Journal of Environmental Economics and Management* 92 (1): 35–53.

Glicksman, Robert L., and Dietrich H. Earnhart. 2007. "The Comparative Effectiveness of Government Interventions on Environmental Performance in the Chemical Industry." *Stanford Environmental Law*

Journal 26 (2): 317–72.
Goodstein, Eban S. 2001. *Economics and the Environment*. New York: John Wiley and Sons. 3rd ed.
Gray, Wayne B., and Jay P. Shimshack. 2011. "The Effectiveness of Environmental Monitoring and Enforcement: A Review of the Empirical Evidence." *Review of Environmental Economics and Policy* 5 (1): 3–24.
Greenstone, Michael, and Rema Hanna. 2014. "Environmental Regulations, Air and Water Pollution, and Infant Mortality in India." *American Economic Review* 104 (10): 3038–72.
Griffiths, Charles, Heather Klemick, Matt Massey, Chris Moore, Steve Newbold, David Simpson, Patrick Walsh, and William Wheeler. 2012. "U.S. Environmental Protection Agency Valuation of Surface Water Quality Improvements." *Review of Environmental Economics and Policy* 6 (1): 130–46.
Grooms, Katherine K. 2016. "Does Water Quality Improve When a Safe Drinking Water Act Violation Is Issued? A Study of the Effectiveness of the SDWA in California." *BE Journal of Economic Analysis and Policy* 16 (1): 1–23.
Gruber, Jonathan. 2010. *Public Finance and Public Policy*. New York: Worth Publishers. 3rd ed.
Hahn, Robert W. 2000. *Reviving Regulatory Reform: A Global Perspective*. Washington, DC: American Enterprise Institute–Brookings Joint Center for Regulatory Studies.
Hausman, Jerry. 2012. "Contingent Valuation: From Dubious to Hopeless." *Journal of Economic Perspectives* 26 (4): 43–56.
He, Guojun, Shaoda Wang, and Bing Zhang. 2018. "Leveraging Political Incentives for Environmental Regulation: Evidence from Chinese Manufacturing Firms." Unpublished.
Helland, Eric. 1998. "The Enforcement of Pollution Control Laws: Inspections, Violations, and Self-Reporting." *Review of Economics and Statistics* 80 (1): 141–53.
Keiser, David A., Catherine L. Kling, and Joseph S. Shapiro. 2019. "The Low but Uncertain Measured Benefits of US Water Quality Policy." *PNAS* 116 (12): 5262–69.
Keiser, David A., and Joseph S. Shapiro. 2019. "Consequences of the Clean Water Act and the Demand for Water Quality." *Quarterly Journal of Economics* 134 (1): 349–96.
Kling, Catherine L., Daniel J. Phaneuf, and Jinhua Zhao. 2012. "From Exxon to BP: Has Some Number Become Better Than No Number?" *Journal of Economic Perspectives* 26 (4): 3–26.
Kolstad, Charles D. 2010. *Environmental Economics*. New York: Oxford University Press. 2nd ed.
Laplante, Benoit, and Paul Rilstone. 1996. "Environmental Inspections and Emissions of the Pulp and Paper Industry in Quebec." *Journal of Environmental Economics and Management* 31 (1): 19–36.
Lee, Christine M., Tiffani Orne, and Blake Schaeffer. 2014. "How Can Remote Sensing Be Used for Water Quality Monitoring?" Session presented at National Water Quality Monitoring Council 9th National Monitoring Conference, Cincinnati, OH, April 28–May 2. https://acwi.gov/monitoring/conference/2014/1ExtendedSessions/L8/Lee_RemoteSensingWorkshop.pdf.
Lipscomb, Molly, and Ahmed Mushfiq Mobarak. 2017. "Decentralization and Pollution Spillovers: Evidence from the Re-drawing of County Borders in Brazil." *Review of Economic Studies* 84 (1): 464–502.
Magat, Wesley A., and W. Kip Viscusi. 1990. "Effectiveness of the EPA's Regulatory Enforcement: The Case of Industrial Effluent Standards." *Journal of Law and Economics* 33 (2): 331–60.
Malik, Arun S., Bruce A. Larson, and Marc Ribuado. 1994. "Economic Incentives for Agricultural Nonpoint Source Pollution Control." *Water Resources Bulletin* 30 (3): 471–80.
Mason, Charles F., Lucija A. Muehlenbachs, and Sheila M. Olmstead. 2015. "The Economics of Shale Gas Development." *Annual Review of Resource Economics* 7 (1): 269–89.
McClelland, Nina I. 1974. "Water Quality Index Application in the Kansas River Basin." EPA Report EPA-907/9-74-001.
Mehan, G. Tracy III. 2010. "A Symphonic Approach to Water Management: The Quest for New Models of Watershed Governance." *Journal of Land Use and Environmental Law* 26 (1): 1–33.
Messner, Michael, Susan Shaw, Stig Regli, Ken Rotert, Valerie Blank, and Jeff Soller. 2006. "An Approach for Developing a National Estimate of Waterborne Disease Due to Drinking Water and a National Estimate Model Application." *Journal of Water and Health* 4 (Suppl. 2): 201–40.
Milazzo, Paul Charles. 2006. *Unlikely Environmentalists: Congress and Clean Water, 1945–1972*. Lawrence: University Press of Kansas.
Muehlenbachs, Lucija, Elisheba Spiller, and Christopher Timmins. 2015. "The Housing Market Impacts of Share Gas Development." *American Economic Review* 105 (12): 3633–59.
National Park Service. 2018. "The Cuyahoga River." https://www.nps.gov/cuva/learn/kidsyouth/the-cuyahoga-river.htm (accessed November 5, 2018).
Nigra, Anne A., Tiffany R. Sanchez, Keeve E. Nachman, David E. Harvey, Steven N. Chillrud, Joseph H. Graziano, and Ana Navas-Acien. 2017. "The Effect of the Environmental Protection Agency

Maximum Contaminant Level on Arsenic Exposure in the USA from 2003 to 2014: An Analysis of the National Health and Nutrition Examination Survey (NHANES)." *Lancet Public Health* 2 (11): e513–21.

Olmstead, Sheila M. 2010. "The Economics of Water Quality." *Review of Environmental Economics and Policy* 4 (1): 44–62.

Olmstead, Sheila M., Lucija Muehlenbachs, Jhih-Shyang Shih, Ziyan Chu, and Alan J. Krupnick. 2013. "Shale Gas Development Impacts on Surface Water Quality in Pennsylvania." *PNAS* 110 (13): 4962–67.

Parris, Kevin. 2011. "Impact of Agriculture on Water Pollution in OECD Countries: Recent Trends and Future Prospects." *International Journal of Water Resources Development* 27 (1): 33–52.

Phaneuf, Daniel J., and Till Requate. 2017. *A Course in Environmental Economics: Theory, Policy, and Practice*. New York: Cambridge University Press.

Public Health Service. 1970. *Community Water Supply Study: Analysis of National Survey Findings*. Washington, DC: Public Health Service.

Raucher, Robert S. 1996. "Public Health and Regulatory Considerations of the Safe Drinking Water Act." *Annual Review of Public Health* 17 (1): 179–202.

Read, Emily K., Lindsay Carr, Laura De Cicco, Hilary A. Dugan, Paul C. Hanson, Julia A. Hart, James Kreft, Jordan S. Read, and Luke A. Winslow. 2017. "Water Quality Data for National-Scale Aquatic Research: The Water Quality Portal." *Water Resources Research* 53 (2): 1735–45.

Roback, Jennifer. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy* 90 (6): 1257–78.

Rosen, Harvey S. 2002. *Public Finance*. Boston: McGraw-Hill Irwin. 6th ed.

Russi, Daniela, and Andrew Farmer. 2018. "Testing a Methodology to Assess the Costs and Benefits of the Implementation of the EU Water Acquis in Selected River Basins." Technical Report, Institute for European Environmental Policy.

SciLine. 2019. "Lead in U.S. Drinking Water." https://www.sciline.org/evidence-blog/lead-drinking-water (accessed June 2, 2019).

Shapiro, Joseph S., and Reed Walker. 2018. "Why Is Pollution from US Manufacturing Declining? The Roles of Environmental Regulation, Productivity, and Trade." *American Economic Review* 108 (12): 3814–54.

Shimshack, Jay P., and Michael B. Ward. 2008. "Enforcement and Over-compliance." *Journal of Environmental Economics and Management* 55 (1): 90–105.

Sigman, Hilary. 2002. "International Spillovers and Water Quality in Rivers: Do Countries Free Ride?" *American Economic Review* 92 (4): 1152–59.

Smith, Richard A., Richard B. Alexander, and M. Gordon Wolman. 1987. "Water-Quality Trends in the Nation's Rivers." *Science* 235 (4796): 1607–15.

Smith, V. Kerry, and Carlos Valcarcel Wolloh. 2012. "Has Surface Water Quality Improved since the Clean Water Act?" NBER Working Paper 18192.

Snow, John. 1855. *On the Mode of Communication of Cholera*. London: John Churchill.

Stigler, George. 1952. *The Theory of Price*. New York: Macmillan. 2nd ed.

Stigler, George. 1966. *The Theory of Price*. New York: Macmillan. 3rd ed.

Sullivan, Patrick J., Franklin J. Agardy, and James J. J. Clark. 2005. *The Environmental Science of Drinking Water*. New York: Elsevier.

Tiemann, Mary. 2017. "Safe Drinking Water Act (SDWA): A Summary of the Act and Its Major Requirements." Report, Congressional Research Service.

Tietenberg, Tom, and Lynne Lewis. 2018. *Environmental and Natural Resource Economics*. New York: Routledge. 11th ed.

Time. 1969. "America's Sewage System and the Price of Optimism." August 1, 1969. http://content.time.com/time/magazine/article/0,9171,901182,00.html.

US Department of Agriculture. 2018. "Watershed Boundary Dataset (WBD) Facts." https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/watersheds/dataset/?cid=nrcs143_021617 (accessed November 27, 2018)

Wrenn, Douglas H., Allen Klaiber, and Edward C. Jaenicke. 2016. "Unconventional Shale Gas Development, Risk Perceptions, and Averting Behavior: Evidence from Bottled Water Purchases." *Journal of the Association of Environmental and Resource Economists* 3 (4): 779–817.

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On Latin American Populism, and Its Echoes around the World

Sebastian Edwards

Most definitions of populism refer to political movements led by individuals with strong and charismatic personalities, whose rhetoric revolves around the causes and consequences of inequality. Populist leaders are nationalistic, and they confront the interests of "the people" with those of the elites, large corporations and banks, multinationals, immigrants, and other foreign institutions, including the International Monetary Fund. Populist politicians appeal directly to the masses. They tend to skip the channels of traditional political parties and often lead their own "movements"—Hugo Chávez's Movimiento Bolivariano in Venezuela is a premier example. Populist leaders regularly show ambivalence, if not open contempt, toward representative democracy and instead exhibit a streak of authoritarianism.

For a long time, populist policies were considered to be a Latin American phenomenon, pursued in places such as Argentina and Venezuela. In the past few years, however, populism has expanded beyond Latin America to countries as diverse as Italy, Russia, Hungary, Poland, Turkey, the United Kingdom, and the United States. I argue that many of the characteristics of traditional Latin American populism are also present in most recent manifestations from around the globe.

Experts across the social sciences define populism differently and, often, imprecisely. For example, sociologist Peter Worsley (1969, 245) wrote that "populism is better regarded as an emphasis, a dimension of political culture in general, not

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simply as a particular kind of overall ideological system or type of organization." Historian Edwin Williamson (1992, 347) defined populism as "the phenomenon where a politician tries to win power . . . with sweeping promises of benefits and concessions to . . . the lower classes. . . ." Political scientist Paul Drake (1982, 218) argued that populists "respond to the problems of underdevelopment . . . through ameliorative redistributive measures." More recently, political scientists Cas Mudde and Cristóbal Rovira Kaltwasser (2017, 19) have posited that populism is a "thin-centered ideology . . . which has come to the fore . . . in many different shapes. . . ." To make attempts at definitions even more complicated, populism is a pejorative term. It is usually tossed around by politicians to discredit rivals. Political theorist Ernesto Laclau (2005, 19) famously said that populism has been generally "denigrated." Almost no politicians are willing to refer to themselves as populists, or to label their political and economic platforms as populist.

Economists have tried to provide more structure to their discussion of populist policies and have offered definitions centered on the use of unsustainable policies (macro and micro) to attain redistribution. Many economists have argued that these policies end up hurting the lower classes, the group that the policies were supposed to help. In the early 1990s, Rudi Dornbusch and I defined populism as a set of economic policies aimed at redistributing income by implementing policies that violate "good economics," including budget constraints and efficiency principles (Dornbusch and Edwards 1990, 1991). According to Rodrik (2018, 196), populism refers to a set of "irresponsible, unsustainable policies that often end in disaster and hurt most the ordinary people they purportedly aim to help." The problem in making this case is that often real-world populism does not appear in "black or white," but rather in shades of gray.

I begin in the next section by making a distinction between "classical" and "new" populism. I provide basic information on 15 populist episodes in Latin America before 1990 and seven cases in the post-1990 period. I argue that all of these experiences have important similarities that can be conceptualized in a five-phases model first suggested by Dornbusch and myself. I then analyze in greater detail the experiences of Chile (1970–1973), Peru (1985–1990), Argentina (2003–2015), Venezuela (1998–present), and Ecuador (2007–2017). I argue that while the existence of "fiscal dominance" has been a key feature of classical populism, it is not necessarily at the center of new populist experiences. I end by comparing experiences from other parts of the world with those of Latin America.

"Classical" and "New" Populism in Latin America

In analyzing populist experiences in Latin America, it is useful to distinguish between "classical populism" and "new populism." Both types of regime are led by charismatic leaders with strong personalities who rely on heterodox economic policies to redistribute income. Most (but not all) cases of "classical populism" took place before 1990 and ended up with major currency crises, runaway inflation, and

a collapse in real wages. In many of these classical episodes, the populist leaders rose to power using nondemocratic means, and they were frequently deposed through a coup d'état. Two examples are Argentina's Juan Domingo Perón (1946–1955) and Peru's Alan García (1985–1990). Although the Venezuelan experiment was initiated in 1998, it followed the path of classical populism.

"New populism," in contrast, refers (mostly) to post-1990 experiences that have taken place under democratic rule. These new experiments are, generally, cases of "microeconomic populism," with a focus on blanket regulations, deep protectionist policies, large expansions of the public sector, and mandated minimum wage increases to redistribute income. New populism in Latin America does not rely exclusively on money creation and has often been accompanied by new constitutions that give the government legal tools to achieve its goals. Two examples of new populism are Ecuador under Rafael Correa (2007–2017) and Bolivia under Evo Morales (2006–present). Argentina under Presidents Nestor Kirchner and Cristina Fernandez de Kirchner (2003–2015) is a mixed case that combines elements from classic and new populism.

The Phases of Classical Populism in Latin America

In 1990, Rudi Dornbusch and I developed a model to analyze the dynamic of populism in Latin America in a five-phase cycle. The analysis recognized that a range of policies—protectionism, agrarian reforms, controls and regulations, and the nationalization of large companies—were put in place by populist regimes, but the emphasis was on fiscal largesse financed by money creation as the main redistributive mechanism. In the past few years a number of authors have used and expanded this framework to investigate the surge of populism around the world (Acemoglu, Egorov, and Solin 2013; Eichengreen 2018; Rodrik 2018; Ocampo 2019).

A summary of the Dornbusch–Edwards five-phases model is as follows. During Phase 1, before the populist leader gains power, the population is deeply dissatisfied with the economy's performance. Often, the country has experienced economic stagnation or outright depression as a result of previous attempts (usually implemented under an International Monetary Fund program) at reducing inflation or recovering from a severe currency crisis. People are experiencing lower standards of living, higher prices for public services, and a high degree of inequality. Citizen frustration increases rapidly, and people are willing to try heterodox policies. In many cases frustration is channeled through the armed forces, which stage a coup d'état and put the populist leader (often an army general) in power. Once in government, populists explicitly ignore constraints on public sector expenditure and monetary expansion. Risks of deficit finance are portrayed as exaggerated. Populists argue that monetary expansions are not inflationary because there is unutilized capacity, and it is always possible to squeeze profit margins by price controls.[1]

[1] In this regard, populist policies have interesting similarities to those of Modern Monetary Theory. For example, four of the countries in this study satisfied a key requirement of Modern Monetary Theory

During Phase 2, populist policymakers may seem fully vindicated in their diagnosis and prescription. The economy reacts strongly to the aggregate demand shock: growth, real wages, and employment are high, and the populist policies appear highly successful. Price controls assure that inflation is not a problem, and shortages are alleviated through an increase in imports. The run-down of inventories and the availability of imports—financed with dwindling international reserves—accommodate demand expansion with little impact on prices.

The fiscal dimension of classical populism is marvelously captured in a letter sent in 1952 by Argentina's Juan Domingo Perón to retired Chilean General Carlos Ibañez del Campo, who had recently been elected to the presidency (Hirschman 1979, 65):

> My dear friend: Give the people, especially to the workers, all that is possible. When it seems to you that already you are giving them too much, give them more. You will see the results. Everybody will try to frighten you with the specter of an economic collapse. But all of this is a lie. There is nothing more elastic than the economy which everyone fears so much because no one understands it. . . .

Another clear statement of classical populist economic strategies is provided by economist Daniel Carbonetto, who during the mid-1980s advised Peruvian President Alan García (Carbonetto 1987, 82): "It is necessary to spend, even at the cost of a fiscal deficit, because, if this deficit transfers public resources to increased consumption of the poorest, they demand more goods and this will bring about a reduction in unit costs; thus the deficit is not inflationary, on the contrary!"

During Phase 3, the economy runs into bottlenecks as a result of expansionary demand, lack of foreign exchange, and capital flight. Black markets for foreign currency and necessities develop. Inflation increases significantly, often above an annual rate of 100 percent. Wages keep up (with a lag) thanks to government-mandated indexation. As inflation rises, the periodicity of wage adjustments increases, first to quarterly and then to monthly. The budget deficit continues to worsen as a result of pervasive subsidies to food, public services, and transportation.

Phase 4 is the prelude to collapse and is characterized by pervasive shortages, increased capital flight, and an extreme acceleration of inflation. Price controls are intensified, and shop-owners are often accused of speculating and are sent to jail. The government may seek to stabilize the economy by cutting subsidies and by devaluing the currency, but the policies are usually timid and end up in further frustration. There is talk of defaulting on the foreign debt. In spite of indexation, inflation-adjusted wages fall. The disparity between inflation (very high) and exchange rates (pegged or depreciating slowly) intensifies the extent

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in that they all had a fiat money that had to be used, by law, to pay taxes. For more discussion of this comparison, see Edwards (2019).

of real exchange rate overvaluation. Often, multiple exchange rates are put in place. Foreign currency becomes a common medium of exchange, as people ditch the domestic currency. Generalized indexation worsens the fiscal accounts, as the government wage bill increases rapidly according to the indexation formula, while tax revenues lag behind.

Phase 5 is the cleanup following the disaster. Usually an orthodox stabilization happens under a new government. More often than not, an International Monetary Fund program will be enacted, and when everything is said and done, the incomes—and in particular the incomes of the poor—will have declined to a level significantly lower than when the episode began (Edwards 2010).

In Table 1, I present information on 15 selected episodes of classical populism in Latin America prior to 1990: four from before 1960 and eleven from the 1961–1990 period. I provide information on the political leaning of the government, inflation at the beginning and at the end of the episode, and whether there was an International Monetary Fund program in force in the years prior to the accession of the populist leader to power.[2] It is important to emphasize that the sample in Table 1 does not pretend to be exhaustive or definitive; others may produce a different list. In the real world, it is not always easy to pronounce whether a government is populist or not. Episodes often have shades of gray.

Several interesting conclusions emerge from this table. First, the vast majority of the experiences correspond to leftist governments. The exceptions are in Brazil: the generals who governed between 1969 and 1973, and the center government of José Sarney from 1985 to 1990 (de Castro and Ronci 1991). Second, in every case, inflation at the end of the experiment was significantly higher than at the beginning. In six of the eleven post-1960 episodes, inflation at the end of the experiment was at or above the three-digit level, and in Peru and Nicaragua it reached hyperinflation levels. Thirteen of these cases occurred after the International Monetary Fund became operational, and in eleven out of these thirteen cases, International Monetary Fund programs preceded the arrival of the populist leader. All eleven of these programs imposed austerity and rapid fiscal retrenchment, policies that amplified the frustration of citizens and increased the appeal of the populist leader. In all eleven episodes, the International Monetary Fund program was suspended after populists attained power.

"New Populism" in Latin America after 1990

In the mid-1990s, a different type of populism began to emerge. This "new" populism still conformed broadly to the phases of the Dornbusch–Edwards model, but the exact nature of these phases was different; these new episodes added additional

[2] In Table 1, inflation at the beginning of the period is defined as the rate of growth of the consumer price index in the full year before the populist government begun. Inflation after the episode is defined as the rate of inflation either during the last year of the experiment or one year after (whichever is higher). The period used to define whether there was an International Monetary Fund program in force corresponds to two years prior to the arrival of the populist leader, or the year of arrival.

Table 1
"Classical" Populism and Inflation in Latin America: Selected Episodes, 1930–1990

Country	*Leader*	*Political persuasion*	*Beginning inflation (%)*	*Final inflation (%)*	*IMF program before arrival*
Argentina (1946–1955)	Juan Domingo Perón	Left, nationalist, capitalism of state	3.9	16.7	Pre-IMF
Brazil (1931–1945)	Getulio Vargas	Left, nationalist	–12.4	14.6	Pre-IMF
Brazil (1951–1954)	Getulio Vargas	Left, nationalist	9.2	22.6	1949, 1950, 1951
Chile (1952–1958)	Carlos Ibañez del Campo	Center left, protectionist	23.5	39.0	1948
Argentina (1973–1976)	Héctor Cámpora/Juan Domingo Perón/Isabel Perón	Left, nationalist, protectionist	58.4	176.1	1971, 1972
Brazil (1961–1963)	João Goulart	Left, nationalist	30.0	91.4	1960, 1961
Brazil (1969–1973)	Arturo Costa e Silva/ Ernesto Geisel	Right, nationalist, protectionist, anticommunist	22.0	27.6	1968
Brazil (1985–1990)	José Sarney	Center, protectionist	192.0	432.0	1983, 1984
Chile (1970–1973)	Salvador Allende	Left, Marxist, pro-Soviet, pro-Cuban	30.6	505.0	1968, 1969
Peru (1968–1980)	Juan Velasco Alvarado/ Francisco Morales Bermúdez	Left, nationalist, protectionist, pro-indigenous	9.8	75.4	1967, 1968
Peru (1985–1990)	Alan García	Left, nationalist, protectionist	110.0	7,481.7	1983, 1984
Mexico (1970–1976)	Luis Echeverría	Left, protectionist	3.4	29.1	None
Mexico (1976–1982)	José López Portillo	Left, anti–banking sector, protectionist	14.9	111.5	1976
Nicaragua (1979–1990)	Daniel Ortega	Left, Marxist, pro-Cuban, pro-Soviet	4.6	13,490	1978, 1979
Venezuela (1974–1978)	Carlos Andrés Pérez	Center left, nationalist	4.1	12.4	None

Source: Dornbusch and Edwards (1991), International Monetary Fund (IMF), World Bank.
Note: The Velasco Alvarado and Morales Bermúdez governments in Peru followed different approaches, with the former being more aggressive in implementing redistributive policies. However, for the purpose of this analysis, it seems appropriate to consider them together as one populist episode.

texture and granularity to populist experiences. In the post-1990 episodes, crises were not necessarily as abrupt and spectacular as in the past. They often were slow-simmering crises, in which unhappiness grew gradually and slowly until it passed

Table 2
Populism in Latin America: Selected Episodes, 1990–2019

Country	*Leader*	*Political persuasion*	*Beginning inflation (%)*	*Final or current inflation (%)*	*IMF program before arrival*
Argentina (2003–2015)	Nestor Kirchner/Cristina Fernandez de Kirchner	Perónist left, progressive antineoliberal	25.9	36.3	2003
Bolivia (2006–present)	Evo Morales	Movement for Socialism, antineoliberal	5.4	2.3	2003, 2004, 2005
Brazil (2019–present)	Jair Bolsonaro	Right wing, social conservative, nationalist	3.6	3.2	None
Ecuador (2007–2017)	Rafael Correa	Left nationalist, antineoliberal	2.7	–0.2	2003
Mexico (2018–present)	Andre Manuel López Obrador	Leftist, nationalistic, antineoliberal, protectionist	4.8	3.2	None
Nicaragua (2007–present)	Daniel Ortega	Left, Frente Sandinista de Liberación Nacional	9.1	4.9	2006, 2007
Venezuela (1998–present)	Hugo Chávez/Nicolas Maduro	Socialism of the XXI Century (Filo Marxist)	35.8	130,000	1996

Source: International Monetary Fund (IMF), World Bank.

some threshold. Massive corruption scandals also added to the degree of frustration and helped populists get to power. Perhaps the most important scandal is the Lava Jato–Odebrecht kickback scheme that erupted in Brazil circa 2014 and affected politicians from the left and the right throughout Latin America. Ocampo (2019) has argued for considering a "frustration gap" index when analyzing the emergence of populist regimes. This gap can grow quickly and explode, as in the case of major devaluation crises and "classical populism," or it can build up slowly. Another difference with classical cases is that in the "new populism" episodes, the final situation is not runaway inflation but rather an unsustainable accumulation of debt. However, not all post-1990 episodes conform with the "new" populism pattern: for example, Venezuela is a clear case of classical populism that has continued well into the twenty-first century.

In Table 2, I present summary information on seven selected populist episodes in Latin America since 1990. Again, this does not pretend to be an exhaustive list of populist governments. For example, I have not included Brazilian President Luiz Inácio Lula da Silva (2003–2011). Lula was concerned about income distribution, poverty alleviation, and social conditions. But his policies were carefully designed to avoid generating inflation or major macro disequilibria. Rather than governing as a populist, Lula was a representative of a group of modern left-of-center politicians in Latin America that included Ricardo Lagos and Michelle Bachelet from Chile and José Mujica and Tabaré Vásquez from Uruguay (Edwards 2010). However, Lula's involvement in the Lava Jato scandal has marred his legacy.

Table 2 helps to clarify some features of this more recent crop of populists. First, six out of the seven are left leaning; Jair Bolsonaro from Brazil is the only exception. Second, except for Venezuela, there are no major outbursts of inflation

during these experiences of new populism. In fact, in Bolivia, Ecuador, and Nicaragua, inflation at the end of the period is at the low one-digit level. (Of course, it is too early to evaluate fully the cases of Mexico and Brazil.) Argentina, as noted, is a mixed case. Inflation was high at the end of President Cristina Fernandez de Kirchner's mandate but was not that much higher than when the regime (headed by her husband Nestor Kirchner) was inaugurated, or as high as end-of-period inflation in the episodes of classical populism in Table 1. Once again, the International Monetary Fund is conspicuous in the years prior to these episodes; there were programs in five of the seven cases.

An important difference between new and classical populists is their attitude toward globalization. Traditional populist leaders, from Juan Domingo Perón in Argentina to Alan García in Peru, were staunchly nationalistic; they opposed foreign investors and, in many cases, nationalized multinational firms. However, the criticisms of new populists go beyond specific foreign companies or banks. New populists, both from the left and from the right, decry globalization in broad terms. They often champion national identity and denounce the loss of cultural heritage. New populists frequently criticize multilateral organizations. In Brazil, Bolsonaro's rejection of foreign assistance in the Amazon fires of 2019 captures vividly the confrontational attitude toward internationalism and multilateralism.

Instead of relying on money creation by the central bank to redistribute income, many of the new populists have emphasized intrusive government controls and restrictions as a way of redirecting income to particular groups. For example, exchange controls were imposed in Argentina in an attempt to reduce the cost of food; foreign companies were nationalized in Bolivia, Ecuador, and Venezuela in an effort to capture profits and raise workers' salaries; contracts with foreign investors were violated in Argentina and Ecuador as a way of maintaining low prices for electricity and gas; prices were controlled at artificial levels in Argentina, Bolivia, Ecuador, and Venezuela; import tariffs were raised in Argentina and Ecuador to protect local industries; export taxes were hiked time and again in Argentina in an effort to finance social programs; and an archaic monetary system that borders on barter was promoted in Venezuela. In all of these countries, protectionism was particularly harmful in ways that went beyond traditional welfare costs measured by small triangles. It increased uncertainty and sent mixed signals that negatively affected investment and increased risk premia.

The new populists have also relied on rapid and massive increases in minimum wages and salaries of state employees to further their goals. According to the United Nations Economic Commission for Latin America, the real minimum wage was raised in Bolivia by 133 percent between 2005 and 2017; in Ecuador, it was raised by 67 percent during the Correa administration; and in Nicaragua, it was raised 75 percent between 2006 and 2017. In all of these countries, changes in public sector wages provide guidelines for private sector negotiations.

The new populists have used the legal system, including new constitutions, to further their redistributive goals. During the past two decades, new constitutions were approved in Venezuela, Ecuador, and Bolivia, and a major constitutional

reform was passed in Nicaragua. All three new constitutions grant vast social rights to the people broadly, to indigenous populations, and to regions. In contrast, new constitutions have not been approved in other Latin American nations since the early 1990s. Constitutions can play an important role in determining economic outcomes, including economic performance and income distribution (Persson and Tabellini 2005). Under the "new Latin American constitutionalism," political constitutions should be changing documents, easy to amend and reform. During their expected life of around ten years, these new constitutions are supposed to help attain certain political goals. In Venezuela, the goal of the "Chávez Constitution" is to construct a political system based on the principles of "Socialism of the XXI Century." These new Latin American constitutions also add "citizens' power" and the "electoral power" to the conventional threesome of executive, legislative, and judiciary powers. In this way, this new doctrine has elevated one of the fundamental characteristics of populism—the direct appeal to the masses through plebiscites and referenda—to the constitutional level (Salamanca, Pastor, and Asensi 2004; Pastor and Dalmau 2008).

Populism, Old and New: Five Episodes

In this section, I analyze five of Latin America's best-known populist episodes: Chile during President Salvador Allende's socialist experiment (1970–1973); Peru during the first Alan García administration (1985–1990); Argentina during the administrations of Presidents Nestor Kirchner and Cristina Fernandez de Kirchner (2003–2015); Venezuela during the administrations of Presidents Hugo Chávez and Nicolas Maduro (1998–present); and Ecuador during Rafael Correa's presidency (2007–2017). Although each case is unique, the five of them share the populist pattern presented above. All five episodes ended badly: three of them with major collapses (Chile, Peru, and Venezuela), one with severe economic dislocations (Argentina), and one on a clearly unsustainable path (Ecuador).

Classical Populism in the Andes: Chile and Peru

In Tables 3 and 4, I present data for Chile and Peru for real GDP growth; fiscal balance as percentage of GDP; the rate of growth of money; inflation; and current account balance over GDP. The years of each populist episode are indicated by asterisks. The similarities are remarkable. In both cases, the initial conditions are characterized by very low (Chile) or negative (Peru) growth. To deal with this situation and to reduce inequality, the populist leader proposed a nationalistic, antiglobalization, and anti-elite redistributive program. In both cases, there were International Monetary Fund programs in place when the populist experiment was initiated. In both cases, these programs ended as soon as the new government was in place.

The "growth to bust" cycle of populism is easily detected. In Chile the economy grew at an impressive 9 percent during the first year of Salvador Allende's Unidad

Table 3
Chile, 1968–1976: Macroeconomic Indicators

	Real GDP growth (% per year)	*Public sector balance (% GDP)*	*Rate of growth of money supply (% per year)*	*Average inflation per annum (%)*	*Current account balance (% GDP)*
1968	3.6	−2.4	36.8	27.9	−2.2
1969	3.7	−1.5	43.6	29.3	−0.1
1970*	1.9	−2.9	66.2	34.9	−1.3
1971*	9.0	−11.2	135.9	22.1	−2.4
1972*	−1.2	−13.5	178.3	163.4	−4.3
1973*	−5.6	−24.6	365.0	508.1	−9.1
1974	1.0	−10.5	319.6	375.9	−3.7
1975	−12.9	−2.6	293.7	340.7	0.0
1976	3.5	−2.3	271.6	174.3	0.0

Source: Edwards and Edwards (1991); Banco Central de Chile; Larraín and Meller (1991).
Note: Asterisks refer to the populist regime years. The Allende government was inaugurated on November 4, 1970.

Table 4
Peru, 1983–1992: Macroeconomic Indicators

	Real GDP growth (% per year)	*Public sector balance (% GDP)*	*Rate of growth of money supply (% per year)*	*Average inflation per annum (%)*	*Current account balance (% GDP)*
1983	−9.3	−11.6	115.1	111.1	−6.8
1984	3.8	−7.9	142.5	110.2	−1.4
1985*	2.1	−3.7	214.9	163.4	0.3
1986*	12.1	−7.8	39.4	77.9	−5.4
1987*	7.7	−10.1	110.5	85.8	−4.3
1988*	−9.4	−11.5	568.2	667	−5.4
1989*	−13.4	−11.3	1,436.6	3,398.3	−0.5
1990*	−5.1	−8.9	7,782.5	7,481.7	−5.1
1991	2.2	−2.9	162.2	409.5	−4.5
1992	−0.5	−4.0	95.8	73.5	−5.4

Source: International Monetary Fund, except for fiscal deficit, which comes from Martinelli and Vega (2018).
Note: Asterisks refer to the populist regime years.

Popular government, and Peru experienced a surge in GDP growth to 12 percent in 1986, Alan García's first full year in office. However, good times did not last long. Chile experienced negative growth in 1972 and 1973, the second and third years of the Allende administration. In Peru, growth was negative from 1988 until the end of García's presidency.

Both episodes involved enormous fiscal expansions. In 1973, the last year of the Allende administration, the central government deficit in Chile reached almost 25 percent of GDP. When state-owned enterprises are included in the "consolidated

public sector," the deficit surpasses 30 percent of GDP. In Peru, the deficit exceeded 10 percent of GDP in 1987, 1988, and 1989, before falling slightly to 8 percent of GDP in 1990.

The high deficits were financed by the central bank through rapid expansion of the money supply. Norberto García (1972, 104), one of the economists behind President Salvador Allende's economic program in Chile, explicitly wrote about the "need" to finance major fiscal expansions through money creation: "Monetary and credit policy provided the financing for fiscal expansion and the deficit. . . ." The Allende government also nationalized the banking sector as a way to facilitate the flow of credit to major public infrastructure projects and newly nationalized companies. In Peru, Alan García planned to nationalize the banking and financial sectors. However, after weeks of protests led by novelist and future Nobel Prize laureate Mario Vargas Llosa, the government gave up on the attempt. Eventually, and not surprisingly, inflation was extremely high. In Chile, it surpassed 500 percent in 1973; in Peru, inflation exceeded 7,000 percent in 1990 (Edwards and Edwards 1991; Lago 1991; Larraín and Meller 1991).

The tables also show growing external imbalances. In Chile, the current account deficit surpassed 9 percent of GDP in 1973. In Peru, one of the first measures undertaken by García was to limit payments on foreign debt to 10 percent of exports; he eventually stopped all payments to all creditors, including the International Monetary Fund. Peru's current account deficit still exceeded 5 percent of GDP in 1986 and 1988.

When these two populist regimes were replaced—in Chile through a violent coup, and in Peru through an election—the economic conditions of the poor were worse than when the experiments began. Real wages declined in Chile by 39 percent; in Peru the decline was 40 percent. Behind this brief analysis, there are, of course, complex stories and intricate political relations and disputes. In particular, in the period before 1990, the Soviet and Cuban models still seemed attractive to large segments of Latin America's society. Both Allende in Chile and García in Peru shared the ideological goal of putting in place some version of socialism.

Post-1990 Experiences: Argentina and Venezuela

Venezuela during the Hugo Chávez and Nicolas Maduro administrations and Argentina under the Kirchners are the two best-known recent populist experiences in Latin America. Although the two cases share a number of characteristics, they ended very differently. The Venezuelan populist experience, which is still ongoing, evolved into hyperinflation and total economic and political collapse, a situation that has fueled one of the most massive peacetime outmigrations of modern times. In contrast, Argentina experienced high but not runaway inflation and ended with a peaceful democratic transition in 2015 to a government led by Mauricio Macri. I discuss these two cases and compare them to Ecuador during Rafael Correa's administration, which is possibly the cleanest case of "new populism" in Latin America.

In Tables 5 and 6, I present data for Argentina and Venezuela. For Argentina I present two series on inflation: official numbers that underestimate true inflation,

Table 5
Argentina, 1999–2016: Macroeconomic Indicators

	Real GDP growth (% per year)	*Public sector balance (% GDP)*	*Rate of growth of money supply (% per year)*	*Average official inflation per annum (%)*	*Average adjusted inflation per annum (%)*	*Current account balance (% GDP)*
1999	–3.4	–3.8	0.7	–1.2	–1.2	–3.9
2000	–0.8	–3.3	–8.7	–0.9	–0.9	–3
2001	–4.4	–5.4	–20.4	–1.1	–1.1	–1.4
2002	–10.9	–2.1	143.3	25.9	25.9	7.9
2003*	8.8	1.2	59.1	13.4	13.4	5.8
2004*	9	3.5	13.1	4.4	4.4	1.8
2005*	8.9	3.2	4.3	9.6	9.6	2.5
2006*	8	1.3	46.3	10.9	10.9	2.8
2007*	9	–0.1	24.0	8.8	25.7	2.1
2008*	4.1	0.2	10.2	8.6	23.0	1.5
2009*	–5.9	–2.6	11.8	6.3	14.8	2.2
2010*	10.1	–1.4	31.1	10.5	25.7	–0.4
2011*	6	–2.7	39.0	9.8	22.5	–1
2012*	–1	–3	37.9	10.2	25.2	–0.4
2013*	2.4	–3.3	22.7	10.6	27.9	–2.1
2014*	–2.5	–4.3	22.6	22.1	38.5	–1.6
2015*	2.7	–5.8	34.9	24.2	27.8	–2.7
2016	–1.8	–6.4	31.7	36.3	40.7	–2.7

Source: International Monetary Fund, except adjusted inflation, which is from Bolsa de Comercio de Santa Fé.
Note: Asterisks refer to the populist regime years.

and an alternative series computed by independent think tanks. For Venezuela, the inflation data are incomplete, since the government stopped publishing economic statistics when inflation got completely out of hand.

In Argentina, President Nestor Kirchner came to power in May 2003 after the major currency and banking crisis of 2001–2002, which marked the end of a currency board regime that had fixed the value of the US dollar and the Argentinian peso at 1:1. During the latter part of the currency board experiment, a series of International Monetary Fund programs had imposed successive rounds of austerity. After the devaluation in early 2002, foreign debt was unilaterally restructured, imposing a 75 percent haircut on investors; unemployment skyrocketed above 20 percent; deposits were frozen; and the peso lost almost 80 percent of its value in three years. Eventually the Argentine peso lost 90 percent of its value, greatly affecting the middle classes.

In Venezuela, the populist policies of Hugo Chávez were put in place after a sequence of economic and political crises and the failure of a succession of International Monetary Fund programs. The events that gave initial impetus to the populist movement were a series of demonstrations in Caracas. On February 27, 1989, riots erupted after a rally to protest a 30 percent increase in public transportation fares.

Table 6
Venezuela, 1998–2018: Macroeconomic Indicators

	Real GDP growth (% per year)	*Public sector balance (% GDP)*	*Rate of growth of money supply (% per year)*	*Average inflation per annum (%)*	*Current account balance (% GDP)*
1998*	0.3	–4.5	7.4	35.8	–4.8
1999*	–6	0.7	21.7	23.6	2.2
2000*	3.7	4.4	33.7	16.2	10.1
2001*	3.4	–4.6	10.7	12.5	1.6
2002*	–8.9	–1.5	14.6	22.4	8
2003*	–7.8	0.2	62.4	31.1	14.1
2004*	18.3	2.5	50.0	21.7	13.8
2005*	10.3	4.1	47.4	16	17.8
2006*	9.9	–1.6	72.7	13.7	14.9
2007*	8.8	–2.8	33.9	18.7	6.1
2008*	5.3	–3.5	28.8	31.4	10.8
2009*	–3.2	–8.7	23.3	26	0.2
2010*	–1.5	–9.2	23.5	28.2	1.9
2011*	4.2	–10.6	49.2	26.1	4.9
2012*	5.6	–14.6	53.3	21.1	0.8
2013*	1.3	–14.1	58.8	43.5	2
2014*	–3.9	–16.5	—	57.3	2.3
2015*	–6.2	–17.6	—	111.8	–6.6
2016*	–16.5	–17.8	—	254.4	–1.6
2017*	–14	–31.8	—	1,087.5	2
2018*	—	—	—	130,000	—

Source: International Monetary Fund.
Note: Asterisks refer to the populist regime years.

The police were called in to control the protestors, but things got out of hand, and more than 300 demonstrators died (Edwards 2010).

In both countries, economic growth shot up during the early years of the populist regime (although 2008–2009, the period of the global financial crisis, is an exception). In both countries, and thanks to very positive terms of trade (agricultural commodities in Argentina, oil in Venezuela), the bonanza lasted for longer than in most historical populist episodes. But eventually, the combination of inflation, distortions, controls, protectionism, violations of property rights and the rule of law, and corruption scandals affected the real economy, and growth collapsed. In Venezuela, growth became negative in 2014, and has stayed negative ever since. In Argentina, growth was negative in 2012 and 2014.

In Argentina, the fiscal deficit exceeded 3 percent of GDP in 2013, when transfer programs were expanded and export tax revenues fell significantly due to declines in commodity prices. The deficit then kept growing, reaching 6.4 percent of GDP in 2016. Because Argentina was cut off from international financial markets, the central bank became a major source of government financing. Argentina's money growth exceeded 30 percent every year since 2010, reflecting strong "fiscal dominance."

The picture for Venezuela, in Table 6, shows that with the exceptions of 1998 and 2001, the early years of the "Bolivarian Revolution" were characterized by (relatively) balanced public sector finances. A very high international price of oil helped. However, once oil prices declined, the deficit shot up. It surpassed 3 percent of GDP in 2008 and increased every year since, reaching a remarkable 31 percent of GDP in 2017. Throughout, it was mostly financed by money creation.[3] Although both the central bank and the international financial organizations (International Monetary Fund, World Bank) stopped publishing official monetary data in 2013, it is estimated that by 2018 the rate of expansion of base money exceeded 5,000 percent. Not surprisingly, as inflation raged, the demand for domestic currency, the bolivar, collapsed.

The inflationary outcome was clearly different in these two experiments. While inflation in Argentina settled at around 35 percent per annum, in Venezuela it turned into one of the most ferocious hyperinflations of modern times. According to official figures, prices increased by 130,000 percent in 2018!

The evolution of real wages was also different in the two countries. According to incomplete and suspiciously optimistic figures, real wages in Venezuela declined by 21 percent between 1999 and 2013. More recent reliable data are not available, but given the hyperinflation and generalized black markets for almost every item, including food and medicines, further precipitous declines seem likely. In Argentina, in contrast, average real wages increased by 13 percent between 2002 and 2016.[4] This was the result of a combination of three factors: deeply depressed salaries at the end of the currency board period (2002); the very significant improvement in export prices during most of the episode; and the fact that although inflation was very high (it peaked at 39 percent), hyperinflation was avoided.

Populism in the Absence of Fiscal Dominance: Ecuador

In the four case studies discussed so far—Chile, Peru, Argentina, and Venezuela—an underlying reality is that the country can undertake an independent and discretionary monetary policy. In this scenario, the central bank can finance massive increases in public expenditures through a variety of channels, including purchases of debt issued by the national government, loans to subnational entities, and loans to state-owned enterprises. But what happens if monetary policy is constrained in a way that fiscal dominance is not possible? I first consider the possible constraints imposed by an independent central bank, which has not worked too well in a Latin American context. I then consider the stronger constraints on monetary policy imposed by "dollarization"—and I analyze the case of Ecuador, a country that gave up its own currency in 2000, yet pursued populist policies during the ten years that Rafael Correa was in office (2007–2017).

In theory, independent central banks constitute a first line of defense against the full populist onslaught. During the late 1980s and early 1990s, most Latin

[3]For reporting on this pattern, see *America Economía* (2010).
[4]Wage data are from the United Nations Economic Commission on Latin America.

American countries implemented reforms that granted a significant degree of independence to their central banks. Carrière-Swallow et al. (2016) constructed an index of the degree of central bank independence that goes from zero to one, with higher numbers denoting a more independent bank. In Argentina, the index rose from 0.31 to 0.83 in 1992; in Venezuela, the indicator climbed from 0.40 to 0.69 that same year. For comparison, the highest value of the index, corresponding to the central bank of Chile, is 0.85.

However, during the 2000s, three of the fourteen Latin American countries in this study reversed the reforms and significantly weakened the degree of central bank independence. These countries are Argentina, Bolivia, and Venezuela, all of which embraced populist policies. Of these, only Bolivia avoided an inflationary surge. In Argentina, a new central bank charter required the bank to promote economic development, in part by lending to small and medium-sized enterprises and to groups that had been excluded from the credit market (Banco Central de la República Argentina 2014, 2). In Venezuela, the relapse toward a "submissive" central bank took place in 2001, three years after Hugo Chávez was elected to the presidency. After that, the central bank was required to work jointly with the government in order to "achieve the highest objectives of the State and the Nation." (Carrière-Swallow et al. 2016, 6).

These cases indicate that in Latin America, having an independent central bank has not been a guarantee against populist policies. Such independence can be taken away as easily as it is granted.[5] One of the first steps taken by most populist politicians when they get to power is to weaken (or eliminate) central bank independence as part of the move toward a "fiscal dominance" regime.

A more drastic "commitment device" is giving up a domestic currency, either by "dollarizing" or by becoming a member of a monetary union led by credible central bankers. Of course, a country could decide to reintroduce its domestic money, but this "exit option" would at a minimum involve a difficult transition. Inflation in dollarized countries is significantly lower and more stable than in countries with a currency of their own (Edwards and Magendzo 2006). This is not surprising, given that dollarized nations rule out, by definition, having a discretionary monetary policy. So with inflation under control, what happens in dollarized countries when a politician with populist inclinations takes power?

The vast majority of dollarized nations (as listed, for example, in Dornbusch 2001) have not been subject to populist regimes. Ecuador, however, is an exception that provides an interesting case study of populism in the absence of fiscal dominance.

[5] Fiscal stabilization laws that impose limits on imbalances have been equally ineffective as restraining devices. In most cases, these laws require the government not to surpass certain limits for the public sector's "structural balance." However, as the history of Latin America has shown repeatedly, these types of laws can be easily altered by politicians who control the majority of the legislative power (Edwards 2010).

In early 2000, in the aftermath of a macroeconomic crisis that resulted in 100 percent inflation, debt default, and a jump in unemployment, Ecuador decided to eliminate its domestic currency, the sucre, and to adopt the US dollar as its currency. Once President Rafael Correa took office in 2007, he argued that dollarization was a "straightjacket" that prevented his administration from using central bank financing to pursue the redistributive policies that the people demanded. According to him, "very few countries in the world have committed a monetary suicide like Ecuador." Noting that Ecuador could not devalue, he compared the situation with that of neighboring countries: "Colombia devalued, Peru devalued, but we could not respond [by devaluing] . . ." (as quoted in Telesur 2016).

The crisis that catapulted Rafael Correa to power had a very important political component. In 2006, when he decided to run for president, the economy was doing relatively well. After dollarization, inflation had moved toward international levels, growth had picked up, and unemployment had declined. In contrast, Ecuador's political system was in disarray. In February 1996, after less than six months in power, President Abdalá Bucaram was deposed by congress. In 1997, Ecuador had three heads of government. In 1998, Jamil Mahuad was elected president, only to be overthrown by the military in January 2000, barely two weeks after he signed the law that dollarized Ecuador's financial and monetary systems. In 2002, new elections were held, and Lucio Gutiérrez was inaugurated as president. Three years later he was impeached by Congress and replaced by an interim head of government. This instability was in part a reflection of a deep historical rivalry between two regions and cities: Quito, the capital, in the highlands, and Guayaquil, the largest city and main port.

During 2006, Rafael Correa, who had been minister of economics for three months in 2005, founded a new political movement—Alianza País—in order to run for president. He was young, charismatic, and articulate. He was perceived as an honest, nationalistic technocrat—he has a PhD in economics from the University of Illinois—who could put an end to political instability and improve social conditions. Correa promised to convene a Constitutional Assembly and to implement policies that would distribute income in a notoriously unequal country. He also vowed to nationalize multinationals, confront the United States, lower interest rates, restructure foreign debt, raise the minimum wage, deal with the negative effects of globalization by hiking import tariffs, and implement a program to empower the country's large indigenous population. On January 15, 2007, after obtaining 57 percent of the vote in the second round of elections, he was inaugurated as president.

In Table 7, I present the evolution of the key macroeconomic indicators for Ecuador during 2005–2018. Again, the years of the populist episode are identified with asterisks. Three patterns stand out. First, the cycle that goes from boom to (severe) slowdown is present, although it is not as pronounced as in the previous four cases. In 2008, a year into Correa's rule, Ecuador's growth jumped to 6.4 percent, and it averaged 5.7 percent during 2010–2012. However, during the last three years of the Correa administration (2015–2017), growth plunged to barely 0.4 percent. This severe slowdown was partially the result of a drop in the international price of

Table 7
Ecuador, 2005–2018: Macroeconomic Indicators

	Real GDP growth (% per year)	*Public sector balance (% GDP)*	*Rate of growth of money supply (% per year)*	*Average inflation per annum (%)*	*Current account balance (% GDP)*
2005	5.3	0.4	—	2.2	1.1
2006	4.4	2.7	—	3.3	3.7
2007*	2.2	3.1	—	2.3	3.7
2008*	6.4	–3.7	—	8.4	2.9
2009*	0.6	–2.4	—	5.2	0.5
2010*	3.5	–1.1	—	3.6	–2.3
2011*	7.9	–0.6	—	4.5	–0.5
2012*	5.6	–1.7	—	5.1	–0.2
2013*	4.9	–5.8	—	2.7	–1.0
2014*	3.8	–6.4	—	3.6	–0.7
2015*	0.1	–6.7	—	4.0	–2.2
2016*	–1.2	–6.8	—	1.7	1.3
2017*	2.4	–4.0	—	0.4	–0.5
2018	1.1	–1.7	—	–0.2	–1.3

Source: International Monetary Fund; World Bank.
Note: Asterisks refer to the populist regime years.

oil (Ecuador's main export), and partially the result of the accumulation of distortions and the perception that the country was pursuing an aggressive antimarket strategy (World Bank 2016).

Second, and in contrast with the other four cases discussed above, there is no rise or explosion of inflation toward the end of the episode. Inflation was always at the one-digit level, as one would expect from a dollarized country. During the Correa administration, inflation averaged only 3.8 percent.

Third, in spite of the absence of "fiscal dominance," fiscal policy was very loose. During 2013–2017 the public sector deficit averaged 6 percent of GDP. Initially the expansive fiscal policy was financed by a large increase in the price of oil. When international oil prices declined in late 2008, Ecuador found additional fiscal space by restructuring its sovereign debt. During the years that followed, fiscal largesse was financed with loans from China and debt issued by the state-owned oil company Petroecuador. In addition, an amendment to the dollarization law allowed the central bank to use its reserves to buy some government bonds linked to specific public sector investment projects (see details below). As a result, between 2010 and 2017, the country's debt-to-GDP ratio more than doubled, from 17.6 to 43.6 percent, which is large for Latin American nations.

Immediately after inauguration, Correa decreed a large increase in the minimum wage and in public sector salaries, a common policy in every populist episode in the region. By late 2015, Ecuador had, by far, the highest minimum wage in Latin America; it was 50 percent higher than the average minimum wage across Brazil, Chile, and Colombia. Relative to income per capita, it was more than twice

the average for those three countries, and 60 percent higher than in Peru, the Latin American country with the second-highest minimum wage relative to GDP (International Monetary Fund 2015).

In the years that followed, a series of controls and regulations were put in place, including higher import tariffs and duties. There were stringent controls on foreign oil companies, and foreign investors were demonized. In 2007, contracts with foreign oil companies were changed retroactively, de facto increasing the tax on oil operations, and in 2011 some oil fields were nationalized. A new constitution that enshrined a large number of rights was adopted. Between 2007 and 2017, Ecuador dropped rapidly in international rankings that measure the "quality" of economic policies, including the Fraser Institute Index of Economic Freedom and the World Bank's Doing Business Index (World Bank 2016; Fraser Institute 2019). The decline was particularly noteworthy in categories related to "business regulations" and "international trade."

In 2015, eight years after Correa was inaugurated, it looked as if Ecuador's experiment was running out of steam and the country was entering the crisis phases of populism. Public sector debt had more than doubled relative to 2010, and growth had collapsed to −1.2 percent. In mid-2015, credit rating agencies downgraded Ecuador's sovereign debt, and the International Monetary Fund issued a report arguing that the nation needed urgent fiscal rectification. Also in 2015, some perceptive analysts found that the Correa administration had used the central bank reserves, which were supposed to back the dollarized financial system, to buy government bonds. Between September 2014 and March 2015, central bank holdings of government paper went from $64 million to $1.1 billion. A second credit rating downgrade was issued in June 2017, generating a large increase in the country risk premium.

As the 2017 elections approached, many investors believed that without major policy changes, the country would face a serious crisis. An article published in the *Investor's Business Daily* (2015) was titled "The End of Dollarization in Ecuador: The Crisis Has Begun." Dollarization seemed to be at risk, and investors warned that a return to the national currency would result in chaos. In 2017, Lenín Moreno, Rafael Correa's vice president, was narrowly elected as president. To general surprise, once in office he decided to change paths and to implement a tighter fiscal policy aimed at stabilizing (and then reducing) the debt-to-GDP ratio. Also, many of the regulations of the Correa years were relaxed or eliminated. The new government was aware that price stability and dollarization were cherished by the population and, in particular, by the poor; an end to dollarization could result in an inflationary spike and in political turmoil. In addition, the Moreno administration believed that in order to revive growth it was indispensable to attract foreign investment, and that foreign companies would come only if the policies of regulation and control were replaced by market-friendly initiatives. In August 2019, a new program with the International Monetary Fund was signed.[6]

[6]This International Monetary Fund agreement immediately resulted in demonstrations by farmers.

Rafael Correa was successful in reducing inequality. Ecuador's Gini coefficient fell from 53.4 in 2006 to 44.7 in 2017 (based on World Bank data), a significant achievement not matched by any Latin American countries in modern times. For comparison, during the same period, the Gini coefficient in Chile, a country generally considered as the poster child of successful market-oriented reforms, declined from 51.5 to 46.6. In Chile, reducing inequality is considered, by both the right and the left, as an antidote to populism.

Ecuador's experience shows that total collapse, wage decline, and runaway inflation are not the unavoidable results of populist policies. Although the data clearly suggest that Ecuador was on an unsustainable path, it is only possible to speculate on what would have happened if President Moreno had not changed course in 2017. One likely outcome would have been a serious fiscal crisis, possibly similar to the one experienced in Greece after 2010. Without a currency of its own, Ecuador might then have had to engineer a large "internal devaluation," including a large public sector adjustment. As Argentina's experience with the currency board shows, that is a politically difficult exercise to implement. The main alternative would have been to accept the high transition costs of exiting from the US dollar, reintroducing the Ecuadorian sucre, and adopting the policies of classical populism.

Connections to Populism around the World: Some Historical and Recent Episodes

Of course, the term populism was not invented in Latin America, or for the Latin American countries. It originated in the United States in the early 1890s, when the People's Party was also referred to as the Populist Party.[7] The term was then used a few years later in relation to Russia's Narodniks, and the Social Credit movement in Canada.

Throughout the years, a number of US politicians have been called populists, often in a disapproving way. Two examples from the late nineteenth and early twentieth century are William Jennings Bryan and Huey Long. During Bryan's three runs for the presidency (1896, 1900, and 1908), he campaigned against the gold standard and advocated the remonetization of silver. This would have created a major increase in liquidity and a sharp decline in interest rates, helping farmers and residents in the agricultural states. Huey Long was governor of Louisiana and then a US senator until his assassination in 1934. He campaigned incessantly for the poor, supported rural workers, and unveiled a populist platform ("Share our Wealth") based on capping fortunes at $50 million and distributing any amount in excess of the cap to the poor.

[7] According to Oxford English Dictionary, "the policies of the Populists included public control of railways, limitation of private ownership of land, extension of the currency by free coinage of silver and increased issue of paper money, a graduated income tax, etc."

Recently, some scholars have argued that there are good and bad populists, and that President Franklin Delano Roosevelt is a premier representative of the good type. Rodrik (2018), for instance, has pointed out that FDR's profound economic reforms were needed to address inequalities that had lingered for decades in the United States. According to Rodrik, FDR was a benevolent "economic populist," not a "dangerous" authoritarian one.

Analyzing Roosevelt's policies to specify their populist elements is well beyond the scope of this paper. However, Rodrik (and others) may be onto something: FDR's rhetoric was at times incendiary and feisty, not very different from that of Latin American populists. He often criticized banks, trusts, and the urban elites. Throughout the campaign and his first year in office (1933), he declared time and again that his main objective was to help farmers and the poor. His June 1933 decision to restructure US debts unilaterally had a distinctive Latin American flavor. In June 1933, all US debt contracts, public and private, which for decades had been written in terms of gold, were voided and rewritten in paper dollars. Once the dollar was devalued with respect to gold in January 1934, creditors suffered large losses (over 40 percent). Similarly, in Argentina, in 2002, contracts in US dollars were unilaterally rewritten in depreciated pesos, imposing huge losses on investors and international firms that had participated in the Argentine privatization process of the 1990s (for details, see Edwards 2018).

The similarities between Latin America and other parts of the world are not confined to the past or to historical figures such as Franklin Delano Roosevelt. In the aftermath of the global financial crisis of 2008–2010, populist movements gathered force in a number of advanced countries, including in the United States. Although every case is unique, many of these episodes share some characteristics with traditional Latin American populism. The cycle begins with an accumulation of grievances and frustration, and it is fed by inequality. As in Latin America, once a populist attains power, the next step is to implement heterodox policies that, at first, appear to work and to deliver growth and social progress. The population is happy, and the populist leader seems vindicated. After some time, however, the costs of heterodoxy become apparent. Protectionism hurts consumers, excessive regulations slow investment and growth, antimigrant policies upset the labor market, excessive debt accumulation increases risk premia, and unreasonably easy money tends to feed bubbles and often results in an acceleration of inflation. In high-income countries, it is improbable that these policies will result in three-digit (or even two-digit) inflationary outbursts. A more likely outcome is that they would end up slowing growth and requiring a significant fiscal correction and policy rectification.

In the United States, in the aftermath of the subprime crisis, many felt that they had been wronged by the elites, by large companies and banks, by traditional politicians, and by foreigners, including migrants. Many citizens abhorred the bailout of banks and financial institutions after 2008. Of course, Donald Trump's rallies were not the same as Hugo Chávez's huge marches, but to many observers there were some striking similarities, including the fierce attacks and mocking of

political rivals, the antiglobalization rhetoric, and the criticism of the elites and the establishment. As in Latin America, the Trump administration implemented protectionist policies. Also, as in Latin America, there have been severe denunciations of traditional institutions. Chávez criticized the Venezuelan supreme court, and then packed it; Correa was critical of Ecuador's monetary system. Before the 2016 election, Trump hinted that he might not feel bound to acknowledge the results if they went against him, something that Chávez and Maduro had declared in Venezuela. Trump disparaged the Federal Reserve—he called its policy "crazy" and "*loco*"—in a way that echoes Chávez's attacks on the independence of Venezuela's central banks. Turkey's Erdoğan also attacked his nation's central bank for not helping his government achieve its redistributive goals. Similarly, Italy's former Deputy Prime Minister Matteo Salvini's attacks on the European Union budget process resembled events in Latin America.

But the recent wave of populism in high-income countries also has some important differences from Latin American classical populism. First, while the vast majority of populists in Latin America have been leftist, populists in many recent advanced countries are right wing. Second, and more important, modern populism in the advanced nations—in the United States, the United Kingdom (Brexit), Italy, and Hungary—has been characterized by a high degree of nativism. Immigrants are blamed for crime, unemployment, and the stagnation of wages. In Latin America, in contrast, populist politicians (both classical and new) have never targeted immigrants. To be sure, they have opposed multinationals, foreign banks, the International Monetary Fund, and globalization more generally—but not foreign workers. A third important difference is that in many of the advanced episodes, the country in question (Italy, Greece) doesn't have a currency of its own and thus cannot use the central bank to finance public sector expansion. In that regard, their experiences are closer to Ecuador's than to Argentina's.

Latin America offers a number of lessons regarding populism. The first, and perhaps the most important one, is that excessive inequality and corruption are fodder for populist politicians. Populists capitalize on citizens' frustrations and offer a set of heterodox policies that are supposed to help the "little people." In that regard, comprehensive, well-designed social programs that foster inclusiveness offer the most efficient inoculation against populism. Major crises that result in large devaluations and require drastic adjustments are also behind the surge of many populist movements.

Second, populist policies come in many different flavors. Classical populism is mostly of a macroeconomic variety. But there is also a microeconomic type of populism, where excessive regulations, protectionism, market disruptions, and very high minimum and public sector wages are put in place. Although most cases of "new populism" don't end up with an inflation outburst, in the medium to longer run they require costly policy rectifications. A related takeaway is that populism is not a black-or-white phenomenon. As noted, populism has many shades of gray, which means that at times it is not straightforward to classify certain experiences as populist.

A third lesson is that even in countries with built-in restrictions on monetary policy—through independent central banks or dollarization—a populist politician will usually find ways of putting in place expansive fiscal policy and accumulate debt at an unsustainable pace (as in Ecuador). Countries that don't have a currency of their own cannot rely on exchange rate adjustments, and thus they go through very painful adjustments once debt financing runs out. In many cases there is no alternative but to call the International Monetary Fund.

Fourth, protectionism and isolationism are harmful in ways that go beyond traditional welfare costs measured by small triangles on supply and demand graphs. Protectionism increases uncertainty and sends mixed signals that increase risk premia and negatively affect investment. A number of Latin American populist leaders have recently referred to the current trade war between the United States and China to justify their nationalistic and protectionist policies.

A final lesson from Latin America has to do with the use of money creation to finance social expenditures, employment programs, income redistribution, and infrastructure initiatives. In all of the 15 populist episodes in Table 1, the country relied on the central bank to finance the growing public sector deficit. And in every one of them, the end game was a disaster, with runaway inflation and a precipitous decline in wages (Edwards 2019). A recurrent development in every one of these populist episodes is that once inflation gets to a certain level (say, mid-two digits or higher), velocity of circulation increases significantly. People still have to use domestic money to pay taxes, but it is not used for anything else. As Argentina's experience has shown again and again, when the demand for money collapses, the price level rises rapidly. Does this mean that using monetary policy to purchase government securities is always harmful? Not necessarily, as the experiences of the Federal Reserve and the European Central Bank with quantitative easing, after 2010, have shown. But an excessive and systematic reliance on money creation to finance public sector expenditure is a path fraught with dangers. The stories of the Latin American countries analyzed in this paper offer sobering cautionary tales.

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References

Acemoglu, Daron, Georgy Egorov, and Konstantin Sonin. 2013. "A Political Theory of Populism." *Quarterly Journal of Economics* 128 (2): 771–805.

America Economía. 2010. "Banco Central de Venezuela Podría Financiar al Gobierno." *America Economía*, March 25, 2010. https://www.americaeconomia.com/politica-sociedad/politica/banco-central-de-venezuela-podria-financiar-al-gobierno.

Banco Central de la República Argentina. 2014. "Objetivos y Planes Respecto del Desarrollo de la Política Monetaria, Financiera, Crediticia y Cambiaria para el Año 2015." http://www.bcra.gov.ar/Pdfs/Institucional/BMA2015.pdf.

Carbonetto, Daniel. 1987. "Marco Teórico de un Modelo de Consistencia Macroeconómica de Corto Plazo." In *Un Modelo Económico Heterodoxo: El Caso Peruano*, edited by Daniel Carbonetto, 351–408. Lima: Instiuto Nacional de Planificacion.

Carrière-Swallow, Yan, Luis Jácome, Nicolás Magud, and Alejandro M. Werner. 2016. "Central Banking in Latin America: The Way Forward." International Monetary Fund Working Paper WP/16/197.

de Castro, Paulo Rabello, and Marcio Ronci. 1991. "Sixty Years of Populism in Brazil." In Dornbusch and Edwards 1991, 151–73.

Dornbusch, Rudiger. 2001. "Fewer Monies, Better Monies." *American Economic Review* 91 (2): 238–42.

Dornbusch, Rudiger, and Sebastian Edwards. 1990. "Macroeconomic Populism." *Journal of Development Economics* 32 (2): 247–77.

Dornbusch, Rudiger, and Sebastian Edwards. 1991. *The Macroeconomics of Populism in Latin America*. Chicago: University of Chicago Press.

Drake, Paul W. 1982. "Conclusion: Requiem for Populism?" In *Latin American Populism in Comparative Perspective*, edited by Michael L. Conniff. Albuquerque: University of New Mexico Press.

Edwards, Sebastian. 2010. *Left Behind: Latin America and the False Promise of Populism*. Chicago: University of Chicago Press.

Edwards, Sebastian. 2018. *American Default: The Untold Story of FDR, the Supreme Court, and the Battle over Gold*. Princeton, NJ: Princeton University Press.

Edwards, Sebastian. 2019. "Modern Monetary Theory: Cautionary Tales from Latin America." Hoover Institution Working Paper 19106.

Edwards, Sebastian, and Alejandra Cox Edwards. 1991. *Monetarism and Liberalization: The Chilean Experiment*. Chicago: University of Chicago Press.

Edwards, Sebastian, and I. Igal Magendzo. 2006. "Strict Dollarization and Economic Performance: An Empirical Investigation." *Journal of Money, Credit and Banking* 38 (1): 269–82.

Eichengreen, Barry. 2018. *The Populist Temptation: Economic Grievance and Political Reaction in the Modern Era*. New York: Oxford University Press.

Fraser Institute. 2019. "Economic Freedom Ranking 2016." https://www.fraserinstitute.org/economic-freedom/map?geozone=world&page=map&year=2016.

García, Norberto. 1972. "La Coyuntura Económica en 1971." In *La Economía Chilena en 1971*, 47–71. Santiago: Instituto de Economía, Universidad de Chile.

Hirschman, Albert O. 1979. "The Turn to Authoritarianism in Latin America and the Search for its Economic Determinants." In *The New Authoritarianism in Latin America*, edited by David Collier, 61–98. Princeton, NJ: Princeton University Press.

International Monetary Fund. 2015. *2015 Article IV Consultation, Ecuador*. Washington, DC: International Monetary Fund.

Investor's Business Daily. 2015. "The End of Dollarization in Ecuador: The Crisis Has Begun." *Investor's Business Daily*, June 24, 2015. https://www.investors.com/politics/editorials/ecuador-weakens-us-dollar-as-its-official-currency/.

Laclau, Ernesto. 2005. *On Populist Reason*. London: Verso.

Lago, Ricardo. 1991. "The Illusion of Pursuing Redistribution through Macropolicy: Peru's Heterodox Experience, 1985–1990." In Dornbusch and Edwards 1991, 263–330.

Larraín, Filipe, and Patricio Meller. 1991. "The Socialist-Populist Chilean Experience, 1970–1973." In Dornbusch and Edwards 1991, 175–221.

Martinelli, César, and Marco Vega. 2018. "Monetary and Fiscal History of Peru 1960–2010: Radical Policy Experiments, Inflation, and Stabilization." Becker Friedman Institute Working Paper.

Mudde, Cas, and Cristóbal Rovira Kaltwasser. 2017. *Populism: A Very Short Introduction*. New York: Oxford

University Press.

Ocampo, Emilio. 2019. "The Economic Analysis of Populism. A Selective Review of the Literature." Serie Documentos de Trabajo UCEMA 694.

Pastor, Roberto Viciano, and Rubén Martínez Dalmau. 2008. "Necesidad y Oportunidad en el Proyecto Venezolano de Reforma Constitucional (2007)." *Revista Venezolana de Economía y Ciencias Sociales* 14 (2): 101–30.

Persson, Torsten, and Guido Tabellini. 2005. *The Economic Effects of Constitutions*. Cambridge, MA: MIT Press.

Rodrik, Dani. 2018. "Is Populism Necessarily Bad Economics?" *AEA Papers and Proceedings* 108 (1): 196–99.

Salamanca, Luis, Roberto Viciano Pastor, and José Asensi. 2004. *Sistema Político en la Constitución Bolivariana de Venezuela*. Caracas: Vadell Hermanos Editores.

Telesur. 2016. "Ecuador Committed 'Monetary Suicide' by Switching to the Dollar." Telesur, August 8, 2016. https://www.telesurtv.net/english/news/Ecuador-Committed-Monetary-Suicide-by-Switching-to-the-Dollar-20160808-0025.html.

Williamson, Edwin. 1992. *The Penguin History of Latin America*. Middlesex, UK: Penguin.

World Bank. 2016. *Doing Business 2016: Measuring Regulatory Quality and Efficiency*. Washington, DC: World Bank.

Worsley, Peter. 1969. "The Concept of Populism." In *Populism: Its Meanings and National Characteristics*, edited by Ghita Ionescu and Ernest Gellner, 212–50. New York: Macmillan.

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Informational Autocrats

Sergei Guriev and Daniel Treisman

The model of dictatorship that dominated in the twentieth century was based on fear. Many rulers terrorized their citizens, killing or imprisoning thousands and deliberately publicizing their brutality to deter opposition. Totalitarians such as Hitler, Stalin, and Mao combined repression with indoctrination into ideologies that demanded devotion to the state. They often placed barriers between their citizens and the rest of the world with overt censorship, travel restrictions, and limits on international trade.

However, in recent years, a less bloody and ideological form of authoritarianism has been spreading. From Hugo Chávez's Venezuela to Vladimir Putin's Russia, illiberal leaders have managed to concentrate power without cutting their countries off from global markets, imposing exotic social philosophies, or resorting to mass murder. Many of these new-style autocrats have come to office in elections and managed to preserve a democratic facade while covertly subverting political institutions. Rather than jailing thousands, they target opposition activists, harassing and humiliating them, accusing them of fabricated crimes, and encouraging them to emigrate. When these autocrats kill, they seek to conceal their responsibility.

The emergence of such softer, nonideological autocracies was unexpected and so far lacks a systematic explanation. How do the new dictators survive without using

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the standard tools of twentieth-century authoritarians and, moreover, without the traditional legitimacy or religious sanction that supported historical monarchs—or even the revolutionary charisma of anticolonial leaders?

The key to such regimes, we argue, is the manipulation of information. Rather than terrorizing or indoctrinating the population, rulers survive by leading citizens to believe—rationally but incorrectly—that they are competent and public-spirited. Having won popularity, dictators score points both at home and abroad by mimicking democracy. Violent repression, rather than helping, would be counterproductive because it would undercut the image of able governance that leaders seek to cultivate.

In this article, we document the changing characteristics of authoritarian states worldwide. Using newly collected data, we show that recent autocrats employ violent repression and impose official ideologies far less often than their predecessors did. They also appear more prone to conceal rather than to publicize cases of state brutality. By analyzing texts of leaders' speeches, we show that "informational autocrats" favor a rhetoric of economic performance and provision of public services that resembles that of democratic leaders far more than it does the discourse of threats and fear embraced by old-style dictators. Authoritarian leaders are increasingly mimicking democracy by holding elections and, where necessary, falsifying the results.

A key element in our theory of informational autocracy is the gap in political knowledge between the "informed elite" and the general public. While the elite accurately observes the limitations of an incompetent incumbent, the public is susceptible to the ruler's propaganda. Using individual-level data from the Gallup World Poll, we show that such a gap does indeed exist in many authoritarian states today. Unlike in democracies, where the highly educated are more likely than others to approve of their government, in authoritarian states the highly educated tend to be more critical. The highly educated are also more aware of media censorship than their less-schooled compatriots.

The manipulation of information is not new in itself—some totalitarian leaders of the past were innovators in the use of propaganda. What is different is how rulers today employ such tools. Where Hitler and Stalin sought to reshape citizens' goals and values by imposing comprehensive ideologies, informational autocrats intervene surgically, attempting only to convince citizens of their competence. Of course, democratic politicians would also like citizens to think them competent, and their public relations efforts are sometimes hard to distinguish from propaganda. Indeed, the boundary between low-quality democracy and informational autocracy is fuzzy, with some regimes and leaders—say, Silvio Berlusconi of Italy or Cristina Kirchner of Argentina—combining characteristics of both. Where most previous models have assumed that formal political institutions constrain such leaders, we place the emphasis on a knowledgeable elite with access to independent media.

At the same time, today's softer dictatorships do not forswear repression completely. Informational autocrats may use considerable violence in fighting ethnic insurgencies and civil wars—as, in fact, do some democracies. They may

also punish journalists as a mode of censorship (although they seek to camouflage the purpose or to conceal the state's role in violent acts). Such states can revert to overt dictatorship, as may have happened after the 2016 coup attempt in Turkey, where the regime of Recep Tayyip Erdoğan detained tens of thousands (Amnesty International 2017). Still, as we show, the extent of mass repression in the regimes we classify as informational autocracies is dwarfed by the bloody exploits of past dictators.

The reasons for this shift in the strategies of authoritarian leaders are complex. We emphasize the role of economic modernization, and in particular the spread of higher education, which makes it harder to control the public by means of crude repression. Education levels have soared in many nondemocracies, and the increase correlates with the fall in violence. But other factors likely contribute. International linkages, the global human rights movement, and new information technologies have raised the cost of visible repression. Such technologies also make it easier for regime opponents to coordinate, although they simultaneously offer new opportunities for surveillance and propaganda. The decline in the appeal of authoritarian ideologies since the end of the Cold War may also have weakened old models of autocracy.

Besides Chávez's Venezuela and Putin's Russia, other informational autocracies include Alberto Fujimori's Peru, Mahathir Mohamad's Malaysia, Viktor Orbán's Hungary, and Rafael Correa's Ecuador. One can see Lee Kuan Yew's Singapore as a pioneer of the model. As we describe later, Lee perfected the unobtrusive management of private media and instructed his Chinese and Malaysian peers on the need to conceal violence. Fujimori's unsavory intelligence chief Vladimiro Montesinos was another early innovator, paying million-dollar bribes to television stations to skew their coverage (as discussed in this journal in McMillan and Zoido 2004).

As these examples suggest, informational autocracy overlaps with the new populism. Chávez and Orbán are known for their populist rhetoric. Yet others—such as Lee Kuan Yew and Mahathir Mohamad—hardly fit the populist template. Informational autocrats and populists both seek to split the "people" from the opposition-minded "elite"—although populists openly attack the elite, while informational autocrats make quiet efforts to co-opt or censor it. Populism is associated with a particular set of political messages, often involving cultural conservatism, anti-immigrant animus, and opposition to globalization. By contrast, informational autocrats are defined by a particular method of rule, which they can combine with various messages. Some—like Putin and Lee—have been committed statists, unlike the many populists who rage against unresponsive bureaucracy. While populists may attack or circumvent the state-controlled media, informational autocrats almost always view it as an essential tool.

Decreasing Violence

Most old-style dictators used violent repression, along with comprehensive censorship and sometimes ideological brainwashing, to control their citizens. Informational

autocrats substitute a more sophisticated kind of information manipulation for overt violence. Thus, if informational autocracies are replacing old-style dictatorships, we should see a decrease over time in the brutality of authoritarian regimes.

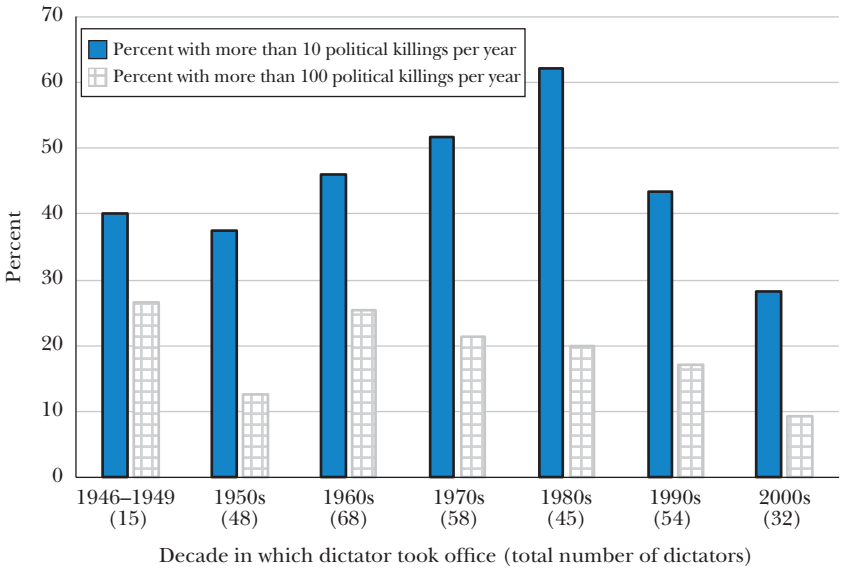
A first measure of this is the changing proportion of nondemocracies experiencing state-sponsored killings. Here and throughout this article, we turn to the widely used "Polity" data from the Virginia-based Center for Systemic Peace to distinguish "democracies" from "nondemocracies." Specifically, the Polity IV dataset rates countries on a 21-point scale from −10, "full autocracy," to +10, "full democracy." It codes countries with a Polity2 score of 6 or higher as democracies.

To gain a better understanding of the dynamics of state violence, we created a dataset on Authoritarian Control Techniques (Guriev and Treisman 2017). We collected information on all leaders who first came to power after 1945 and remained in power for at least five consecutive years in a nondemocracy. Using more than 950 sources—reports of human rights organizations, government bodies, and international agencies; historical accounts; newspapers; truth commission reports; and other publications—we assembled estimates of the number of state political killings under each leader, up to 2015. By state killings, we mean all killings of nonviolent individuals by agents of the state for political reasons, including assassinations, executions of political prisoners or detainees, and all other deaths in custody of political prisoners and detainees, even if the authorities blamed natural causes (in such cases, the state is responsible for failing to provide adequate medical care). We also include indiscriminate killings of protesters and other unarmed civilians by the police, armed forces, or security personnel, as these often serve the political goal of spreading terror. Finally, we interpret "political reasons" broadly and also count protesters killed in demonstrations making economic demands and those killed because of their religion (for example, persecuted sects). We do not include killings in two-sided violence. While the availability and accuracy of data on state violence are problematic and we do not attempt to make fine-grained comparisons, we believe these data can reliably distinguish countries whose records of political violence differ by orders of magnitude.[1] For instance, we can distinguish dictators such as Uganda's Idi Amin, with political killings in the tens of thousands per year, from those such as Argentina's Jorge Videla, with killings in the thousands per year, and others such as Uzbekistan's Islam Karimov, with killings in the hundreds per year.

Figure 1 plots the trend in political killings. Because the incidence of violence is uneven across years and the tenure of dictators varies, we compare the average number of deaths per year under each leader. If sources give a range of estimates, we take the midpoint. To show the dynamic, we classify by the decade in which the leader first took power.

[1] The main bias to fear is that the spread of global media and human rights movements in recent decades will have rendered reporting progressively more comprehensive (Clark and Sikkink 2013; Ulfelder 2015). This factor should tend to lead to higher reporting over time of the violent incidents described here, which means that the downward trends noted in this section may underestimate the true decline in violence in these regimes.

Figure 1
Political Killings per Year in Nondemocracies



Source: Guriev and Treisman (2017).
Note: Only leaders who served at least five years in a nondemocracy (Polity2 < 6) are included. State "political killings" are all killings of nonviolent individuals by agents of the state for political reasons, including executions and all other deaths in custody of political prisoners or detainees, assassinations, and indiscriminate killings of unarmed civilians by armed forces, security personnel, or police. Deaths in two-sided violence are not included.

As Figure 1 shows, the frequency of state political killings has fallen sharply under leaders taking office since the 1980s. Whereas 62 percent of dictators who started in the 1980s (and lasted at least five years) had more than ten political killings per year, that was true of only 28 percent of those who started in the 2000s. Not all early dictators were mass murderers: in each cohort, some were accused of few or no killings. And not all recent autocrats are less violent: Bashar al-Assad of Syria, for instance, averaged nearly 1,500 estimated killings per year (up to 2015). But the balance has shifted.

Consider Cuba, for instance, where the estimated number of state killings under Fulgencio Batista in the 1950s was in the thousands per year; under Fidel Castro fewer than 100 per year; and under Raul Castro in the single digits. Or compare Morocco's King Hassan, who ruled from 1961 to 1999, under whom about 16 state killings per year were reported, with his son, King Mohammed, who has ruled since then and under whom less than one state killing per year has been reported.

We can exclude two possible explanations for the decrease. First, civil wars tend to increase other kinds of violence, and civil wars have become rarer since the 1990s. However, if we exclude from consideration all dictators whose terms overlapped with civil wars or major insurgencies, the recent fall in violence is even more dramatic. Second, dictators who came to power in the 2000s could not have ruled for as long

as some of their longest-lasting predecessors. We already normalize by the leader's tenure and include only those who survived at least five years. But if very long-lasting leaders tended to commit atrocities late in their tenure, that might distort the pattern. However, if we consider only leaders who served no more than ten years (and who had left office by the end of 2015), again excluding civil war cases, the decrease in killings is more dramatic than it appears in Figure 1: the proportion of nondemocracies with more than ten political killings per year now falls from a peak of 61 percent for the 1970s cohort of dictators to 17 percent for the 2000s cohort.[2]

The pattern of reduced violence shows up in other measures as well. For example, mass killings by the state can be defined as "any event in which the actions of state agents result in the intentional death of at least 1,000 noncombatants from a discrete group in a period of sustained violence" (Ulfelder and Valentino 2008). The annual rate of such killings among nondemocracies peaked in 1992 at 33 percent but since then has fallen sharply, reaching 12 percent in 2013.[3]

We also collected data on the number of political prisoners and detainees held under each authoritarian leader. We focus on the year in which the reported number in jail for political reasons was highest because complete annual counts were not available. We include detentions of antigovernment protesters if they were held for more than a few hours.

As Figure 2 shows, the share of authoritarian leaders holding large numbers of political prisoners or detainees has fallen markedly since the 1970s. Whereas 59 percent of those dictators who started in the 1970s (and lasted at least five years) held more than 1,000 political prisoners in their peak year, this was true of only 16 percent of those who came to office in the 2000s. The proportion of dictators holding more than 100 political prisoners fell from 88 percent to 44 percent.

Finally, although allegations of torture of political prisoners or detainees remain extremely common, their frequency seems to have fallen. Seventy-four percent of dictators taking office in the 2000s (and surviving at least five years) were alleged by human rights groups, historians, or other sources to have tortured political dissidents, compared with 96 percent of those starting in the 1980s. This is doubly surprising given the increased scope of human rights monitoring, which should make data for recent decades more comprehensive.[4]

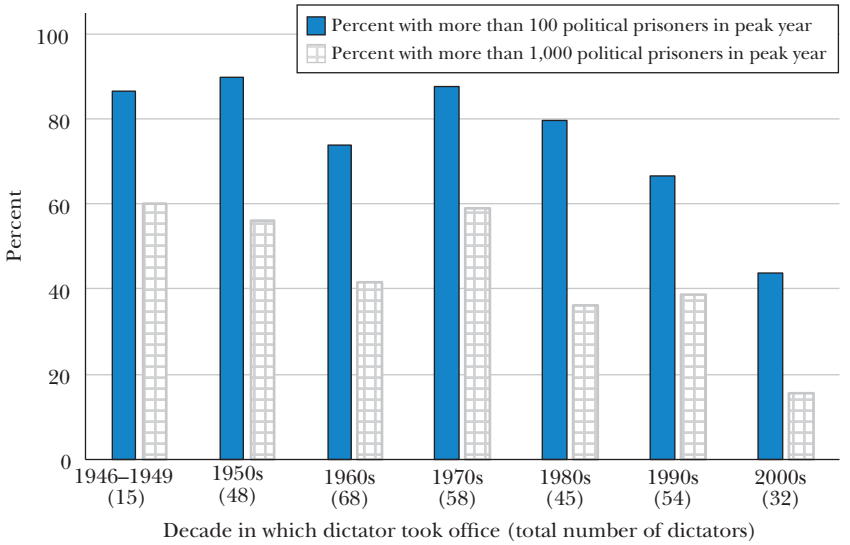
These patterns suggest change across cohorts of autocrats. But individual leaders may also adapt while in office. Anecdotal evidence illustrates how some dictators have substituted less brutal techniques for open repression. Early on,

[2] In online Appendix A, available with this article at the *Journal of Economic Perspectives* website, Figure A2 shows a graph similar to the one in the text, but excluding all dictators whose terms overlapped with civil wars or major insurgencies. Figure A3 includes only leaders who served no more than ten years (and who had left office by the end of 2015), again excluding civil war cases.

[3] For an illustration of this point, see Figure A1 in online Appendix A.

[4] Figure A4 in online Appendix A illustrates this pattern. We do not include torture of ordinary criminal suspects, nor can we verify whether torture actually took place. However, the decreased frequency of allegations suggests in itself that dictators are increasingly eager to avoid a reputation for abuses (as discussed in the next section).

Figure 2
Political Prisoners and Detainees in Dictator's Peak Year



Source: Guriev and Treisman (2017).
Note: Only leaders who served at least five years in a nondemocracy (Polity2 < 6) are included. "Political prisoners" are individuals imprisoned or detained for more than a few hours by the state or its agents for political—rather than normal criminal—reasons, whether or not they are tried and convicted. We do not include those imprisoned for violent acts (as an example, ETA terrorists in Spain), but we do include people imprisoned for seeking to overthrow the regime if, as best we can tell, they did not commit violence, as well as people detained for more than a few hours for participating nonviolently in antigovernment protests.

Singapore's leader Lee Kuan Yew detained more than 100 political prisoners (Amnesty International 1980), but later he pioneered low-violence methods. In an interview, he recalled how, after the Tiananmen Square massacre, he had lectured China's leaders (as quoted in Elegant and Elliott 2005):

> I said later to [then Premier] Li Peng, "When I had trouble with my sit-in communist students, squatting in school premises and keeping their teachers captive, I cordoned off the whole area around the schools, shut off the water and electricity, and just waited. I told their parents that health conditions were deteriorating, dysentery was going to spread. And they broke it up without any difficulty." I said to Li Peng, you had the world's TV cameras there waiting for the meeting with Gorbachev, and you stage this grand show. His answer was: We are completely inexperienced in these matters.

Peruvian President Fujimori's intelligence chief, Vladimiro Montesinos, underwent a similar evolution. The regime brutally crushed the Sendero Luminoso insurgency, and Montesinos organized death squads. Yet later, he came to favor

indirect methods. When an aide suggested using death threats against a television magnate, he replied: "Remember why Pinochet had his problems. We will not be so clumsy." Instead, he stripped the tycoon of Peruvian citizenship, letting regulations against foreign media ownership do the rest (in this journal, McMillan and Zoido 2004, 74, 85).

Instead of long sentences for dissidents, many rulers now favor short detentions interspersed with amnesties. Unlike his brother Fidel, who jailed some dissidents for more than ten years, Cuba's Raul Castro held dissidents for just a few days, enough to intimidate without attracting much attention (Amnesty International 2012). Authorities in Russia and Morocco use preventative short-term detentions to disrupt opposition events. Related techniques include house arrest, job loss, and denial of housing, educational opportunities, or travel documents—all of which can be cast more easily as nonpolitical. The ability to identify and target troublemakers before they act has been enhanced by new surveillance technology.

Decreased violence may improve the dictator's odds of retiring safely, rather than being overthrown. Although we cannot make causal claims, our data are consistent with this possibility. Among leaders of nondemocracies who left office between 1946 and 2013 after serving at least five years, the probability of exile, imprisonment, or death within a year of exit correlated positively with the scale of political killing under the leader's rule. For those with no recorded political killings, the probability of these three post-tenure mishaps was only 0.36; for those with more than 10,000 killings per year, it was 0.86. The probability of post-tenure exile, imprisonment, or quick death was 0.46 for those who had held political prisoners, but just 0.17 for those who had not, and 0.49 for those accused of torturing political detainees, compared with 0.26 for those not facing such accusations.[5]

Violence Concealed

In many autocracies, leaders publicize their brutality to deter opposition or energize supporters. From medieval monarchs to the Afghan Taliban, rulers have staged show trials and bloody executions of "traitors" and "heretics." Some organize macabre public rituals to increase the impact. Dominican dictator Rafael Trujillo, for instance, paraded the corpse of an executed rebel in a chair through his home province, forcing the rebel's peasant supporters "to dance with his remains" (Derby 2009, 2–3). Ahmad bin Yahya, the king of Yemen, had the heads of executed "traitors" "hung on the branches of trees as a warning" (Roucek 1962, 312–13).

The effect on observers is as important as that on the victim. General Muammar Gaddafi of Libya mocked those rulers who killed their enemies secretly, boasting that *his* opponents had been "executed on television" (Amnesty International 1988,

[5] In online Appendix A, Figure A5 illustrates these patterns. Of course, we cannot exclude the possibility that violence increases both the odds of punishment after stepping down and the odds of surviving indefinitely in office, which would lead to censoring of our data.

247–48). Generalissimo Francisco Franco of Spain even had a special sentence for those whose fate he wanted to advertise broadly: *garotte y prensa*, which loosely translates as "strangulation by garotte with press coverage" (Preston 2003, 42).

The point of such gruesome acts is not just sadism. In traditional dictatorships, especially those with limited state capacity, the horror of punishments must compensate for the relatively limited probability that disloyal acts will be detected. "Why should we fear a bit of shock?" Chairman Mao Zedong of China once asked. "We want to be shocking" (Mao 1964). Pakistan's General Muhammad Zia-ul-Haq insisted: "Martial law should be based on fear" (as quoted in Noman 1989, 33).[6] For some dictators, violence was not just a deterrent but a tool of social engineering. Benito Mussolini hoped it would transform Italians from a "race of sheep" into a "Nordic people" (Adler 2005, 299). Tens of thousands of Italians who resisted were held in concentration camps on remote islands (Ebner 2011).

In informational autocracies, by contrast, violence can puncture the dictator's image, prompting a spiral of protest and insider defections. In Ukraine in 2000, a tape apparently implicating President Leonid Kuchma in a journalist's killing sparked demonstrations that ultimately led to the country's "Orange Revolution." In 1980s Poland, the murder by the security services of a popular priest, Father Jerzy Popieluszko, had a similar effect (Bloom 2013, 354). More generally, among the 46 cases from 1989 to 2011 in which a government's violent response to an unarmed protest caused more than 25 deaths, the crackdown catalyzed domestic mobilization in 30 percent of these cases and prompted security force defections in 17 percent (Sutton, Butcher, and Svensson 2014). Such repression backfired more often in countries with higher income and opposition media.

Those—usually in the security forces—who prefer a regime of raw repression sometimes commit atrocities to compromise their leader, hoping to compel a switch from information manipulation to blatant force. This dynamic also shows why an incompetent security apparatus can imperil a dictator. After troops shot dead the Philippine opposition leader Benigno Aquino in 1983, President Ferdinand Marcos could not deny complicity. This murder ignited the "People's Power" movement that eventually split Marcos's military support, triggering his overthrow.

Informational autocrats use various tricks to camouflage those acts of repression they still commit. One is to prosecute dissidents for nonpolitical—preferably embarrassing—crimes. Nicolae Ceauşescu of Romania instructed his security chief to use "inventiveness and creativity" in neutralizing dissidents: "We can arrest them as embezzlers or speculators, accuse them of dereliction of their professional duties, or whatever else best fits each case. Once a fellow's in prison, he's yours" (as quoted in Pacepa 1990, 144–45). Lee Kuan Yew of Singapore berated his Malaysian counterpart Mahathir Mohamad for arresting the opposition leader Anwar Ibrahim in 1998 under the Internal Security Act rather than for some ordinary crime (Pereira 2000).

[6]For other examples of deliberately public violence, see Table A1 in online Appendix A.

The nonpolitical offenses that recent dictators have used to charge political opponents range from what one might expect, such as corruption or adultery, to more exotic charges, such as disrupting traffic, stealing street art, and illegal elk hunting.[7]

End of Ideology

Many past autocrats sought to impose comprehensive ideologies. In totalitarian systems, these often involved holistic conceptions of man and society that legitimized the dictator's rule and required personal sacrifices (Linz 2000, 76), while decisively rejecting capitalist democracy. Some nontotalitarian autocrats also adopted guiding doctrines. Reactionaries constructed world views based on Catholic teachings. Leftists combined Marxism with indigenous elements.

Almost all such ideologies defined regime opponents as evil and, in this way, justified harsh measures against them. We see their use as aimed, at least in part, at motivating state agents to violently punish opposition. Ideology is often a complement of repression.

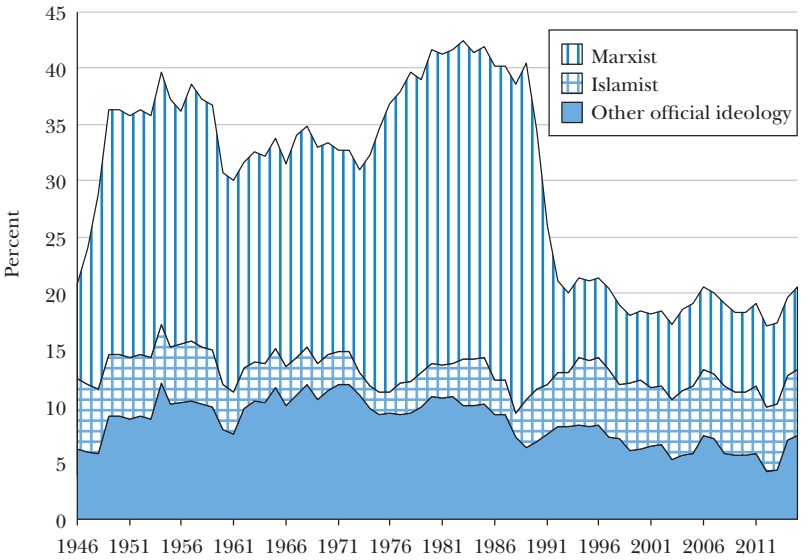
Informational autocrats, eschewing mass repression, have less need for ideology. Although they are often critical of the West, they rarely reject democracy per se, merely insisting that it evolve within their unique conditions. For Hungary's Viktor Orbán, that means "illiberal democracy"; for Russia's Vladimir Putin, "sovereign democracy." Many have no ideology at all. Those who do—for instance, Hugo Chávez, with his populist "Chavismo"—use it to signal commitment to social causes, rather than to control citizens' thought. In all these cases, the rulers pretend to care for citizens' well-being, thus mimicking democratic leaders.

We collected data on which postwar nondemocracies had an official ideology—that is, a social, political, or religious doctrine, endorsed by top officials, that influenced the content of laws. As Figure 3 shows, by far the most frequent was some form of Marxism: we coded regimes as Marxist if the government was dominated by a communist party or if the leader publicly said he was a Marxist. We categorized nondemocracies as Islamist if they privileged Islamic over secular law on a broad range of issues. A residual category, "other ideologies," contains more exotic alternatives such as Ba'athism, Nasserism, Pancasila, and Kemalism.

The proportion of nondemocracies with official ideologies dwindles from 42 percent in 1983 to around 20 percent in the 1990s and 2000s. This reflects a sharp drop in Marxist regimes (from 28 percent to about 7 percent), although "other ideologies" also lost ground. Islamism increased, but only from around 2 percent in the mid-1970s to 6 percent in 2015.

[7]For a list of some other nonpolitical offenses with which opposition members have been charged, see Table A2 in online Appendix A.

Figure 3
Percentage of Nondemocracies with an Official Ideology



Source: Guriev and Treisman (2017).
Note: The number of nondemocracies (Polity2 < 6) rose from 48 in 1946 to a peak of 108 in 1977, before falling to 68 in 2015.

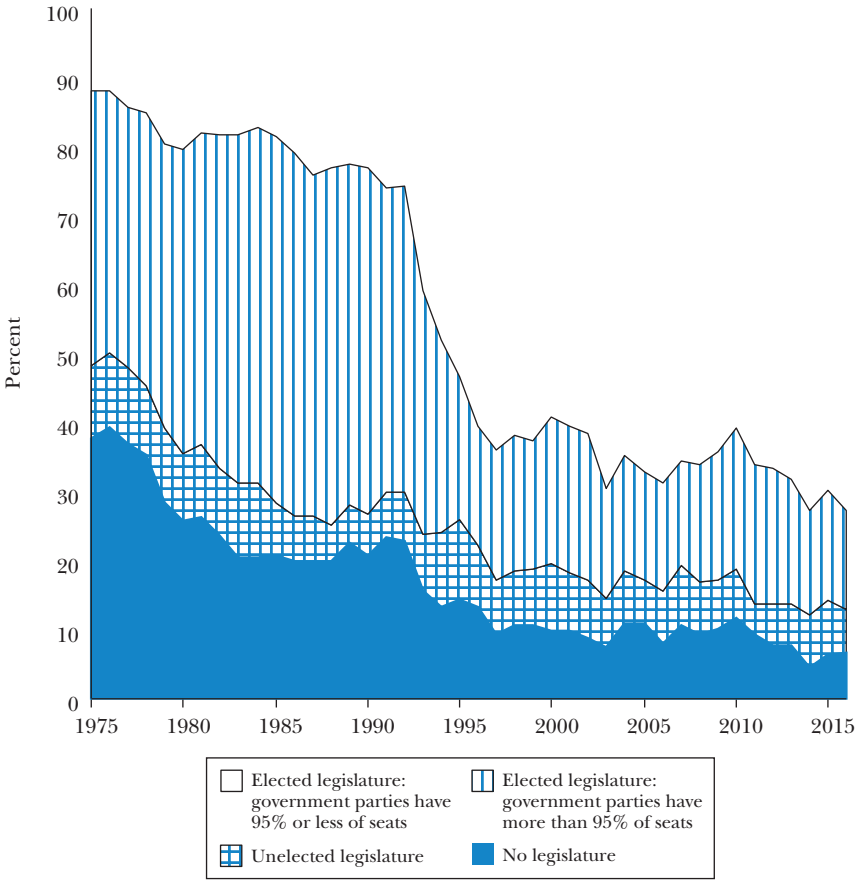
Mimicking Democracy

Overt dictatorships should have little use for ostensibly democratic institutions such as legal opposition parties, popularly elected parliaments, and partially free presidential elections. Such institutions complicate decision-making and could help opposition actors coordinate. Yet with the proliferation of informational autocracies, such institutions have multiplied. Consider elected parliaments. Whereas in 1975 almost one-half of nondemocracies had no elected legislature at all, by 2015 more than two-thirds had parliaments in which nongovernment parties had at least a token presence, as shown in Figure 4.

Voting for head of the executive branch of government has also spread. More and more authoritarian leaders have been taking office by election, rather than by military coup or some other irregular path. Between the 1970s cohort and the 2000s cohort of dictators (who remained in office at least five years), the percentage originally elected rose from 14 to 56 percent (Guriev and Treisman 2017).

Coming to power through an election—like avoiding violent repression while in office—may increase a dictator's odds of a peaceful retirement. Again, we cannot make causal claims, but the evidence is consistent with this. Among dictators stepping down between 1946 and 2013 (after at least five years in power), more than

Figure 4
Percentage of Nondemocracies with Legislatures of Different Types



Source: Cruz, Keefer, and Scartascini (2016).
Note: The number of nondemocracies (Polity2 < 6) was 107 in 1975 and 68 in 2015.

one-half of those who had *not* come to power through election were either exiled, imprisoned, or killed within one year. Among those who had been elected, only about one-third suffered any of these fates.

While totalitarian states also mobilize citizens to vote in ritual elections, most authoritarian states today seek to render their elections more credible. Rather than banning opposition parties outright—thus revealing a lack of confidence—they permit opposition but then harass candidates and manipulate the media to ensure large victories. Between the early 1990s and 2012, the share of elections in nondemocracies in which media bias favoring the incumbent was alleged rose from 35 to 58 percent. In the same period, the share in which state harassment of opposition candidates was alleged rose from 29 to 45 percent (of those cases

in which opposition was allowed; Hyde and Marinov 2012). Seeking external and internal legitimacy, regimes invite international monitors, who tend to focus on the immediate pre-election period rather than on longer-term policies that disadvantage challengers. Since the late 1980s, the percentage of such elections monitored by international observers rose from 26 to 84 percent (Hyde and Marinov 2012).

Rhetoric of Performance Rather Than Violence

When old-style dictators address the general public, they seek to instill anxiety, prompting citizens to rally behind the nation's protector-in-chief. We argue that informational autocrats, like democratic leaders, aim for something different: a reputation for competence. Thus, we expect the rhetorical style of informational autocrats to diverge from that of overt dictators and to mimic that of democrats. To see whether this is the case, we compared speeches of several key examples of overt dictators, informational autocrats, and democrats.

Speech Data

Which statesmen should serve as exemplars of these three categories? Our selection was determined by a mix of theory and data availability. We used two criteria: (1) leaders considered important in the historical or current literature and (2) leaders for whom we could find a sufficient number of appropriate speeches.

To identify informational autocrats, we focused on the level of repression. We singled out leaders of nondemocracies under whom fewer than five state political killings occurred per year and no more than 100 political prisoners were held at the peak, and chose four of these for whom appropriate speeches were available: Vladimir Putin (Russia), Rafael Correa (Ecuador), Hugo Chávez (Venezuela), and Nursultan Nazarbayev (Kazakhstan).[8] In addition, we included Lee Kuan Yew of Singapore, using only speeches from his later years in office, when the number of political prisoners was well below 100. (Early in his tenure, more than 100 had been reported.) We see Lee as evolving from a relatively moderate overt dictator to a pioneer of informational autocracy. The overt dictators whose speeches we include all come from violent nondemocracies: Josef Stalin, Adolf Hitler, Benito Mussolini, Francisco Franco, Saddam Hussein, Fidel Castro, and Kim Jong Un. The democrats are Franklin Delano Roosevelt, Jawaharlal Nehru, Dwight Eisenhower, David Cameron, Nicolas Sarkozy, and Barack Obama. In both cases, we sought to include a mix of newer and older leaders.

We chose speeches directed at the general public rather than the elite or specific subgroups. Thus, we focused on those broadcast nationwide by radio or television. We excluded speeches made during wars, at party meetings, or outside the country, as well as those targeting primarily international audiences. We used addresses to

[8] Polity IV codes the Putin regime a nondemocracy only from 2008, so we used texts only from that year on.

parliament only when they were broadcast nationally and when better materials were unavailable—such speeches, although communicating with the public, may also incorporate strictly legislative business—and excluded interviews or press conferences where interviewers chose the topics. However, in several cases (for example, Putin, Eisenhower) we used the leader's answers to questions from citizens in televised call-in or town hall meeting events (of course, dropping speech of questioners or hosts). Although the questioners—like interviewers—help set the agenda in such shows, the range of issues is usually broad, allowing the leader considerable freedom. (In addition, the leader's team may vet questions.)

We often included campaign speeches and regular radio or television addresses. For Barack Obama, we took a random sample of 40 (out of his roughly 400) weekly radio addresses. For Franklin Roosevelt, we used the 13 "Fireside Chats" before World War II. For Hugo Chávez, we randomly selected 6 of 378 episodes of *Alo Presidente*, a lengthy television show in which he chatted with ministers and citizens, dropping parts not spoken by Chávez himself. Similarly, we used twelve recent episodes of Ecuadoran President Rafael Correa's broadcast *Enlace Ciudadano* (*Citizens' Link*) that were available online, again excluding parts not spoken by him.

It might seem desirable to analyze texts in the speaker's language. However, each analysis employs a dictionary relating words to particular topics, and the different language dictionaries may not fully correspond. Therefore, we used English translations of each non-English speech. For most of the speeches, we could find high-quality English versions, but for a few leaders, far more numerous appropriate speeches were available in the original language. While the best machine translation programs remain imperfect for most tasks, word count text analysis is arguably an exception. When estimating word frequencies, the order of words, punctuation, grammar, and so on do not matter, so the "software needs only to correctly translate the significant terms in the original document" (Lucas et al. 2015, 7). As recommended by Lucas et al., we used Google Translate to obtain English versions of texts in the few relevant cases (Franco in Spain, Chávez in Venezuela, Correa in Ecuador).

Results

We used a dictionary method of text analysis to compare the frequency of certain words in the speeches of different leaders (Grimmer and Stewart 2013). Our hypothesis was that appeals to the general public by informational autocrats will in key respects resemble those of democrats more than those of overt dictators. We focused on three aspects. Overt dictators will use vocabulary related to violence (both domestic and external) to create anxiety among listeners. By contrast, informational autocrats—like democrats—will emphasize economic performance and public service provision in the attempt to convince citizens they are competent and effective leaders.

Our first task was to construct lists of words representative of the rhetorical strategies of dictators, informational autocrats, and democrats. Since we aimed to

compare the vocabulary of informational autocrats to those of overt dictators and of democrats, we used the speeches of overt dictators and democrats as sources. From these, we compiled lists of candidate words and their cognates for all three topics. Of course, many words have multiple meanings. We therefore scanned the speeches to check how frequently a given word was used with the "wrong" meaning. (For instance, "spending" money is relevant to economic performance and public service provision; "spending" time is not.) When we found more than two nongermane uses, we excluded the word from the list.

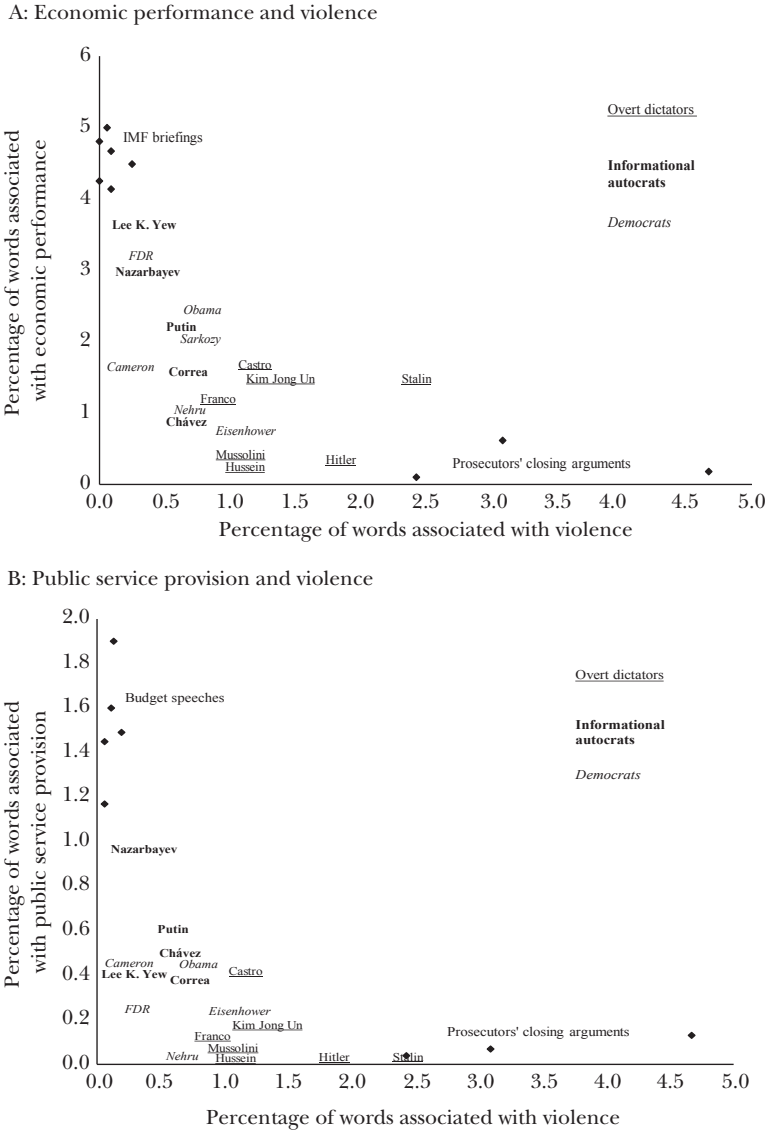
This approach produced three "dictionaries" or lists of words in three categories: violence (142 word stems, with examples including death*, massacre*, war, blood, prison), economic performance (112 word stems, including sales, wages, wealthy, inflation, prosper*), and public service provision (28 word stems, including expenditure, childcare, hospitals, education, funding). We used the text analysis program LIWC2015 (Pennebaker et al. 2015) to count the frequencies of words from the respective dictionaries.

To validate the dictionaries, we used them first to analyze three sets of texts deliberately selected to contain high concentrations of words related to: (1) economic performance (transcripts of six International Monetary Fund briefings on the *World Economic Outlook*), (2) public service provision (budget speeches by the finance ministers of five democracies), and (3) violence (closing arguments of prosecutors at the Nuremberg trial of Nazi leaders, the International Criminal Tribunal trial of former Serb leader Radovan Karadzic, and the trial of terrorist Dzhokhar Tsarnaev). If the word lists are well constructed, the International Monetary Fund briefings should rate relatively high on economic performance (but not on violence), the budget speeches should rate high on public service provision (but, again, not on violence), and the prosecutors' statements should rate high on violence (but not on economic performance or public service provision). Indeed, the scores of these three sets of validation texts should define benchmarks against which the leaders' speeches can be judged. In each case, the dictionary reliably placed the texts in the appropriate ranges on the three dimensions.[9]

Figure 5 presents the results for the leaders' speeches. For reference, we also plot the scores of the validation texts using diamond markers—International Monetary Fund briefings (high on economic performance words, low on violence), prosecutors' speeches (high on violence, low on economic performance and public service provision), budget speeches (high on public service provision, low on violence). As expected, the overt dictatorships cluster in the high violence and low economic performance and service provision parts of the graph. Stalin's public addresses sound about as violent as the prosecutor's summation in the Karadzic war crimes trial. Also as expected, the democratic leaders

[9] See online Appendix A for more details. For sources of all the speeches used, see Table A3. Table A4 provides the three lists of words used. Sources for the three sets of texts used as comparison for purposes of validation are in Table A5. Figure A7 shows how frequently words from the three dictionaries appear in the validation texts.

Figure 5
Rhetoric of Different Types of Leaders



Source: Authors' calculations. For dictionaries and sources of texts, see Tables A3 and A4 in online Appendix A, available with this article at the *Journal of Economic Perspectives* website.
Note: Lee Kuan Yew speeches are from 1980 to 1990; Putin speeches are after 2008. "IMF briefings" are transcripts of six International Monetary Fund briefings on the World Economic Outlook. "Budget speeches" are budget speeches by the finance ministers of five democracies in 2016–2018 (Australia, Trinidad and Tobago, India, South Africa, United Kingdom). "Prosecutors' closing arguments" are prosecutors' closing statements from the Nuremberg trial of Nazi leaders, the International Criminal Tribunal trial of former Serb leader Radovan Karadzic, and the trial of terrorist Dzhokhar Tsarnaev. For details, see Table A5 in online Appendix A.

Table 1
Means, Standard Errors, and Significance Levels in Two-Tailed Tests of Equivalence of Means

	Violence	*Economic performance*	*Public service provision*
Overt dictators	1.41	0.99	0.12
	(0.21)	(0.23)	(0.06)
Democrats	0.65	1.87	0.32
	(0.13)	(0.37)	(0.07)
Informational autocrats	0.51	2.28	0.58
	(0.08)	(0.48)	(0.10)
Informational autocrats versus overt dictators	$p = 0.006$	$p = 0.02$	$p = 0.002$
Informational autocrats versus democrats	$p = 0.42$	$p = 0.51$	$p = 0.07$

Source: Calculations by the authors using announcement information from the *Wall Street Journal* and stock price data from the Center for Research in Security Prices.

cluster in the low violence and high economic performance and service provision areas. Among overt dictators, Fidel Castro's rhetoric is the most oriented toward economic performance and service provision, but he still surpasses all democrats for violent imagery. Among democrats, Eisenhower employed unusually violent vocabulary—a function of the intense Cold War period (although we exclude all war years, so all Eisenhower's speeches are from after the end of the Korean War). Nehru spoke relatively little about service provision. These anomalies notwithstanding, the democrats and overt dictators mostly separate out neatly on these dimensions.

What about the informational autocrats? As hypothesized, they blend in with the democrats, emphasizing economic performance and service provision rather than violence. Indeed, the leader with the most insistent discourse of economic performance is Lee Kuan Yew, whose speeches sounded almost like International Monetary Fund briefings. The leader in discourse on service provision is Kazakhstan's President Nazarbayev, whose "State of the Nation" addresses resemble democratic leaders' budget speeches.

As Table 1 shows, the differences between the informational autocrats and overt dictators included in the graphs are meaningful in size and unlikely to have arisen by chance. Whereas words associated with violence made up 1.41 percent of all those in the speeches of overt dictators, violent words were just 0.51 percent of those used by informational autocrats. Roughly every fortieth word of an informational autocrat—but only every hundredth word of an overt dictator—concerned economic performance. The informational autocrats were very close to the democratic leaders on vocabulary of violence and of economic performance, and they actually used more words related to public service than the democrats.

Beliefs of Elites and Masses

In a recent paper, we offer a formal account of how informational autocrats hold onto power (Guriev and Treisman 2018). The underlying logic is that of a game with asymmetric information. The ruler may be competent or incompetent. The general public does not observe competence directly, but a small "informed elite" does. Both the elite and the public prefer a competent ruler, because this leads to higher living standards on average. If the public concludes that the ruler is incompetent, it overthrows the leader in a revolt. The elite may send messages to the public, and the leader can try to block these with censorship or to buy the elite's silence—but at the cost of diverting resources from sustaining living standards. The ruler can also send "propaganda" messages, blaming economic failures on external conditions.[10]

In some circumstances, the ruler achieves a higher probability of survival by manipulating information than by deterring revolt through repression (overt dictatorship) or alternatively by devoting all resources to improving living standards (democracy). Whether informational autocracy constitutes an equilibrium depends on two key variables—the size of the informed elite and the ease with which, given technology, the state can monopolize the media. Both of these relate to a country's level of economic development. In highly modern countries, the informed elite is generally too large for manipulation to work, and censoring all private media is costly: democracy is the only option. In undeveloped countries, repression often remains more cost effective. But at intermediate levels of development, both democracy and informational autocracy are possible outcomes. Which one occurs will depend on how effectively the state can dominate political communications to ordinary citizens.

From this perspective, the key goal of informational autocrats is to prevent elite members from revealing the regime's flaws to the general public. Of course, such manipulation works only if the public does not detect it. This has two implications: (1) the public should be less aware of censorship than the elite, and (2) informational autocrats should be more popular with the public than with the elite.

To test these implications, we use individual-level data from the Gallup World Poll for 2006–2017. This annual poll surveys around 1,000 respondents from each of more than 120 countries, with broad coverage of democracies and informational autocracies.[11] As a rough proxy for membership in the informed elite, we use here a dummy for whether the respondent had completed tertiary education.

[10] In a related paper, Shadmehr and Bernhardt (2015) analyze the inference problem for citizens who must decide whether the absence of "bad news" is due to state censorship or to a lack of bad news for journalists to report.

[11] As data are for recent years, almost all nondemocracies in the Gallup World Poll are informational autocracies. Coverage of the few remaining overt dictatorships is sparse: for example, there are no polls of North Korea or Syria and only one of Cuba.

Censorship

Many twentieth-century dictators used censorship, like public violence, to intimidate possible opponents. The Nazis burned certain books in public squares, and the Soviets demonstratively banned them. In Chile, Augusto Pinochet stationed censors in every newspaper, magazine, radio station, and television channel (Spooner 1999, 89). African autocrats shuttered papers and imprisoned, exiled, or murdered their reporters (Lamb 1987, 245–46).

For informational autocrats, such measures would be self-defeating, exposing their need to hide the truth. Instead, they adopt less obvious techniques. In Singapore, Lee Kuan Yew co-opted shareholders in key media companies. Newspapers' corporate boards—supposedly independent—then did the censoring for him. When loyalty failed, he punished offending journalists with lawsuits. In one analyst's words: "forsaken profits and stiff legal penalties have been more effective in fostering self-censorship than earlier methods of intimidation" (Rodan 1998, 69).

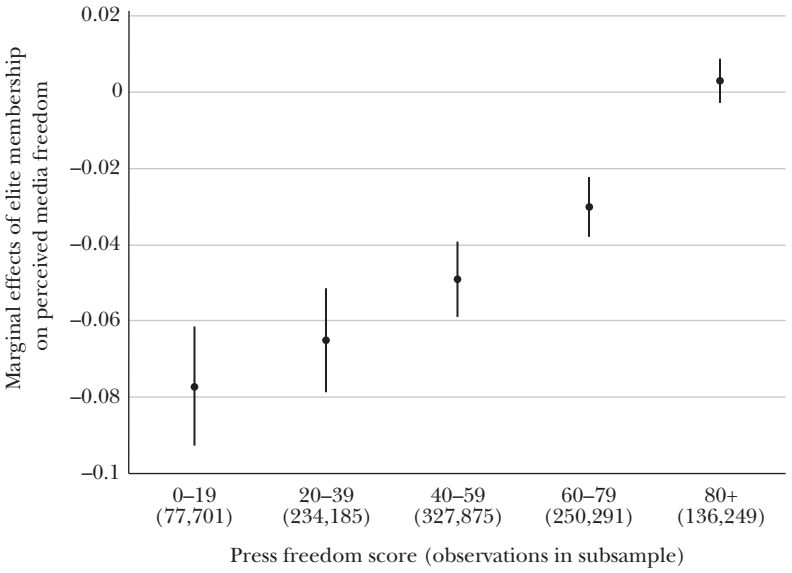
Others have acted similarly. Orbán, in Hungary, has starved critical radio stations of state advertising, leaving them vulnerable to takeovers by government allies (Howard 2014). In Russia, Putin has "often relied on surrogates and economic pressure to keep editors and journalists in line" (Gehlbach 2010, 78). Peru's Fujimori bribed most private media (Faiola 1999).

Such indirect methods of censorship, besides protecting the dictator's image, also avoid stimulating a search for the censored information. In China, blocking websites outright inspires net users to "jump the great firewall," but introducing technical search friction does not (Roberts 2018). Moreover, if censored sparingly, social networks can be used by the state as a tool of surveillance (in this journal, Qin, Strömberg, and Wu 2017). In Russia, the Kremlin enlists supposedly independent hackers and trolls to hinder opposition communication. When informational autocrats do admit to censorship, they often claim—as Russia's government does—to be protecting citizens from "extremism," "vandalism," and child pornography (Kramer 2007).

Such techniques aim to conceal censorship from the public. If they succeed, ordinary citizens should have higher estimates of media freedom than members of the elite, who experience restrictions firsthand. To test this, we used a Gallup World Poll question that asked: "Do the media in this country have a lot of freedom, or not?" We created a dummy, taking the value 1 for an answer of "yes" and 0 for an answer of "no." (Respondents could also say "don't know," or refuse to answer.) We regressed this on elite membership, using a linear probability model, including country-year fixed effects, and clustering standard errors by country-year. (Note that the country-year fixed effects control for *actual* media freedom, as well as other country-wide influences.)

We divided countries up according to actual media freedom, as measured in Freedom House's press freedom ratings. Where the media are free, both the elite and the public should observe this, and so no perceptions gap should exist. However, as freedom falls, the gap between actual press freedom—as perceived accurately

Figure 6
Perceptions of Media Freedom, Elite versus General Public

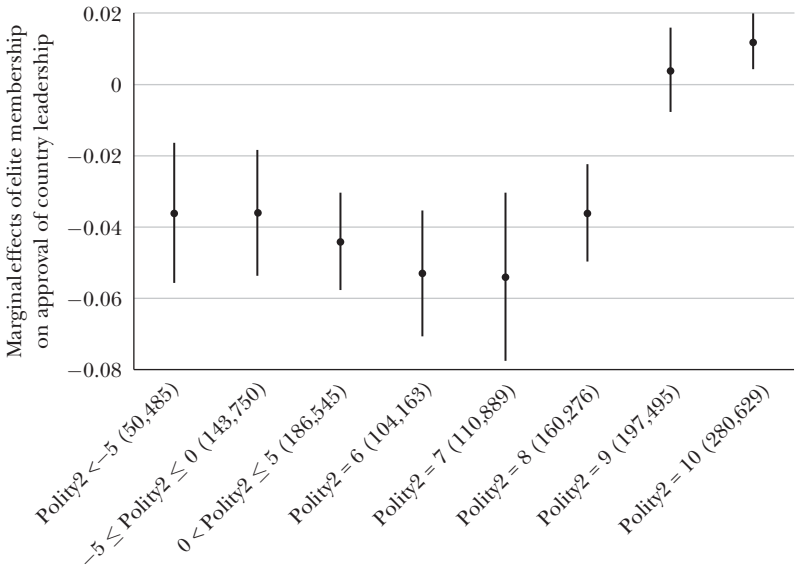


Source: Gallup World Poll, Freedom House, and authors' calculations.
Note: The chart reports confidence intervals for the effect of elite membership on perceived media freedom for five subsamples of countries defined by their Freedom House press freedom scores (0–19, 20–39, 40–59, 60–79, 80–100). We normalize the score so that 0 is perfect censorship and 100 is full press freedom. Numbers in parentheses represent the number of individual observations in each subsample. The regressions include country-year fixed effects. Standard errors are clustered by country-year. See Table A6 in online Appendix A, available with this article at the *Journal of Economic Perspectives* website, for robustness checks including controls for age, age squared, gender, and urban status.

by the elite—and the overly positive assessment of the manipulated public should grow. As Figure 6 shows, the data strongly confirm this supposition. For countries with high press freedom, the gap between elite and public perceptions is zero. As actual press freedom falls, the gap widens to a maximum of almost 8 percentage points. Where the press is censored, the general public—as predicted—is less aware of this than are highly educated citizens.[12]

[12] In online Appendix A, Table A6 provides a robustness check with controls for individual characteristics. Table A7 reports results for additional specifications, including the interaction between tertiary education and actual press freedom, and operationalizing the latter in several ways. In all specifications, results resemble those in Figure 6: the stronger the censorship, the greater the gap between perceptions of media freedom among the elite and ordinary citizens. In online Appendix B, we also consider a simple model microfounding the relationship between the true and perceived media freedom; its predictions are in line with the results in Table A7.

Figure 7
Approval of Country's Leadership: Elite versus General Public



Source: Gallup World Poll, Polity IV, and authors' calculations.
Note: The chart reports confidence intervals for the effect of elite membership on approval of the country's leadership for subsamples defined by Polity2 score. Numbers in parentheses represent the number of observations in each subsample. The regressions include country-year fixed effects. Standard errors are clustered at country-year level. For a robustness check including controls for individual characteristics (age, age squared, gender, urban status), see Table A8 in online Appendix A, available with this article at the *Journal of Economic Perspectives* website.

Regime Support

Here we use the Gallup World Poll question: "Do you approve or disapprove of the job performance of the leadership of this country?" Again using a linear probability model, we regressed a dummy for positive approval on a dummy for elite membership, in sets of countries divided up according to their regime type. As noted earlier, the Polity IV data rate countries on a 21-point scale from −10, "full autocracy," to +10, "full democracy." As before, we controlled for country-year fixed effects and clustered standard errors by country-year. The main results are presented in Figure 7.

As predicted, in authoritarian states—as well as in flawed democracies, with Polity2 scores of 6 to 8—approval of the national leadership was lower among the highly educated. This contrasts with the consolidated democracies—with scores of 9 or 10—where the highly educated were, if anything, *more* supportive of their government. Since the highly educated tend to earn more, their lower support for leaders in authoritarian states might seem surprising.[13] But it fits the notion—central

[13] We estimated the relationship for the full sample including both elite membership and its interaction with the level of democracy (see Table A9 in online Appendix A). The results are very similar. We also

to our theory—that the elite perceives its rulers' incompetence more accurately than does the general public.

As a placebo test, we checked whether in nondemocracies the highly educated also had lower life satisfaction than the general public. They did not: in fact, as in democracies, their life satisfaction was substantially higher. We also tried controlling for income; education remained associated with lower approval, while the effect of income was insignificant.[14] This is consistent with our argument that it is political knowledge, proxied by higher education, that predisposes citizens to oppose authoritarian regimes. Income may include co-optation payments to some members of the elite, which align recipients' interests with those of the ruler.

Other Theories of Modern Authoritarian Governance

The logic of informational autocracy explains some otherwise puzzling features of current authoritarian politics. Much recent analysis assumes that citizens in such states detest their rulers but cannot coordinate to overthrow them. Dictators take a number of actions that can be interpreted as ways of blocking revolts: they restrict communication among citizens and criminalize protests (Kricheli, Livne, and Magaloni 2011), censor calls for antiregime collective action (King, Pan, and Roberts 2013), publish misleading propaganda about their repressive capacity (Edmond 2013; Huang 2015), or use both propaganda and censorship to divide opponents (Chen and Xu 2017). Some argue that these actions can lead to trade-offs for the ruler—censorship needed to prevent coordination deprives the regime of useful information (Egorov, Guriev, and Sonin 2009; Lorentzen 2014).

However, some autocratic leaders today—although corrupt and ineffective—seem genuinely popular. It is not that citizens cannot coordinate to resist them: many do not want to. Notwithstanding the difficulties of polling in unfree societies, most experts agree that Putin in Russia, Erdoğan in Turkey, and Chávez in Venezuela have for substantial periods of time enjoyed genuine public support. This popularity is not based on the brainwashing and personality cults of totalitarian leaders, or on narrow sectarian or ethnic identities and interests. At least some dictators in power today survive not by preventing the masses from rebelling, but by removing their desire to do so.

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estimated a Mincerian equation using Gallup World Poll data (Table A10). Controlling for gender, age, age squared, and urban status, individuals with tertiary education earned salaries 40 percent higher than those with secondary education (the difference was 30 percent if we controlled for occupation). As shown in Table A11, the returns to tertiary education are similar across countries with different levels of democracy (Polity2 score).

[14] In online Appendix A, Table A12 shows the correlation between being highly educated and life satisfaction across nondemocracies. Table A13 shows that the correlation continues to hold after controlling for income in nondemocracies. By contrast, in democracies both education and income—even if included together—were both positively related to approval.

Another key feature of informational autocracies is the use of formally democratic institutions. Many scholars have pondered the role of such institutions in dictatorships. Some see them as mechanisms for solving time inconsistency problems. If a ruler creates institutions that constrain his own actions, that ruler can commit to repay state debts and to respect property rights (North and Weingast 1989; Gehlbach and Keefer 2011), to redistribute income to the poor (Boix 2003; Acemoglu and Robinson 2006), or to share power with colleagues (Myerson 2008; Svolik 2012; Boix and Svolik 2013). Partly competitive elections may inform the ruler about local attitudes or his agents' effectiveness (Cox 2009; Blaydes 2010) and project strength—both to his allies (Gandhi and Lust-Okar 2009; Simpser 2013; Gehlbach and Simpser 2015) and to his opponents (Egorov and Sonin 2014; Little 2016; Rozenas 2016).

These arguments make sense, although some dictators seem to relish retracting the commitments that scholars had previously thought credible (as a recent example, consider Xi Jinping's elimination of presidential term limits in China). However, such institutions may perform a simpler function. If information manipulation has successfully inflated the autocrat's reputation, elections can be used to distill popularity into legitimacy. The appearance of democracy can be added to the image of competence.

Another literature models interactions between dictators and their support group when these are not mediated by institutions. Key questions in this approach are how the ruler chooses the size and characteristics of the ruler's inner circle and how this, in turn, determines policy choices and survival odds for the ruler (Bueno de Mesquita et al. 2003; Egorov and Sonin 2011). Like our approach, the "selectorate theory" of Bueno de Mesquita et al. considers three actors: a ruling individual or group, an elite, and the public. However, selectorate theory concerns the distribution of material benefits under—in most cases—perfect information, while ours focuses on the transmission of information about the dictator's type. And while the selectorate gets to choose the ruler, our informed elite has no power except to influence and assist the public. Whereas rulers in selectorate theory bribe elites to prevent coups, our rulers bribe them—or censor them—to stay silent so as to avoid mass unrest.

A number of authors have suggested alternative ways to classify nondemocracies. Some emphasize the *objectives* of rulers. Besides the familiar distinction between authoritarian and totalitarian regimes, which aim for different degrees of social control (Linz 2000), Wintrobe (1990) introduces the "tinpot" dictator, who maximizes consumption subject to a power constraint. Others highlight the identity of the ruling group: for example, Geddes, Wright, and Frantz (2018) distinguish among monarchies and military, one-party, and personalist dictatorships. Our distinction between "overt dictatorships" and "informational autocracies" focuses on the *method* of maintaining power and thus cuts across previous categories. Informational autocrats can aim for more or less power and more or less personal wealth. They are most often personalist dictators, but they can also be found in one-party

regimes (Singapore, Malaysia) and even monarchies (some Middle Eastern and North African states).

Concluding Remarks

The totalitarian tyrants of the past employed mass violence, ideological indoctrination, and closed borders to monopolize power. Most authoritarian rulers also used brutal repression to spread fear. However, in recent decades, a growing number of nondemocratic leaders have chosen a different approach. Their goal—concentrating power—remains the same. But their strategy is new. Rather than intimidating the public, they manipulate information—buying the elite's silence, censoring private media, and broadcasting propaganda—in order to boost their popularity and eliminate threats.

We documented the growing presence of such informational autocracies. Modern authoritarians tend to be less brutal than their predecessors—and more secretive when they do repress. Eschewing official ideologies, they imitate democracy, creating legislatures and holding elections, harassing opposition candidates more often than banning them outright. Like democratic leaders, most dictators today focus on economic performance and service provision when they address the public and avoid the violent rhetoric of old-style autocrats. They often seem to succeed in winning support from ordinary citizens while concealing from them the extent of their deception.

What explains the shift in models of autocracy? Global influences have likely contributed. The end of the Cold War, the emergence of an international human rights movement, and advances in information technology have all called into question old approaches. The cost of terrorizing one's most productive citizens is higher in an internationally connected economy that depends on innovation and mobile capital. Autarky is less feasible today than 50 years ago.

Our own favored explanation emphasizes change in *domestic* conditions—in particular, the spread of education and other aspects of social and economic modernization. As more and more citizens develop the skills and knowledge to organize opposition, repressing all potential rebels becomes difficult. Yet if the educated elite is not *too* large and the state can control the mass media, autocrats can still achieve dominance by distorting information flows. One attraction of this method—if it is successful—is that many citizens do not realize they are being dominated. The argument combines the optimism of modernization theory with the pessimism of twentieth-century critics of "mass society," who feared that mobilization of unsophisticated groups into politics would leave them vulnerable to manipulation (for example, Kornhauser 1960).

Informational autocracy could spread in two ways: through change *of* leaders, as more modern autocrats take over from older ones, or change *in* leaders, as incumbents adapt to new conditions or learn from experience while in office. The decline in violence across successive cohorts (as shown in Figure 1) suggests

replacement of leaders plays an important part. This echoes recent literature on democratization, which finds that economic development prompts political reform mostly right after new leaders take over (Treisman 2015).

Establishing whether incumbents change strategies while in office is harder. Even if they did not, they might seem to be more violent early on. A new dictator must establish credibility, which then can last for years without the need for additional brutal acts. Some autocrats come to power in coups or civil wars, which give their initial period a bloody coloration. For these reasons, we compared the average level of political killing over the entire course of each dictator's tenure. Still, anecdotal evidence suggests that some leaders, such as Lee Kuan Yew, do innovate or learn in office—and even share their discoveries with authoritarian peers.

Although better adapted to today's world than overt dictatorship, informational autocracy has clear limitations. The emphasis on economic performance leaves leaders vulnerable to downturns, the facts of which are hard to conceal from those laid off or suffering wage cuts. In Russia, rather than censoring bad economic news, Kremlin spokesmen have sought—with some success—to redirect blame onto foreign enemies (Rozenas and Stukal 2019).

Paradoxically, good economic performance can, over time, be equally destabilizing. As economic development expands the educated class, the cost of silencing it via co-optation or censorship rises. Informational autocrats therefore struggle to find a balance between supporting growth, which signals competence, and resisting economic progress out of fear of its political and social spillovers. Although increased propaganda and censorship can offset such spillovers for a while, in the long run, continued modernization renders democracy the only equilibrium.

Thus, in Taiwan, an overt dictatorship under Chiang Kai-Shek evolved into an informational autocracy under his son, Chiang Ching-Kuo, in his later years, before transitioning to full democracy in the 1990s. In Malaysia, the informational autocracy of Mahathir Mohamad edged over the line into corrupt democracy in the 2000s. Such changes are never secure at first; countries can slide backward, especially if growth stalls. And the timing of such transitions—since they depend in part on coordinated action by regime opponents—cannot be predicted with confidence. Still, as Taiwan demonstrates, with continuing development the change can last.

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References

Acemoglu, Daron, and James A. Robinson. 2006. *Economic Origins of Dictatorship and Democracy.* New York: Cambridge University Press.

Adler, Franklin Hugh. 2005. "Why Mussolini Turned on the Jews." *Patterns of Prejudice* 39 (3): 285–300.

Amnesty International. 1980. *Report of an Amnesty International Mission to Singapore, 30 November to 5 December 1978.* London: Amnesty International Publications. Excerpted at http://singaporerebel.blogspot.com/2007/02/political-detention-in-singapore.html.

Amnesty International. 1988. *Amnesty International Report 1988.* London: Amnesty International Publications.

Amnesty International. 2012. *Routine Repression: Political Short-Term Detentions and Harassment in Cuba.* London: Amnesty International Publications.

Amnesty International. 2017. *Amnesty International Report 2016/17: The State of the World's Human Rights.* London: Amnesty International Publications.

Blaydes, Lisa. 2010. *Elections and Distributive Politics in Mubarak's Egypt.* Cambridge: Cambridge University Press.

Bloom, Jack M. 2013. *Seeing through the Eyes of the Polish Revolution: Solidarity and the Struggle against Communism in Poland.* Boston: Brill.

Boix, Carles. 2003. *Democracy and Redistribution.* New York: Cambridge University Press.

Boix, Carles, and Milan W. Svolik. 2013. "The Foundations of Limited Authoritarian Government: Institutions, Commitment, and Power-Sharing in Dictatorships." *Journal of Politics* 75 (2): 300–16.

Bueno de Mesquita, Bruce, Alastair Smith, Randolph M. Siverson, and James D. Morrow. 2003. *The Logic of Political Survival.* Cambridge, MA: MIT Press.

Chen, Jidong, and Yiqing Xu. 2017. "Information Manipulation and Reform in Authoritarian Regimes." *Political Science Research and Methods* 5 (1): 163–78.

Clark, Ann Marie, and Kathryn Sikkink. 2013. "Information Effects and Human Rights Data: Is the Good News about Increased Human Rights Information Bad News for Human Rights Measures?" *Human Rights Quarterly* 35 (3): 539–68.

Cox, Gary W. 2009. "Authoritarian Elections and Leadership Succession, 1975–2004." American Political Science Association 2009 Toronto Meeting Paper. https://ssrn.com/abstract=1449034.

Cruz, Cesi, Philip Keefer, and Carlos Scartascini. 2016. *Database of Political Institutions Codebook, 2015 Update*. Washington, DC: Inter-American Development Bank.

Derby, Lauren. 2009. *The Dictator's Seduction: Politics and the Popular Imagination in the Era of Trujillo*. Durham, NC: Duke University Press.

Ebner, Michael R. 2011. *Ordinary Violence in Mussolini's Italy*. New York: Cambridge University Press.

Edmond, Chris. 2013. "Information Manipulation, Coordination, and Regime Change." *Review of Economic Studies* 80 (4): 1422–58.

Egorov, Georgy, Sergei Guriev, and Konstantin Sonin. 2009. "Why Resource-Poor Dictators Allow Freer Media: A Theory and Evidence from Panel Data." *American Political Science Review* 103 (4): 645–68.

Egorov, Georgy, and Konstantin Sonin. 2011. "Dictators and Their Viziers: Endogenizing The Loyalty-Competence Trade-Off." *Journal of the European Economic Association* 9 (5): 903–30.

Egorov, Georgy, and Konstantin Sonin. 2014. "Incumbency Advantage in Non-democracies." NBER Working Paper 20519.

Elegant, Simon, and Michael Elliott. 2005. "Lee Kuan Yew: The Man Who Saw It All." *Time Magazine*, December 12, 2005. http://content.time.com/time/magazine/article/0,9171,1137707,00.html.

Faiola, Anthony. 1999. "Peruvian Government Targets Critical Media; S. American Nation Ranks with Cuba as a Violator of Basic Press Freedoms." *Washington Post*, July 13, 1999, A14.

Gandhi, Jennifer, and Ellen Lust-Okar. 2009. "Elections under Authoritarianism." *Annual Review of Political Science* 12 (1): 403–22.

Geddes, Barbara, Joseph Wright, and Erica Frantz. 2018. *How Dictatorships Work: Power, Personalization, and Collapse*. New York: Cambridge University Press.

Gehlbach, Scott. 2010 "Reflections on Putin and the Media." *Post-Soviet Affairs* 26 (1): 77–87.

Gehlbach, Scott, and Philip Keefer. 2011. "Investment Without Democracy: Ruling-Party Institutionalization and Credible Commitment in Autocracies." *Journal of Comparative Economics* 39 (2):123–39.

Gehlbach, Scott, and Alberto Simpser. 2015. "Electoral Manipulation as Bureaucratic Control." *American Journal of Political Science* 59 (1): 212–24.

Grimmer, Justin, and Brandon M. Stewart. 2013. "Text as Data: The Promise and Pitfalls of Automatic Content Analysis Methods for Political Texts." *Political Analysis* 21 (3): 267–97.

Guriev, Sergei, and Daniel Treisman. 2017. *Authoritarian Control Techniques Dataset V.1*. UCLA: dataset. https://www.danieltreisman.org/s/Replication.zip.

Guriev, Sergei, and Daniel Treisman. 2018. "Informational Autocracy: Theory and Empirics of Modern Authoritarianism." https://ssrn.com/abstract=2571905.

Howard, Philip N. 2014. "Hungary's Crackdown on the Press." *New York Times*, September 8, 2014. https://www.nytimes.com/2014/09/09/opinion/hungarys-crackdown-on-the-press.html.

Huang, Haifeng. 2015. "Propaganda as Signaling." *Comparative Politics* 47 (4): 419–44.

Hyde, Susan D., and Nikolay Marinov. 2012. "Which Elections Can Be Lost?" *Political Analysis* 20 (2): 191–201.

King, Gary, Jennifer Pan, and Margaret E. Roberts. 2013. "How Censorship in China Allows Government Criticism but Silences Collective Expression." *American Political Science Review* 107 (2): 326–43.

Kornhauser, William. 1960. *The Politics of Mass Society*. New York: Routledge.

Kramer, Andrew E. 2007. "50% Good News Is the Bad News in Russian Radio." *New York Times*, April 22, 2007. https://www.nytimes.com/2007/04/22/world/europe/22russia.html.

Kricheli, Ruth, Yair Livne, and Beatriz Magaloni. 2011. "Taking to the Streets: Theory and Evidence on Protests under Authoritarianism." American Political Science Association 2010 Annual Meeting Paper. https://ssrn.com/abstract=1642040.

Lamb, David. 1987. *The Africans*. New York: Vintage Books.

Linz, Juan J. 2000. *Totalitarian and Authoritarian Regimes*. Boulder, CO: Lynne Rienner.

Little, Andrew. 2016. "Communication Technology and Protest." *Journal of Politics* 78 (1): 152–66.

Lorentzen, Peter. 2014. "China's Strategic Censorship." *American Journal of Political Science* 58 (2): 402–14.

Lucas, Christopher, Richard A. Nielsen, Margaret E. Roberts, Brandon M. Stewart, Alex Storer, and Dustin Tingley. 2015. "Computer-Assisted Text Analysis for Comparative Politics." *Political Analysis* 23 (2): 254–77.

Mao, Zedong. 1964. "Remarks at the Small Group Meeting of the Central Party Work Conference." In *Database for the History of Contemporary Chinese Political Movements*, edited by Song Yongyi.

Cambridge, MA: Fairbank Center for Chinese Studies, Harvard University.

McMillan, John, and Pablo Zoido. 2004. "How to Subvert Democracy: Montesinos in Peru." *Journal of Economic Perspectives* 18 (4): 69–92.

Myerson, Roger B. 2008. "The Autocrat's Credibility Problem and Foundations of the Constitutional State." *American Political Science Review* 102 (1): 125–39.

Noman, Omar. 1989. "Pakistan and General Zia: Era and Legacy." *Third World Quarterly* 11 (1): 28–54.

North, Douglass C., and Barry R. Weingast. 1989. "Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth-Century England." *Journal of Economic History* 49 (4): 803–32.

Pacepa, Ion Mihai. 1990. *Red Horizons: The True Story of Nicolae and Elena Ceausescus' Crimes, Lifestyle, and Corruption*. New York: Regnery.

Pennebaker, James W., Ryan L. Boyd, Kayla Jordan, and Kate Blackburn. 2015. "The Development and Psychometric Properties of LIWC2015." https://repositories.lib.utexas.edu/handle/2152/31333.

Pereira, Brendan. 2000. "Anwar Affair: 'Some Errors in Judgment Were Made.'" *Straits Times*, August 18, 2000, 43.

Preston, Paul. 2003. *The Politics of Revenge: Fascism and the Military in 20th Century Spain*. New York: Routledge.

Qin, Bei, David Strömberg, and Yanhui Wu. 2017. "Why Does China Allow Freer Social Media? Protests versus Surveillance and Propaganda." *Journal of Economic Perspectives* 31 (1): 117–40.

Roberts, Margaret. 2018. *Censored: Distraction and Diversion Inside China's Great Firewall*. Princeton, NJ: Princeton University Press.

Rodan, Garry. 1998. "The Internet and Political Control in Singapore." *Political Science Quarterly* 113 (1): 63–89.

Roucek, Joseph F. 1962. "Yemen in Geopolitics." *Contemporary Review* 202 (1163): 310–17.

Rozenas, Arturas. 2016. "Office Insecurity and Electoral Manipulation." *Journal of Politics* 78 (1): 232–48.

Rozenas, Arturas, and Denis Stukal. 2019. "How Autocrats Manipulate Economic News: Evidence from Russia's State-Controlled Television." *Journal of Politics* 81 (3): 982–96.

Shadmehr, Mehdi, and Dan Bernhardt. 2015. "State Censorship." *American Economic Journal: Microeconomics* 7 (2): 280–307.

Simpser, Alberto. 2013. *Why Governments and Parties Manipulate Elections: Theory, Practice, and Implications*. New York: Cambridge University Press.

Spooner, Mary Helen. 1999. *Soldiers in a Narrow Land: The Pinochet Regime in Chile*. Berkeley: University of California Press.

Svolik, Milan W. 2012. *The Politics of Authoritarian Rule*. New York: Cambridge University Press.

Sutton, Jonathan, Charles R. Butcher, and Isak Svensson. 2014. "Explaining Political Jiu-Jitsu: Institution-Building and the Outcomes of Regime Violence against Unarmed Protests." *Journal of Peace Research* 51 (5): 559–73.

Treisman, Daniel. 2015. "Income, Democracy, and Leader Turnover." *American Journal of Political Science* 59 (4): 927–42.

Ulfelder, Jay. 2015. "It's Getting Better All the Time." *Foreign Policy*, November 24, 2015. http://foreignpolicy.com/2015/11/24/its-getting-better-all-the-time-human-rights/.

Ulfelder, Jay, and Benjamin Valentino. 2008. "Assessing Risks of State-Sponsored Mass Killing." http://ssrn.com/abstract=1703426.

Wintrobe, Ronald. 1990. "The Tinpot and the Totalitarian: An Economic Theory of Dictatorship." *American Political Science Review* 84 (3): 849–72.

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The Surge of Economic Nationalism in Western Europe

Italo Colantone and Piero Stanig

The populist parties and candidates who have experienced a wave of success across Western democracies in the past few years share a broad political narrative: they are against the establishment and claim to speak for the people against the elites. However, the populists are quite heterogeneous in their policy proposals. Their economic recipes range from extreme-left pro-redistribution platforms to rather conservative ones. From an economic perspective, then, it is rather difficult—and arguably not so useful—to identify a single populist platform. In his seminal work, Mudde (2004) has defined populism as no more than a "thin-centered ideology," based on the opposition between "pure people" and "corrupt elites," without a coherent political agenda. According to Bonikowski (2016), we should not even think about populism as an ideology, but rather as a "discursive frame" through which different substantive ideological positions can be expressed.

When looking deeper into the populist wave of western Europe, the surge of radical-right parties emerges as a main development. A common characteristic of these parties, when it comes to substantive policy proposals, is a political platform centered on "economic nationalism." This platform combines conservative economic proposals with nationalist stances on international trade and cooperation, as well as on immigration. While this platform is typical of radical-right parties,

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it gets proposed in various forms by other parties as well. Economic nationalism was already on the rise from the early 1990s, and it has been at the core of euroskeptic campaigns such as Brexit. Understanding the root economic causes of its success and reflecting on the possible future political developments in Europe are the main aims of this article.

We begin by describing "embedded liberalism" (Ruggie 1982), a broad term meant to convey the social contract underlying the success of mainstream political parties in Western democracies in the decades after World War II. This contract was based on the promise that liberal policies would generate a sustained and diffused improvement in living standards for a large fraction of the population. The crisis of this model from the 1990s onward provides us with a general framework for understanding the rise of antiestablishment forces in western Europe. We document these dynamics on the basis of election data. Our focus is on parties promoting economic nationalism, but we also discuss related movements such as the rise of isolationist parties of the left.

We then turn to discussing how economic shocks drive the observed political shifts, looking in turn at theory and evidence on the political effects of globalization, technological change, and the financial and sovereign debt crises that rocked Europe in 2008–2009 and 2011–2013, along with immigration. We highlight the parallels between these recent trends and historical episodes of economic dynamics leading to political turmoil, especially with reference to the rise of nationalism in advanced countries in the early decades of the twentieth century. We discuss how the economic explanations compete with and complement the "cultural backlash" view. We close the article by reflecting on possible future developments. The mixture of economic structural changes may shift, perhaps with less disruption coming from rising globalization but more coming from automation. A lot will depend on how well governments succeed at addressing the distributional consequences of economic changes. In addition, changes on the supply side of politics will play an important role. If traditional mainstream parties, or new forces, are able to assemble social coalitions in favor of inclusive progress and open societies, we might observe a setback of the nationalists in the coming years.

Economic Nationalism in Western Europe

The concept of "embedded liberalism" was introduced by Ruggie (1982) to characterize the international economic order that emerged from the end of World War II in Western democracies. Postwar trade liberalization and multilateralism were coupled with policies aimed at promoting domestic economic growth, and with measures designed to buffer the domestic economy from external shocks and minimize their social costs. Consistent with this line of argument, both Cameron (1978) and Rodrik (1998) found evidence of higher public spending in countries characterized by higher openness.

In western Europe, the decades from the 1950s onward saw embedded liberalism play out through the creation of a customs union and a gradual movement toward what became the European single market and its guarantee of four "fundamental freedoms": the free movement of goods, capital, services, and labor across member states. This process of economic integration led to the launch of the Economic and Monetary Union in 1992, followed by the introduction of the euro as a single currency in 1999. In a half century, a growing group of independent European countries reached a level of economic integration and political cooperation that was unthinkable for previous generations. At the same time, the European bloc was an active driver of globalization, both at the multilateral level—within the General Agreement on Tariffs and Trade and the World Trade Organization negotiations—and through regional trade agreements.

In line with the idea of embedded liberalism, economic liberalization in Europe was associated with the development of generous welfare state systems. This combination of "liberal" economic policies and universal welfare provisions constitutes the core of the traditional European "social market economy" model. The sustained economic growth obtained after World War II produced diffused benefits in society and widespread political support. This was channeled through votes for mainstream parties on both the left and the right sides of the political spectrum. While relying on a somewhat different policy mix—with less public welfare and more measures to promote a dynamic labor market with sustained wage growth—the United States achieved a comparable level of prosperity for a broad middle class, while containing income inequality.

However, the sustainability of the embedded liberalism model had started to become problematic in the 1990s, bursting into a full-blown crisis from the Great Recession onward. There has been declining confidence both that governments are providing policies that generate economic growth and that government policies are providing sufficient cushion against the forces of structural economic change. The increase in income inequality observed in many countries undermined the credibility of the idea that the liberal model promoted by mainstream parties would produce a generalized improvement in economic conditions, thus breaking the promise underlying the social contract of embedded liberalism.

The result has been a shift to "economic nationalism," which is a policy platform bundling together three key elements: (1) isolationism; (2) economic conservatism; and (3) a nationalist narrative, which is often centered on the goal of "taking back control" of the country (Colantone and Stanig 2018c).

In western Europe, the three key elements of economic nationalism are expressed with different nuances, and mixed in various degrees by different parties. Isolationism in international matters includes protectionist stances on international trade and investment, as well as opposition to multilateralism and supranational institutions, like the European Union, the World Trade Organization, and the United Nations. Economic conservatism involves calls for lower income taxes, scant reliance on redistribution, and a skeptical attitude regarding the welfare state. While isolationism is meant to appeal to the working class threatened by

globalization, economic conservatism is more appealing to the middle class. A nationalist narrative—the third key element of the bundle—then binds together these heterogeneous constituencies. This narrative involves appeals to national sovereignty, as well as the defense of traditional morality, cultural homogeneity, and the national way of life. To understand the importance of nationalist rhetoric, one should consider that trade policy is not, in general, a topic that can easily stir political passions if addressed in neutral, technical terms. In order to be a politically viable strategy, protectionism is therefore often cast in terms of national pride and self-sufficiency.

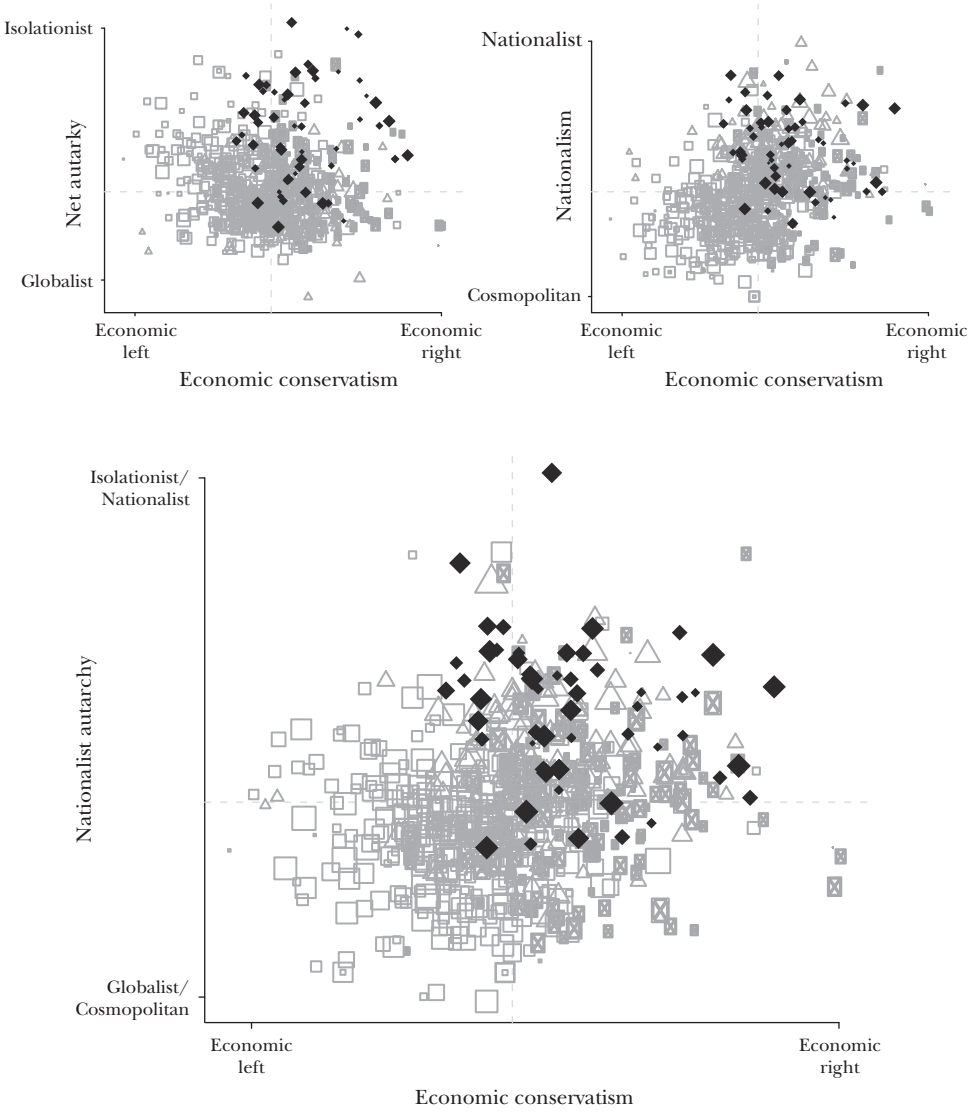
To illustrate further the concept of economic nationalism, the parties that are supplying such a policy bundle, and their increasing success over time, we proceed by discussing two figures. Figure 1 displays the ideological position of political parties in 15 western European countries, in the years between 1985 and 2015. The figure contains three plots exploiting four different ideology scores, which are meant to capture the key elements of economic nationalism. Each point in the figure corresponds to one party in one election. The ideology scores are based on data from the Manifesto Project (Volkens et al. 2018), which provides information on the number of claims on an array of different issues in party programs. We compute party scores combining these data using the methodology by Lowe et al. (2011).

The variable considered on the horizontal axis is always the degree of economic conservatism of the party. This score reflects the classical left-right divide on domestic economic issues. Specifically, it summarizes the manifesto stances in favor of or against redistribution and the welfare state, trade unions, Keynesian demand management policies, and regulation of economic activity. Higher scores correspond to more conservative positions, located on the right side of each graph.

The variable on the vertical axis changes across the three plots. In the first one, we consider the net autarky score, which takes into account claims about protectionism and opposition to the European Union and to multilateralism in general (Burgoon 2009). In the second plot, we consider the nationalism score, which captures the nationalist rhetoric in terms of appeals to national sovereignty and opposition to multiculturalism (Colantone and Stanig 2018c). Finally, in the third plot, we employ a comprehensive score called nationalist autarchy, which combines the policy items included in the nationalism and in the net autarky scores. The latter measure was originally proposed by Burgoon (2009), and it is the most comprehensive among those we use in our own work (Colantone and Stanig 2018c). In all plots, higher scores reflect more isolationist and nationalist positions, placed in the upper part of each graph. The dashed lines split the plots into four quadrants, according to the median positions on each policy dimension.

Triangles refer to Christian-democratic parties, usually found on the economic center-right. Squares are communist, socialist, and green parties, typically found on the economic left. Hollow dots are conservative and liberal parties, typically found on the economic right. The allocation of parties to these groups is based on the party families coding in the Manifesto Project. Finally, solid diamonds are radical-right parties, identified on the basis of a number of contributions in the

Figure 1
Policy Bundles and Parties in Western Europe



Source: Authors' elaboration based on Manifesto Project data (Volkens et al. 2018).
Note: Each data point is one party in one election between 1985 and 2015. Triangles refer to Christian-democratic parties; squares are communist, socialist, and green parties; hollow dots are liberal and conservative parties; solid diamonds are radical-right parties. The size of each symbol is proportional to (log) national vote share. The list of countries considered in the figure includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom (as in Colantone and Stanig 2018c). The group of radical-right parties includes the FPÖ and the Team Frank Stronach in Austria; the Vlaams Blok and the Vlaams Belang in Belgium; the True Finns in Finland; the Front National in France; Golden Dawn and LAOS in Greece; the Alternative für Deutschland, the NPD, and Die Republikaner in Germany; the Northern League in Italy; the PVV and the List Fortuyn in the Netherlands; the Sweden Democrats in Sweden; the AN/NA, the Swiss Democrats, the Swiss People's Party, and the Freedom Party of Switzerland in Switzerland; and the UKIP in the United Kingdom.

political science literature. In general, this literature classifies parties as radical right if they have the following characteristics: (1) radicalism, meant as a criticism of the established order, in particular of liberal democracy and its system of institutional checks on the will of the majority; (2) exclusionary nationalism and nativism; and (3) populism, expressed as a rejection of both liberal pluralism (which accepts the presence of unsolvable differences of opinion within society) and elitism (Golder 2016). As Rydgren (2007, 242) remarks, while some disagreement exists in the literature regarding the necessary elements to be classified within the radical right, there is "near consensus on which parties should be included in the party family." On the basis of this conventional wisdom (for example, Mudde 2013; Rooduijn et al. 2017), we include in the radical-right group the following 20 parties: the FPÖ and the Team Frank Stronach in Austria; the Vlaams Blok and the Vlaams Belang in Belgium; the True Finns in Finland; the Front National in France; Golden Dawn and LAOS in Greece; the Alternative für Deutschland, the NPD, and Die Republikaner in Germany; the Northern League in Italy; the PVV and the List Fortuyn in the Netherlands; the Sweden Democrats in Sweden; the AN/NA, the Swiss Democrats, the Swiss People's Party, and the Freedom Party of Switzerland in Switzerland; and the UKIP in the United Kingdom.

When we look at the first plot, two important messages emerge. First, parties can be pro-market when it comes to domestic economic issues, as signaled by relatively high economic conservatism scores, while at the same time being isolationist and protectionist in terms of trade and international relations. Second, radical-right parties tend to follow this pattern. Indeed, most of them, as identified by the solid diamonds in the figure, sit in the top-right quadrant. The evidence is similar when we consider the second plot, which has nationalism on the vertical axis.

Both ideology dimensions are then combined in the third panel, through the nationalist autarchy score, which, along with economic conservatism, allows us to obtain a comprehensive measure of economic nationalism. Parties sitting in the top-right quadrant are identified as proponents of economic nationalist platforms, combining in various degrees economic conservatism with nationalism and isolationism. Two decades ago, a seminal book identified this combination of policy proposals as the "winning formula" of the radical right (Kitschelt and McGann 1997). Indeed, most radical-right parties are found in the top-right quadrant. Yet a substantial number of economic nationalist parties are not classified as radical right but rather as Christian-democratic (triangles) or conservative (circles). As it is plausible to expect, there is ideological heterogeneity within all party families. For instance, many parties commonly classified as radical right lie near the center of the diagram, and some of them even sit slightly to the left of the median. A paradigmatic example is provided by the True Finns in Finland, who are known for supporting a generous welfare state, even though they propose to restrict welfare access strictly to natives.

In what follows, we refer to the top-right quadrant of the third plot as the economic nationalist area. The top-left quadrant identifies the isolationist left. The bottom-left quadrant corresponds to the pro-trade and internationalist left, while

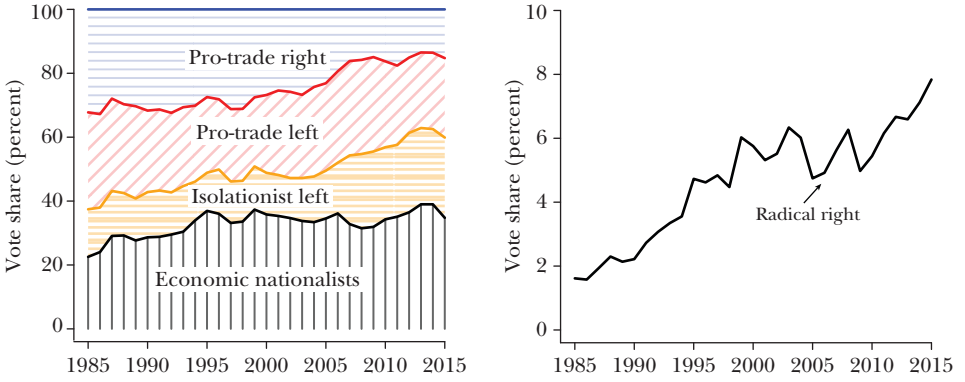
the bottom-right area contains the pro-trade and internationalist right. The left panel of Figure 2 displays performance over time for these four party groups. We first compute the total vote share for each group at the national level in all legislative elections based on Manifesto Project data (Volkens et al. 2018). Then, we take the average across all elections taking place in a given year. Countries do not hold legislative elections every year, so part of the year-to-year variation is driven by compositional effects. To avoid overstating the variability due to these compositional effects, we display the ten-year rolling mean of the vote shares for each group. For instance, the value for 1985 is the average of vote shares between 1976 and 1985. By following this procedure, we include, on average, two elections per country for each data point we display. This procedure is conservative, and to an extent, it understates the time trends. The lines in the plot show cumulative vote shares for the four party groups, in this bottom-up order: economic nationalists, isolationist left, pro-trade left, and pro-trade right.[1] To illustrate, the black line in the plot displays the vote share for economic nationalist parties; the distance between the yellow line and the black line gives the vote share for the isolationist left, and so on up until 100 percent of votes cast. The right panel of Figure 2 displays the vote share for the 20 parties classified as radical right, using the same moving average approach described above.

Taken together, the two panels display a remarkable increase in support for the economic nationalist camp in general, and for radical-right parties in particular. There is also a substantial rise for the isolationist left later in the sample, particularly during and after the years of the Great Recession and the euro crisis. These parties support pro-redistribution policies and state intervention in the economy, while also displaying isolationist (chiefly, anti-EU) elements in their platforms. Many of these parties are what one might have in mind when discussing "left-wing populism" in Europe. The most successful are from crisis-plagued southern Europe: for example, the Five Star Movement in Italy, Podemos in Spain, and Syriza in Greece. Overall, the two isolationist/nationalist categories rise from less than 40 percent of the total vote in 1985 to almost 60 percent of the total vote in 2015. This is a remarkable change in the European political landscape.

In the sections that follow, we discuss the theory and evidence of how globalization, technology, Europe's two recent economic and financial crises, and immigration contribute to explain these shifts in political behavior. One interesting pattern that emerges is that structural shocks such as globalization and automation are strong factors behind the growth of economic nationalist and radical-right parties, while they have no effect on increasing support for the isolationist left. In other words, not only are different populist and antiestablishment parties very heterogeneous in their policy proposals, but the economic factors behind their success also seem to be rather diverse.

[1] Some minor parties are not included in the Manifesto Project data collection and thus are not attributable to any of the four families. On average, excluded parties account for about 3.7 percent of votes cast. The vote shares of the classifiable parties are normalized to sum to 100.

Figure 2
Electoral Dynamics by Party Groups



Source: Authors' elaboration based on Manifesto Project data (Volkens et al. 2018).
Note: The left panel displays the cumulative vote share of economic nationalists (black line), plus the isolationist left (yellow line), plus the pro-trade left (red line), plus the pro-trade right (blue line). The lines display ten-year moving averages of vote shares by ideological group in the 15 countries in our analysis. The right panel shows the evolution of support for the radical-right family. The line displays the ten-year moving average of the vote share for the 20 parties classified as radical right.

Globalization

Globalization creates winners and losers. The canonical example of losers from globalization are those workers who lose their jobs because their company is outcompeted by foreign imports. Such job losses can be part of a process leading to aggregate welfare gains, but nonetheless, they can bring painful adjustment costs. From a political perspective, structural changes generating aggregate gains with winners and losers could spur two types of reaction: (1) a demand for compensation and redistribution or (2) a quest for restoration of the earlier status quo. From the 1990s onward, western European countries seem to have made a transition from the first to the second scenario.

Part of the reason for this change is that, over the past three decades, these countries have been exposed to stronger trade shocks, such as the surge of China and other emerging economies as leading global exporters. These shocks have hit disproportionately the social segments of low-wage and low-skilled workers and have generated persistent employment and income losses that are concentrated in import-competing regions.

In addition, as earlier noticed by Rodrik (1997) and Hays (2009), governments became increasingly ineffective at delivering offsetting policies of compensation and redistribution. The gains of the "winners" do not seem to translate into additional public resources sufficient to finance a revamp of the welfare state and massive investments in education. To a nonnegligible extent, this is also due to deepening

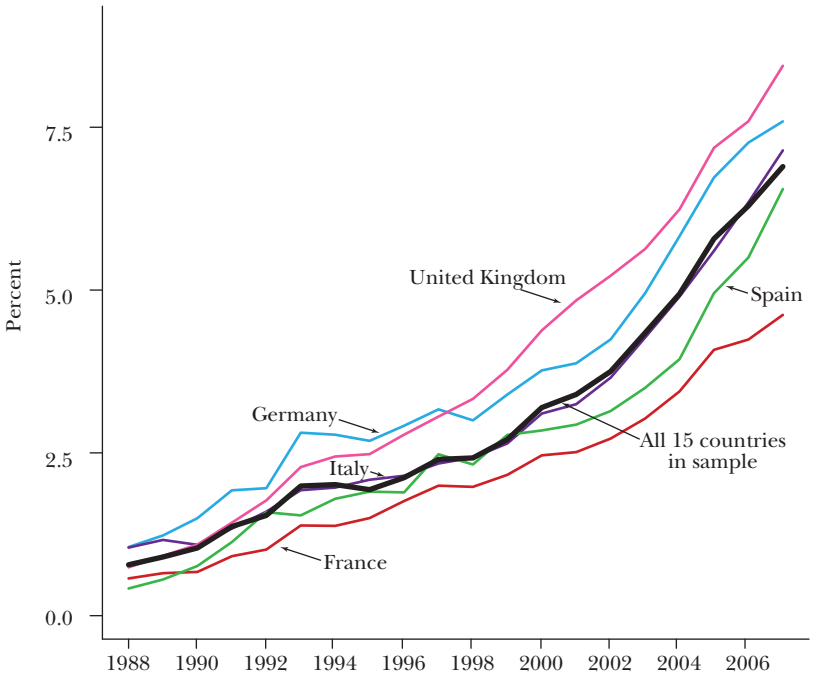
globalization, since the liberalization of factor markets made it increasingly difficult for national governments to raise tax revenues from top earners and multinational companies. Focusing on a large sample of 65 countries, Egger, Nigai, and Strecker (2019) find that between 1994 and 2007 there has been a globalization-induced rise in the labor-income tax burden of the middle class, while the top 1 percent of workers and employees witnessed a reduction. In parallel, there has been a decline in corporate taxes, and profit-shifting practices to tax havens have soared. According to Tørlsøv, Wier, and Zucman (2018), non-tax-haven EU countries actually appear to be among the largest losers from corporate profit-shifting in the world.

In such a situation, it has become very hard for mainstream parties to sell the idea that globalization works for all. Plenty of voters have seen companies in their communities shutting down or offshoring activities to low-wage countries. Entire manufacturing regions have lost prosperity over time. All this provides fertile ground for the electoral success of parties promising protectionism. As Frieden (2017) notes, the dissatisfaction with mainstream parties stems not only from *failures of compensation*, but also from *failures of representation*, as a large fraction of voters feel that their problems have not been adequately understood and considered, let alone addressed.

Here, we focus in particular on the political implications of what has become known as the "China shock"—that is, the surge in Chinese exports from the end of the 1980s onward as China became one of the leading global economic players. In their seminal work, Autor, Dorn, and Hanson (2013) highlight the negative effects of the China shock on the US economy due to the displacement of domestic manufacturing. In particular, they find that a stronger exposure to Chinese competition causes lower employment rates and lower wages at the level of local labor markets. Moreover, at the individual level, the shock has stronger implications for low-wage workers, who face more job churning and higher earning losses (Autor et al. 2014; Chetverikov, Larsen, and Palmer 2016). Similar evidence of displacement induced by China has also been found in Europe (for example, Utar 2014, 2018; Bloom, Draca, and Van Reenen 2016), in line with theoretical predictions on the effects of trade integration between rich capital-abundant countries and an emerging labor-abundant economy such as China.

Figure 3 shows the sharp growth in the share of overall imports to western Europe accounted for by China, between 1988 and 2007. The thick black line considers jointly the 15 countries in our sample: the Chinese share of imports grows from less than 1 percent to about 7 percent, with an acceleration following China's accession to the World Trade Organization in 2001. This growth is even more remarkable if one takes into account the fact that overall imports in Europe were more than doubling in real terms at the same time. The import patterns are very similar across countries, as can be seen for the five major economies in the figure, and they are also very close to what has been shown for the United States (Autor, Dorn, and Hanson 2013). This is in line with the idea that the surge in Chinese imports is predominantly driven by supply-side changes in China, rather than by domestic factors specific to any Western country.

Figure 3
The China Shock in Western Europe
(imports from China as a share of total imports)



Source: Authors' elaboration based on Eurostat Comext and CEPII-BACI data.
Note: The thick black line displays the ratio between imports from China and total manufacturing imports within the 15 countries of our sample, jointly considered. The thin colored lines single out the same ratio for the five major western European economies: France, Germany, Italy, Spain, and the United Kingdom.

In Colantone and Stanig (2018c), we study the effects of the China shock on electoral outcomes across 15 western European countries, focusing on elections taking place between 1990 and 2007.[2] This time span covers the bulk of the shock, from the start until the peak before the Great Recession and the resulting sharp fall in global trade. We measure the regional exposure to the China shock using the official classification of territorial units of the European Union, which is called the Nomenclature of Territorial Units for Statistics, or NUTS. In particular, we focus on the NUTS-2 level of disaggregation, which refers to regions with a population between 800,000 and 3 million.

[2]The list of western European countries is the same as in Figure 1.

We follow the methodology developed by Autor, Dorn, and Hanson (2013), which builds upon a straightforward intuition: regions are exposed to Chinese imports to a higher or lower extent depending upon their pre-shock industry specialization. In particular, for a given growth in Chinese imports within a certain country, industry, and year, the implied shock is stronger in the regions of the country where a higher share of workers were initially employed in industries witnessing faster import growth. Essentially, this methodology assigns stronger shocks to regions that were historically specialized in labor-intensive manufacturing industries where China's relevance has grown the most over time, such as textiles and electronics.

To study the political consequences of the China shock in Europe, we use district-level data on 76 legislative elections. Data are sourced from the Constituency-Level Elections Archive (Kollman et al. 2016) and the Global Elections Database (Brancati 2016). For each district, in each election, we know the vote share for each party. These data are matched with information on party ideology calculated from the Manifesto Project. We then obtain measures of the ideological leaning of each district in each election. For example, we compute a nationalism score by taking a weighted average of the nationalism score of each party, where the weights correspond to the party vote shares in the district. Alternatively, we compute the vote shares for families of parties sharing similar ideological positioning—such as the overall vote share for radical-right parties. To study the effects of globalization on political outcomes, we then regress these electoral variables at the district level against the China shock in the region where each district is located. The shock is measured over two years prior to each election. The idea is to capture the growth in import pressure that is due to exogenous changes in supply conditions in China, rather than to any domestic factors in Europe. Thus, we employ an instrumental variable obtained by exploiting the growth in Chinese imports in the United States instead of each European country (again in the spirit of Autor, Dorn, and Hanson 2013).

We find that a stronger exposure to the China shock causes: (1) an increase in support for nationalist and isolationist parties, (2) an increase in support for radical-right parties, and (3) a general shift to the right in the electorate. These findings are confirmed when we use individual-level data on voting behavior from the European Social Survey, attributing to each respondent the import competition shock experienced by the region of residence. In addition, the individual data allow us to investigate whether the impact of the shock varies systematically across different groups of voters. We find that the effect of the China shock reaches beyond the categories of individuals who are more likely to be directly exposed, such as the unemployed or manufacturing workers. Even service workers or public sector workers, who are in principle more sheltered from a manufacturing trade shock, seem to react with their voting behavior in a similar way.

Overall, our evidence suggests that citizens respond to a decline in the economic conditions of their community beyond any direct personal distress; in other words, the shift in electoral results seems to reflect a community-level reaction. This evidence resonates with the media narrative of the "left-behind" areas of

globalization, where people vote to oppose the perceived erosion of the prosperity of their region.

How persistent are these effects? The evidence discussed so far has mainly a short-run horizon, as it focuses on the link between electoral results and the growth in imports just before each election. In Colantone and Stanig (2018a), we take a longer-run approach to study the effect of the China shock on the Brexit referendum. In particular, we measure the cumulative import shock for each region of the United Kingdom between 1989 and 2007. We find that this has a strong positive impact on the Leave vote share in the referendum of 2016, almost ten years later. During these years, regions that were more exposed to the China shock had been falling behind in terms of GDP per capita, not only with respect to the richest region of the country (London), but also compared with the median region. This evidence suggests that the adjustment process has not been effective enough, resulting in persistent, and politically consequential, economic decline.

Our findings are in line with those of Autor, Dorn, and Hanson (2016) for the United States. As they point out, the economic decline of affected areas has extended for over a decade, and many workers have experienced permanent negative effects. Overall, this displacement might take a generation to readjust. These results also resonate with the work of Moretti (2012) on the new geography of US jobs and the increasing divergence in performance across different areas of the country, of which globalization seems to be an important driver.

A wide array of empirical research has linked the dislocations from globalization to political support for nationalist and radical-right parties. For readers interested in investigating this area, other useful starting points include Dippel, Heblich, and Gold (2015) on Germany, Malgouyres (2014) on France, and Guiso et al. (2017) on cross-country European data. With regard to US politics, evidence on the role of trade in voting patterns has been provided by Autor et al. (2016), Che et al. (2016), Margalit (2011), and Jensen, Quinn, and Weymouth (2017). Some historical literature also suggests that the first wave of globalization, which ended with the start of World War I, generated distributional implications that triggered a nationalist backlash (James 2002; Franzese 2019).

Technological Change

The economic and political effects of globalization have been paralleled and compounded by those of technological progress, which is another phenomenon generating winners and losers (at least in relative terms). Technological innovation creates new opportunities for workers who are endowed with skills that are complementary to technology, but it also replaces jobs and feeds generalized fears of technological unemployment.

In particular, as reviewed in this journal by Autor (2015), the information technology revolution, with its widespread adoption of computer-based technologies from the 1980s onward, has led to increasing polarization of the labor market both

in the United States and in Europe. Job polarization entails a decrease in the relative number of routine middle-income jobs, leading to a growing share of nonroutine jobs at the two ends of the income distribution: either of the cognitive, high-income type or of the manual, low-income type. In terms of wages, the main winners of computerization have been the high-skilled workers in cognitive occupations. Their incomes have been diverging from those of the middle class, which has been falling closer to the group of low-skilled and low-income workers.

A recent major development in computer-based technologies has been the diffusion of mobile robotics, which allows automation not only of routine tasks but also of a growing set of nonroutine tasks. These involve assembly-line operations at manufacturing plants, but also logistic services, transportation, maintenance, demolition, and construction (Frey and Osborne 2017). According to micro data from the International Federation of Robotics, the adoption of industrial robots worldwide has grown exponentially from the mid-1990s, in what is often referred to as the "robot shock."

A rapidly expanding literature investigates the economic effects of robot adoption. Acemoglu and Restrepo (2018) show that US regions that have been relatively more exposed to automation have experienced net employment losses and relative wage declines, especially concentrated in the bottom half of the wage distribution. These results are akin to those obtained by Autor, Dorn, and Hanson (2013) on the China shock. Similar findings have been obtained for Europe by Chiacchio, Petropoulos, and Pichler (2018). Graetz and Michaels (2018), on a larger sample of countries, find that robot adoption has a positive effect on productivity but a negative impact on the share of hours worked by low-skilled workers. Dauth et al. (2018), using German data, find a negative effect of robot adoption on manufacturing employment, although with offsetting gains in the services sector. At the same time, wage inequality increases, as automation benefits managers and high-skilled workers performing abstract tasks, while low- and medium-skilled workers see their earnings decrease.

Our focus is on how technological change may affect electoral outcomes. In Anelli, Colantone, and Stanig (2019), we study the political implications of automation across western European countries between 1993 and 2016. Exposure to robot adoption is measured in two different ways. At the regional level, we follow Acemoglu and Restrepo (2018), combining data on the pre-sample distribution of employment, by industry, with year-specific data on robot adoption in each industry. At the level of individuals, we measure exposure to automation by using the predicted probabilities of employment in each occupation, estimated according to individual characteristics such as age, gender, and education as well as the historical employment patterns in the region of residence. Such probabilities are then combined with the propensity of automation of each occupation, obtained from various sources, to compute an individual measure of vulnerability to automation. Intuitively, higher vulnerability scores are assigned to individuals whose characteristics would have made them more likely, in the past, to be employed in occupations that are more at risk of automation. The individual vulnerability measure is then interacted with the country-specific speed of robot adoption before each election.

In whatever way we measure exposure to automation, the implications are similar to those of the China shock. That is, a higher exposure to robot adoption pushes voters toward nationalist and radical-right parties and away from mainstream parties on both the left and right sides of the political spectrum. The results on automation are robust to controlling for the China shock. However, it is worth noting that there may be an interaction between these two phenomena, for instance because an import shock can provide an incentive to invest in robots.

Our evidence aligns with other recent contributions to the literature. Focusing on eleven European countries, Im et al. (2019) find that individuals employed in occupations at higher risk of automation are more likely to vote for radical-right parties. Looking at Sweden, Dal Bò et al. (2018) find that the share of automation-vulnerable workers in a municipality is positively associated with support for the Sweden Democrats radical-right party. Evidence in the same direction has been found for the United States. Specifically, focusing on the 2016 US presidential election, Frey, Berger, and Chen (2018) find that higher exposure to robot adoption, at the regional level, led to higher support for Donald Trump, who was running on an economic nationalist political platform that has many points of contact with the European radical right.

In light of the analysis of the political effects of globalization and technological change, the increasing support for nationalist and radical-right parties might not simply be the reflection of an ephemeral "protest vote." Instead, the counterpositioning of winners and losers from these forms of structural economic change has created a new political cleavage that might last a long time, as presciently observed by Kriesi (1998). Along this new dividing line, the coalition of losers is backing parties of the economic nationalist and radical-right type, while the winners keep supporting mainstream and proglobalization parties on both sides of the political spectrum. This insight helps to explain why political arenas across many countries of western Europe are almost unrecognizable compared with the situation just two decades ago, with mainstream parties shrinking and nationalist parties becoming main contenders for control of the government.

Future work might investigate the mechanisms by which these economic shocks translate into higher support for nationalist and radical-right parties. We propose three mechanisms that are not mutually exclusive. First, people may react to perceived economic hardship by voting against the incumbent elites. Such a vote can be cast even in "blind retrospection" (Achen and Bartels 2016); that is, people may vote against the elites without necessarily understanding either the root causes of their economic distress or whether the nationalist proposals would actually help. Second, people may feel they are voting to take back control of the country, against external powers like the European Union that are perceived as exerting a negative influence on the domestic economy. Finally, a nationalist vote in response to economic hardship can also be conceived and interpreted as a vote against immigration, which is perceived more as a problem in a situation of economic distress. We address this issue more extensively below.

The Two European Recessions

In western Europe, the Great Recession of 2008–2009 started as a financial crisis. Then, after a brief recovery, it was followed by a recession over 2011–2013 driven by the sovereign debt crisis. These macroeconomic shocks may have played a role in the observed political backlash through various mechanisms.

First, the crises exposed several European governments to a risk of default, which essentially happened in the Greek case. As a response, tougher fiscal discipline has been enforced, which in turn has hampered the ability of governments to spend on welfare state and redistribution policies. This has exacerbated the failure of compensation of previous years, at a time when citizens were facing even more adverse economic conditions than before. The result has been a further loss of credibility for the embedded liberalism social contract.

Moreover, several aspects of how these economic crises unfolded and how they were addressed helped to feed a strongly antiestablishment and euroskeptic refrain. Many private banks were rescued using taxpayers' money, thus reinforcing the view that governments were not really defending the interests of the people, but rather were defending those of big banks and multinational corporations. Moreover, national-level austerity policies have been imposed by the EU institutions. Thus, nationalist parties have found it straightforward to capitalize on the mounting euroskeptic sentiment, depicting the European Union as a technocratic body of unelected officials who impose unnecessary sacrifices on people.

However, the crisis has fostered nationalist and euroskeptic parties not only in distressed countries of southern Europe but also in northern European countries such as Germany, for symmetric reasons related to a fundamental lack of trust. While citizens in southern Europe rejected the idea of imposed austerity policies emanating from Berlin through Brussels, taxpayers in northern Europe thought that their governments were being too generous and feared that they would end up paying for the debts of profligate southerners. Despite the opposite perspectives and motivations, the result has been a cross-country decline in support for traditional pro-European parties and a parallel growth of euroskeptic forces, both on the left and on the right side of the political spectrum, as documented by Hernández and Kriesi (2016), Algan et al. (2017), and Frieden and Walter (2017).

There is a growing literature on the political effects of the recent crisis and austerity policies. In the Colantone and Stanig (2018a) study on Brexit, mentioned above, we find a positive association between exposure to UK fiscal cuts after 2010 and support for the Leave option. There seems also to be a positive interaction between the strength of the China shock pre-crisis and subsequent fiscal cuts in affecting support for Brexit. In another study focused on the United Kingdom, Fetzer (forthcoming) exploits both regional and individual data on exposure to austerity, finding a positive effect on support for the UKIP radical-right party and for the Leave vote in the Brexit referendum.

Along similar lines, Dal Bó et al. (2018) study the remarkable growth of the Sweden Democrats over the past 15 years. They find this electoral success to be

related to the widening gap in the labor market between secure insiders on the one hand and outsiders and vulnerable insiders on the other. In turn, this dynamic is related to recent cuts in the welfare state and to the effects of the financial crisis, which have increased income inequality in Sweden. In a comprehensive study on the European Union, Guiso et al. (2019) find that exposure to the China shock and to the financial crisis raises support for populist parties to a larger extent in countries that belong to the eurozone. Their intuition is that the constraints to policymaking implied by EU membership and single currency amplify the frustration of voters with respect to the incumbents.

Findings on the political implications of the Great Recession are consistent with the historical literature on recessions. In particular, de Bromhead, Eichengreen, and O'Rourke (2013) provide evidence on the rise of radical-right parties in Europe in the 1920s and 1930s, as linked to the Great Depression. Over a longer time horizon, from 1870 to 2014, Funke, Schularick, and Trebesch (2016) find a positive and distinctive effect of financial crises on extreme-right support.

It is not the purpose of this article to assess whether the double-dip recession could have been managed in a better way at the EU level (our answer is "probably yes"), or whether the fiscal policies enforced by the EU institutions have been fully appropriate (our answer is "probably no"). Our focus here is on the political implications, where people's perceptions matter even beyond the actual merit of policies (Hobolt and de Vries 2016). From this point of view, the European Union represents what Rodrik (2018) would call a "liberal technocracy," where economic decisions are taken at a level that is perceived as too distant from the national democratic process. Mounk (2018) highlights that such a disconnect is potentially dangerous for democracy, as citizens may get the feeling that their vote does not make any difference. Yet we should also keep in mind that within a club of independent countries such as the European Union, where the actions of each member can generate spillovers on the others, certain fiscal rules are necessary to preserve trust. Striking a balance between perceived representativeness and the preservation of a credible rules-based system will be a key challenge for the European Union in the coming years.

Immigration

Restrictive stances on immigration, often with ethnic, nativist, or racial undertones, are typically at the core of the manifestos of radical-right parties. A substantial fraction of voters supporting these parties declare that they are doing so because of concerns about immigration (Rydgren 2008).

The past two decades have seen an increase in immigration inflows in western Europe. One set of substantial inflows arrived from the new central and eastern countries of the European Union, which acceded between 2004 and 2007. These inflows have been paralleled by sustained immigration from other areas, especially North Africa and the Middle East region. In particular, after 2010, geopolitical

instability in this area, with events such as the Arab Spring and the Libyan crisis, has fueled immigration even further. The inflow of economic migrants has been compounded by a large number of refugees, especially from war-plagued Syria. The refugee crisis has been particularly visible in the media and has generated widespread concerns that immigration was rising out of control.

Immigration might affect electoral outcomes in a number of ways, whether via the economic impact of immigrants or through the cultural and identitarian issues posed by a growing foreign-born population. We regard immigration not as a first-order economic determinant of electoral outcomes, but rather as a visible catalyst for the political consequences of the economic distress driven by structural changes such as globalization and technological progress.

The evidence on the overall direct economic effects of immigration, in terms of natives' employment and wages, suggests that these effects tend to be very small, and on average positive (in this journal, Peri 2016). Public opinion research consistently finds that direct competition with immigrants on the labor market is not an important predictor of anti-immigration sentiments. Instead, anti-immigrant views are mostly driven by generalized fears of potential economic or social harm caused by immigration, perceived as a threat to national culture (Hainmueller and Hopkins 2014). Cultural distance from newcomers is documented to have played a major role in fostering anti-immigrant sentiments during the Age of Mass Migration to the United States (Tabellini forthcoming). More recently, cultural concerns might also explain why refugee allocation increases support for nativist parties in rural settings, while possibly reducing it in the largest urban contexts of Sweden (Dustmann, Vasiljeva, and Damm 2019).

Empirical evidence suggests that economic hardship of different origin may be a more important predictor of anti-immigration sentiments than the actual presence of immigrants in a region. As one vivid example, immigration was one of the single most important issues motivating Leave voters in the Brexit referendum of 2016 (Ashcroft 2016; Ipsos MORI 2016). Yet there is no robust evidence of higher Leave vote shares in regions where a larger fraction of the population is foreign born, or where relatively more immigrants arrived in the years prior to the referendum (Colantone and Stanig 2018a). Consistently, our own empirical evidence shows that negative attitudes about immigration at the individual level are driven not by the share of foreign-born population in the region of residence, nor by the recent arrival rates of immigrants. Rather, what seems to explain nativist attitudes is contextual economic distress—for instance, driven by the exposure to the Chinese import shock (Colantone and Stanig 2018a). Economic distress also seems to drive more cultural concerns about immigration, such as the belief that immigrants do not make a positive contribution to the national cultural life (Colantone and Stanig 2018a, b).

In a situation of poor economic performance, it can be easy and politically rewarding to blame immigrants, even when the underlying economic grievances have very different origins, as in the case of globalization. The causal effects of structural economic changes can be difficult to grasp. For people who are having a

hard time finding a job, or who are worried about whether the welfare system has sufficient funding, immigrants are a visible minority and provide an easy target for discontent.

More broadly, economic shocks can translate into voting behavior through changes in people's attitudes that might seem only indirectly related to the economic shifts. In Colantone and Stanig (2018b), we provide a comprehensive analysis of this issue, using survey data from the European Social Survey and the European Values Study, spanning the period 1988–2008. We find that individuals residing in regions exposed to stronger import shocks from China not only are more concerned with immigration, especially in terms of a perceived threat to the national cultural life, but also are systematically less supportive of democracy and liberal values. Such a nativist and authoritarian shift in attitudes naturally tilts voters toward the nationalist right and away from left parties, which are perceived as backing multiculturalism and a sort of "proletarian international solidarity" (Betz and Meret 2012; Kriesi et al. 2012). Besides these factors, it is important to consider that a key element in the winning formula of the economic nationalists is lower taxes, which has helped them to gain support from the western European middle class. In this respect, pro-redistribution parties of the left are penalized, even in a context in which, arguably, lack of sufficient redistribution has been a core problem. As Gennaioli and Tabellini (2018) suggest, demand for redistribution may be dampened as identitarian issues become more salient due to economic shocks.

The Interaction of Cultural and Economic Factors

In this article, we have discussed the economic factors behind the recent political backlash, with specific focus on economic nationalist and radical-right parties. However, other authors have emphasized the role of cultural drivers, such as nativism and status threat (prominent examples in this literature include Inglehart and Norris 2017; Mutz 2018). Our stance is that economic and cultural factors should be seen as tightly interrelated explanations for the observed political shifts, rather than as mutually exclusive alternatives. Indeed, as we have just discussed, a fundamental way in which economic shocks lead to political consequences is by affecting people's attitudes and opinions. Similarly, Gidron and Hall (2017, 2019) argue that cultural and economic factors are joint determinants of anxiety about social status. To borrow an expression from Franzese (2019, emphases in the original), "the question is ill-formed: it's not status threat *or* economic hardship, it's *and*, or even *because*."

As a methodological corollary, we regard as problematic any econometric exercise where economic conditions and social attitudes are included jointly as explanatory variables in regressions that have voting behavior as a dependent variable, as is often done in the literature. To the extent that attitudes are endogenous to economic determinants, a lack of significance for the economic variables in this

type of analysis should not be interpreted as compelling evidence that the economy does not matter, as also emphasized by Morgan (2018).

Overall, it would be unwise to dismiss the economic determinants of the populist backlash. Indeed, the extant evidence shows that the effects of economic factors on voting in a populist direction are substantial. For instance, Fetzer's (forthcoming) estimates on the role of austerity in the Brexit referendum suggest that the Remain vote would have been almost 6 percentage points higher, reversing the outcome, in the absence of fiscal austerity. A back-of-the-envelope calculation based on our estimates for the Brexit vote shows that the Remain option would have prevailed, all else equal, if all the regions of the United Kingdom had received the China shock of the region at the first quartile (Colantone and Stanig 2018c). In our study of 15 countries in western Europe, variation of the order of one standard deviation in the China shock alone predicts differences of, respectively, almost 2 and 4 percentage points—within a given election—in terms of support for radical-right and economic nationalist parties (Colantone and Stanig 2018c). Considering that the standard deviations of the vote shares for these party families, net of country-year fixed effects, are 4 and 12 percentage points, respectively, these effects are quite consequential. Similarly, in our cross-country study on the role of automation (Anelli, Colantone, and Stanig 2019), we find that a one standard deviation increase in robot exposure at the regional level leads to an increase of almost 2 percentage points in support for the radical right. Along the same lines, Dal Bó et al. (2018) estimate that a one standard deviation higher share of automation-vulnerable workers in a municipality is associated with more than 2 percentage points higher support for the radical right in Sweden.

Clearly, all these are estimates of the effect of specific economic shocks on electoral outcomes. The main message emerging from this literature is that economic factors are consequential. What we cannot infer from the available evidence, as Margalit (in this issue; see also Margalit 2019) also notices, is the overall effect of economic drivers vis-à-vis cultural or social status factors. This type of question is very difficult to address, especially as different economic shocks not only interact with one another but also influence cultural factors, as we have just discussed. In our view, and especially in thinking about policy implications, it might not even be the most relevant question to ask. What matters for us is that a coherent body of evidence is pointing in the same direction: failures in addressing the distributional consequences of economic shocks may have dangerous political implications.

Dismissing the economic determinants of the populist backlash could lead the elites to a dangerous conclusion, against the evidence, that nothing has gone wrong in the management of structural economic changes. Of course, pointing for instance to how the adjustment costs of globalization and automation increase support for economic nationalism is not an endorsement of radical-right parties. Far from that, we believe that recognizing and addressing the distributional consequences of economic change are prerequisites for promoting politically sustainable liberal policies in an open society.

Concluding Remarks

How is the political setting of western Europe likely to evolve? Of course, future developments will depend upon the evolving intensities of various shocks, and on the strength and persistence of adjustment costs. The supply side of the political system will also play a critical role.

In thinking about globalization, the bulk of the China shock had already unfolded before the trade collapse of 2008. However, the distributional consequences of this shock seem quite persistent, and a substantial group of workers has witnessed permanent losses. The ensuing political discontent might take a generation to wane. Meanwhile, automation is producing similar and ongoing adjustment costs and political consequences, and this shock is only expected to accelerate in the coming years. On the bright side, though, automation thrives in a context of successful domestic firms, which makes the management of the transition potentially easier. As to the financial and euro crisis, the recovery has been unequal, not only between countries but also within countries, with an increase in regional inequalities as compared with the pre-crisis period. Failures in addressing such divergence might feed social discontent in the coming years.

Concerning the supply side of politics, the success of antiestablishment parties has hinged crucially upon the public holding traditional mainstream parties responsible for all kinds of previous failures. However, as new forces have gained political power and influence, they will presumably be held responsible for how their policies unfold. On the economic nationalist side, the Brexit negotiations have revealed that many promises of Leave campaigners were unrealistic, and Brexit itself is likely to backfire on the vulnerable segments of the British society who have supported it. The populist government of Italy, formed in 2018 and led de facto by the radical right, collapsed after slightly more than one year, having struggled to deal with the policy constraints imposed in the first place by a very high level of public debt, let alone by the existing multilateral agreements. Overall, in the future, it might be more difficult for economic nationalists to campaign successfully on the same platforms.

As we have discussed, the recent political shifts may reflect a structural realignment of social groups and parties along new political dividing lines, which might be here to stay. In the half century after World War II, the politics of advanced western European democracies were structured to a large extent by a conflict between labor and owners of capital, and took the form of choices between more reliance on markets and deeper state intervention in the context of European economic and political integration. In the coming years, political conflict might capture a fundamental contraposition between winners and losers of structural changes in the economy, and may be centered mainly on a cosmopolitan versus nationalist conflict. The result could well be a credible restructuring of current traditional parties or the emergence of new parties that might assemble social constituencies in favor of inclusive globalization and technological progress. As such changes occur, the representation of vulnerable segments of society is not bound to be a prerogative of

economic nationalist and radical-right forces. The challenge for believers in liberal policies is how to popularize a version of embedded liberalism that will be responsive to the current challenges of slow growth and structural economic shifts.

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References

Acemoglu, Daron, and Pascual Restrepo. 2018. "The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment." *American Economic Review* 108 (6): 1488–542.

Achen, Christopher H., and Larry M. Bartels. 2016. *Democracy for Realists: Why Elections Do Not Produce Responsive Government*. Princeton, NJ: Princeton University Press.

Algan, Yann, Sergei Guriev, Elias Papaioannou, and Evgenia Passari. 2017. "The European Trust Crisis and the Rise of Populism." *Brookings Papers on Economic Activity* 2017 (2): 309–400.

Anelli, Massimo, Italo Colantone, and Piero Stanig. 2019. "We Were the Robots: Automation and Voting Behavior in Western Europe." IZA Discussion Paper 12485.

Ashcroft, Michael. 2016. "How the United Kingdom Voted on Thursday . . . and Why." Lord Ashcroft Polls, June 24, 2016. https://lordashcroftpolls.com/2016/06/how-the-united-kingdom-voted-and-why/.

Autor, David H. 2015. "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." *Journal of Economic Perspectives* 29 (15): 3–30.

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103 (6): 2121–68.

Autor, David H., David Dorn, and Gordon H. Hanson. 2016. "The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade." *Annual Review of Economics* 8 (1): 205–40.

Autor, David H., David Dorn, Gordon H. Hanson, and Kaveh Majlesi. 2016. "Importing Political Polarization? The Electoral Consequences of Rising Trade Exposure." NBER Working Paper 22637.

Autor, David H., David Dorn, Gordon H. Hanson, and Jae Song. 2014. "Trade Adjustment: Worker-Level Evidence." *Quarterly Journal of Economics* 129 (4): 1799–860.

Betz, Hans-Georg, and Susi Meret. 2012. "Right-Wing Populist Parties and the Working-Class Vote." Chap. 6 in *Class Politics and the Radical Right*, edited by Jens Rydgren, 107–21. Oxford, UK: Routledge.

Bloom, Nicholas, Mirko Draca, and John Van Reenen. 2016. "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity." *Review of Economic Studies* 83 (1): 87–117.

Bonikowski, Bart. 2016. "Three Lessons of Contemporary Populism in Europe and the United States." *Brown Journal of World Affairs* 23 (1): 9–25.

Brancati, Dawn. 2016. *Global Elections Database*. New York: Global Elections Database. http://www.globalelectionsdatabase.com/.

Burgoon, Brian. 2009. "Globalization and Backlash: Polayni's Revenge?" *Review of International Political Economy* 16 (2): 145–77.

Cameron, David R. 1978. "The Expansion of the Public Economy: A Comparative Analysis." *American Political Science Review* 72 (4): 1243–61.

Che, Yi, Yi Lu, Justin R. Pierce, Peter K. Schott, and Zhigang Tao. 2016. "Does Trade Liberalization with China Influence U.S. Elections?" NBER Working Paper 22178.

Chetverikov, Denis, Bradley Larsen, and Christopher Palmer. 2016. "IV Quantile Regression for Group-Level Treatments, with an Application to the Distributional Effects of Trade." *Econometrica*

84 (2): 809–33.

Chiacchio, Francesco, Georgios Petropoulos, and David Pichler. 2018. "The Impact of Industrial Robots on EU Employment and Wages: A Local Labour Market Approach." Bruegel Working Paper 02-2018.

Colantone, Italo, and Piero Stanig. 2018a. "Global Competition and Brexit." *American Political Science Review* 112 (2): 201–18.

Colantone, Italo, and Piero Stanig. 2018b. "The Economic Determinants of the 'Cultural Backlash': Globalization and Attitudes in Western Europe." Baffi Carefin Centre Research Paper 2018-91.

Colantone, Italo, and Piero Stanig. 2018c. "The Trade Origins of Economic Nationalism: Import Competition and Voting Behavior in Western Europe." *American Journal of Political Science* 62 (4): 936–53.

Dal Bó, Ernesto, Frederico Finan, Olle Folke, Torsten Persson, and Johanna Rickne. 2018. "Economic Losers and Political Winners: Sweden's Radical Right." http://perseus.iies.su.se/~tpers/papers/Draft180902.pdf.

Dauth, Wolfgang, Sebastian Findeisen, Jens Suedekum, and Nicole Woessner. 2018. "Adjusting to Robots: Worker-Level Evidence." Federal Reserve Bank of Minneapolis, Opportunity and Inclusive Growth Institute Working Paper 13.

de Bromhead, Alan, Barry Eichengreen, and Kevin H. O'Rourke. 2013. "Political Extremism in the 1920s and 1930s: Do German Lessons Generalize?" *Journal of Economic History* 73 (2): 371–406.

Dippel, Christian, Stephan Heblich, and Robert Gold. 2015. "Globalization and Its (Dis-)Content: Trade Shocks and Voting Behavior." NBER Working Paper 21812.

Dustmann, Christian, Kristine Vasiljeva, and Anna Piil Damm. 2019. "Refugee Migration and Electoral Outcomes." *Review of Economic Studies* 86 (5): 2035–91.

Egger, Peter H., Sergey Nigai, and Nora M. Strecker. 2019. "The Taxing Deed of Globalization." *American Economic Review* 109 (2): 353–90.

Fetzer, Thiemo. Forthcoming. "Did Austerity Cause Brexit?" *American Economic Review*.

Franzese, Robert J. Jr. 2019. "The Comparative and International Political Economy of Anti-Globalization Populism." In *Oxford Research Encyclopedia of Politics*. Oxford: Oxford University Press.

Frey, Carl Benedikt, Thor Berger, and Chinchih Chen. 2018. "Political Machinery: Did Robots Swing the 2016 US Presidential Election?" *Oxford Review of Economic Policy* 34 (3): 418–42.

Frey, Carl Benedikt, and Michael A. Osborne. 2017. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" *Technological Forecasting and Social Change* 114 (1): 254–80.

Frieden, Jeffry. 2017. "The Politics of the Globalization Backlash: Sources and Implications." https://scholar.harvard.edu/files/jfrieden/files/the_politics_of_the_globalization_backlash.pdf.

Frieden, Jeffry, and Stefanie Walter. 2017. "Understanding the Political Economy of the Eurozone Crisis." *Annual Review of Political Science* 20 (1): 371–90.

Funke, Manuel, Moritz Schularick, and Christoph Trebesch. 2016. "Going to Extremes: Politics after Financial Crises, 1870–2014." *European Economic Review* 88 (1): 227–60.

Gennaioli, Nicola, and Guido Tabellini. 2018. "Identity, Beliefs, and Political Conflict." https://didattica.unibocconi.it/mypage/upload/154156_20190711_111651_IDENTITY_AND_BELIEFS_JULY2019_FINAL.PDF.

Gidron, Noam, and Peter A. Hall. 2017. "The Politics of Social Status: Economic and Cultural Roots of the Populist Right." *British Journal of Sociology* 68 (S1): S57–84.

Gidron, Noam, and Peter A. Hall. 2019. "Populism as a Problem of Social Integration." https://scholar.harvard.edu/hall/publications/populism-problem-social-integration.

Golder, Matt. 2016. "Far Right Parties in Europe." *Annual Review of Political Science* 19 (1): 477–97.

Graetz, Georg, and Guy Michaels. 2018. "Robots at Work." *Review of Economics and Statistics* 100 (5): 753–68.

Guiso, Luigi, Helios Herrera, Massimo Morelli, and Tommaso Sonno. 2017. "Populism: Demand and Supply." CEPR Discussion Paper DP11871.

Guiso, Luigi, Helios Herrera, Massimo Morelli, and Tommaso Sonno. 2019. "Global Crises and Populism: The Role of the Eurozone Institutions." *Economic Policy* 34 (97): 95–139.

Hainmueller, Jens, and Daniel J. Hopkins. 2014. "Public Attitudes toward Immigration." *Annual Review of Political Science* 17 (1): 225–49.

Hays, Jude C. 2009. *Globalization and the New Politics of Embedded Liberalism*. Oxford: Oxford University Press.

Hernández, Enrique, and Hanspeter Kriesi. 2016. "The Electoral Consequences of the Financial and Economic Crisis in Europe." *European Journal of Political Research* 55 (2): 203–24.

Hobolt, Sara B., and Catherine de Vries. 2016. "Turning against the Union? The Impact of the Crisis on the Eurosceptic Vote in the 2014 European Parliament Elections." *Electoral Studies* 44 (1): 504–14.

Im, Zhen Jie, Nonna Mayer, Bruno Palier, and Jan Rovny. 2019. "The 'Losers of Automation': A Reservoir of Votes for the Radical Right?" *Research and Politics* 6 (1): 1–7.

Inglehart, Ronald, and Pippa Norris. 2017. "Trump and Populist Authoritarian Parties: *The Silent Revolution* in Reverse." *Perspectives on Politics* 15 (2): 443–54.

Ipsos MORI. 2016. "Britain Remains Split as 9 in Ten Say They Would Not Change Their Referendum Vote." Ipsos MORI, July 1, 2016. https://www.ipsos.com/ipsos-mori/en-uk/britain-remains-split-9-ten-say-they-would-not-change-their-referendum-vote.

James, Harold. 2002. *The End of Globalization: Lessons from the Great Depression*. Cambridge, MA: Harvard University Press.

Jensen, J. Bradford, Dennis P. Quinn, and Stephen Weymouth. 2017. "Winners and Losers in International Trade: The Effects on US Presidential Voting." *International Organization* 71 (3): 423–57.

Kitschelt, Herbert, and Anthony J. McGann. 1997. *The Radical Right in Western Europe: A Comparative Analysis*. Ann Arbor: University of Michigan Press.

Kollman, Ken, Allen Hicken, Daniele Caramani, David Backer, and David Lublin. 2016. *Constituency-Level Elections Archive (CLEA)*. Ann Arbor: Center for Political Studies, University of Michigan. http://www.electiondataarchive.org.

Kriesi, Hanspeter. 1998. "The Transformation of Cleavage Politics: The 1997 Stein Rokkan Lecture." *European Journal of Political Research* 33 (2): 165–85.

Kriesi, Hanspeter, Edgar Grande, Martin Dolezal, Marc Helbling, Dominic Höglinger, Swen Hutter, and Bruno Wüest. 2012. *Political Conflict in Western Europe*. New York: Cambridge University Press.

Lowe, Will, Kenneth Benoit, Slava Mikhaylov, and Michael Laver. 2011. "Scaling Policy Preferences from Coded Political Texts." *Legislative Studies Quarterly* 36 (1): 123–55.

Malgouyres, Clément. 2014. "The Impact of Exposure to Low-Wage Country Competition on Votes for the Far-Right: Evidence from French Presidential Elections." https://goo.gl/wLbZRJ.

Margalit, Yotam. 2011. "Costly Jobs: Trade-Related Layoffs, Government Compensation, and Voting in U.S. Elections." *American Political Science Review* 105 (1): 166–88.

Margalit, Yotam. 2019. "Political Responses to Economic Shocks." *Annual Review of Political Science* 22 (1): 277–95.

Moretti, Enrico. 2012. *The New Geography of Jobs*. New York: Houghton Mifflin Harcourt.

Morgan, Stephen L. 2018. "Status Threat, Material Interests, and the 2016 Presidential Vote." *Socius: Sociological Research for a Dynamic World* 4 (1): 1–17.

Mounk, Yascha. 2018. *The People vs. Democracy: Why Our Freedom Is in Danger and How to Save It*. Cambridge, MA: Harvard University Press.

Mudde, Cas. 2004. "The Populist Zeitgeist." *Government and Opposition* 39 (4): 541–63.

Mudde, Cas. 2013. "Three Decades of Populist Radical Right Parties in Western Europe: So What?" *European Journal of Political Research* 52 (1): 1–19.

Mutz, Diana C. 2018. "Status Threat, Not Economic Hardship, Explains the 2016 Presidential Vote." *PNAS* 115 (19): E4330–39.

Peri, Giovanni. 2016. "Immigrants, Productivity, and Labor Markets." *Journal of Economic Perspectives* 30 (4): 3–30.

Rodrik, Dani. 1997. "Has Globalization Gone Too Far?" *California Management Review* 39 (3): 29–53.

Rodrik, Dani. 1998. "Why Do More Open Economies Have Bigger Governments?" *Journal of Political Economy* 106 (5): 997–1032.

Rodrik, Dani. 2018. "Is Populism Necessarily Bad Economics?" *AEA Papers and Proceedings* 108 (1): 196–99.

Rooduijn, Matthijs, Brian Burgoon, Erika J. van Elsas, and Herman G. van de Werfhorst. 2017. "Radical Distinction: Support for Radical Left and Radical Right Parties in Europe." *European Union Politics* 18 (4): 536–59.

Ruggie, John Gerard. 1982. "International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order." *International Organization* 36 (2): 379–415.

Rydgren, Jens. 2007. "The Sociology of the Radical Right." *Annual Review of Sociology* 33 (1): 241–62.

Rydgren, Jens. 2008. "Immigration Sceptics, Xenophobes or Racists? Radical Right-Wing Voting in Six West European Countries." *European Journal of Political Research* 47 (6): 737–65.

Tabellini, Marco. Forthcoming. "Gifts of the Immigrants, Woes of the Natives: Lessons from the Age of Mass Migration." *Review of Economic Studies*.

Tørsløv, Thomas R., Ludvig S. Wier, and Gabriel Zucman. 2018. "The Missing Profits of Nations." NBER Working Paper 24701.

Utar, Hale. 2014. "When the Floodgates Open: 'Northern' Firms' Response to Removal of Trade Quotas on Chinese Goods." *American Economic Journal: Applied Economics* 6 (4): 226–50.

Utar, Hale. 2018. "Workers beneath the Floodgates: Low-Wage Import Competition and Workers' Adjustment." *Review of Economics and Statistics* 100 (4): 631–47.

Volkens, Andrea, Pola Lehmann, Theres Matthieß, Nicolas Merz, Sven Regel, and Bernhard Weßels. 2018. *The Manifesto Data Collection. Manifesto Project (MRG/CMP/MARPOR).* Version 2018a. Berlin: Wissenschaftszentrum Berlin für Sozialforschung (WZB). https://doi.org/10.25522/manifesto.mpds.2018a (accessed August 12, 2018).

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Economic Insecurity and the Causes of Populism, Reconsidered

Yotam Margalit

The rise of populist forces in many established democracies is undoubtedly one of the most notable political developments in recent years. Donald Trump's victory in the US presidential election of November 2016 and the Brexit vote in June 2016 have perhaps received the most attention, but the populist phenomenon stretches across a wide range of countries and contexts. Examples include political advances by far-right parties in western and northern Europe, such as France and Sweden; ethno-nationalist parties in eastern and central Europe, like Poland and Hungary; and far-left movements in southern Europe, including Greece and Spain. The widespread and apparently growing appeal of populism has spawned intense debate over both its causes and its consequences.

"Populism" has no single definition (for discussion of different definitions, see Mudde 2004; Gidron and Bonikowski 2013). One difficulty in defining the term is that adherents of populism—unlike other "isms" such as communism or socialism—rarely describe themselves as such (Canovan 1981). But a common theme is that populism is characterized first and foremost by its claim to represent the will of the people versus some "other," commonly represented as a corrupt and self-serving elite. Many of the accounts put forward to explain the rise of populism have centered on its economic antecedents. While different causal factors are cited, they generally share a similar story line: a certain development, such as globalization, technological progress, or the financial crisis, has transformed labor markets and generated widespread dislocation and economic insecurity. Such changes, this argument holds, have eroded voters' trust in the political system and led the losers to opt for populist

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parties that represent a break from the status quo and offer seemingly appealing solutions to voters' economic malaise—be it trade protectionism, building a border wall, or exiting the European Union.

Versions of this economics-based explanation for populism have gained substantial traction among scholars and pundits, including many economists. As one example, Rodrik (2018) argues that "advanced stages of globalization are prone to a populist backlash," which he describes as "perfectly predictable" by economic history and economic theory. By Rodrik's account, the different variants of populism that we observe across countries are a function of the differences in the globalization-related shocks that those countries experienced. In a similar spirit, Roubini (2016) attributes the Brexit vote to a "populist/nationalist backlash" from a list of causes including "globalization, free trade, offshoring, labor migration, market-oriented policies, supra-national authorities, and even technological change." He further attributes President Trump's victory to his appeal as the "hero of angry workers threatened by trade, migration and technological change." Guiso et al. (2017) analyze the role of economic insecurity in explaining support for populist parties and conclude that "the key reason for the unprecedented wave of populism on both sides of the Atlantic is economic."

I will argue that these accounts overstate the role of economic insecurity in explaining the populist vote. My focus is on populism in Europe and the United States, though the argument may extend to other regions as well. The next section begins with a brief summary of the key economic explanations of the populist vote. In the subsequent three sections, I expand on three shortcomings of this line of explanation.

First, I contend that the empirical evidence put forth to date does not establish that populism is predominantly an outcome of a rise in economic insecurity. Specifically, my contention is that the discussion regarding the role of economic insecurity in explaining the populist vote conflates what I define as "outcome significance" and "explanatory significance." As an example, consider the Brexit vote, which was decided by a margin of less than 4 percentage points. Economic insecurity and displacement caused by globalization may well have shifted the vote by a few points, enough to tip the referendum in favor of the "Leave" camp. The outcome significance was therefore high. However, the overall phenomenon to be explained is why 52 percent of the electorate voted to leave the European Union. Examination of the empirical evidence on the vote for populists in an array of countries reveals a similar pattern: economic insecurity affects the electoral outcome on the margin, sometimes in a highly consequential manner, but the overall explanatory significance for the level of support for populists is modest.

Second, I assess whether and how immigration—arguably the most salient issue for many populist parties—and its economic impact explain populist support. While immigration itself is often motivated by an economic rationale, studies using recent innovations in survey experimental research indicate that voters' concerns about immigration have little to do with economic insecurity or immigration's (real or perceived) impact on their economic standing. Thus, while immigration is often

a major concern of populist voters, treating immigration as an economic driver of populism seems misguided.

Finally, I discuss the role of cultural issues in fueling populism. Analyses that focus on the economic sources of populism tend to treat voters' cultural grievances and concerns largely as a by-product of economic ones. This approach underplays the important independent role of cultural issues in driving support for populists. It also ignores the reverse causal process: namely, that grievances about the economic changes presumed to fuel populism (such as globalization, immigration, and EU market integration) are driven in part by cultural and social implications of those changes, a pattern evident in much of the recent work on communities with high rates of support for populism. Thus, in seeking to explain the growing populist vote, greater attention should be paid to people's subjective assessments of economic change and the noneconomic influences underlying those assessments.

Economic Change and Populism

In what ways might populism be driven by economic change and resulting insecurities? This section briefly describes four of the arguments that have been proposed, related to increased import competition, technological change, financial crisis, and immigration. In the following sections, I will discuss several limitations of these arguments and why they should be assessed more critically.

One prominent account holds that the rise in imports from mid- and low-wage countries has hurt domestic workers employed in import-competing industries, mostly in manufacturing. In particular, the massive surge of imported goods from China following its accession to the World Trade Organization in 2001—henceforth the "China shock"—had major adverse effects on US industries with higher exposure to Chinese competition (Acemoglu et al. 2016). Local US labor markets with a high share of trade-exposed industries suffered from high rates of job loss, decreases in labor market participation, and an enduring rise in unemployment (Autor, Dorn, and Hanson 2013). This argument holds that these negative and persistent effects have had political repercussions by increasing support for a wide array of populist candidates, parties, and causes in both the United States and Europe (for example, Autor et al. 2017; Dippel et al. 2017; Colantone and Stanig 2018a, b).

A second and related argument holds that the populist vote is a response to a combination of technological advances and deindustrialization. Technology has contributed to a shift from manufacturing to service sector jobs, and has accentuated the gaps between low- and high-skilled occupations. Furthermore, automation has made a range of routine skills redundant and contributed to the decline in demand for middling-skilled occupations (Autor, Katz, and Kearney 2006; Goos, Manning, and Salomons 2014). In some cases, these changes were followed by growing geographic disparities in economic activity and depopulation of rural areas. These shifts proved fertile ground for populist forces (Tomlinson 2017; Frey, Berger, and Chen 2018).

A third claim is that financial crises and how governments respond to them can foster populism. In particular, a common recent claim is that the Great Recession led to widespread disillusionment with mainstream parties that were seen as responsible for the crisis and its aftermath (Algan et al. 2017). More generally, crises tend to make tensions between debtors and creditors salient, and to give rise to a popular sentiment that the "little man" is made to pay for the mistakes and corruption of the economic and political leadership (Mian, Sufi, and Trebbi 2014). This argument holds that populist parties seizing on this sense of disillusionment capture the voice of the discontented by promising a sharp break from the dominance of the old elites.

Finally, the economic repercussions of immigration are cited as offering an explanation of rising populism. This argument holds that competition posed by foreign workers, at least in certain sectors and labor market segments, has threatened jobs and wages of native workers. Furthermore, immigration's fiscal costs and the strain these have added to already limited public services increased concerns about its impact on the welfare state. Such concerns have contributed to the appeal of right-wing populist parties, particularly in areas with high settlement rates of immigrants (Halla, Wagner, and Zweimüller 2017; Dustmann, Vasiljeva, and Damm 2018; Edo et al. 2019).

These four accounts of the populist vote are all individually plausible. Nonetheless, they also raise difficult issues, in terms of both theory and empirics. Do those adverse economic changes always bring about a populist response, and if not, on what other factors does the response depend? How substantial is the contribution of those economic changes to the populist vote? Are they deep causes of populism or merely triggers that activate other sources of grievance? When one digs into such issues, the strength of these accounts comes into question.

Levels and Changes in Explanations of Populism

Consider a case in which a certain factor contributes a couple of percentage points to one candidate's vote share, thus handing the candidate an electoral victory in a tight election that otherwise would have been lost. The *outcome significance* of that factor—transforming loss to victory—is of course major. Yet if the candidate received over half the vote, the swing of 2 percentage points hardly amounts to "explaining" the phenomenon of the overall electoral backing for that candidate. Put differently, the *explanatory significance* of that factor is low.

However, discussion of populist success often conflates outcome and explanatory significance. For example, a common explanation for President Trump's electoral victory in 2016 described how he appealed to globalization's losers, thereby cracking the Democrats' so-called "blue wall" in Pennsylvania, Wisconsin, and Michigan. Analysis by Autor et al. (2017) gives credence to this argument in terms of outcome significance by finding that the adverse effects of the China shock accounted for a vote share sizable enough to flip several states in favor of

Trump. Their estimates indicate that if the import shock had been half of what it was, the margin in favor of the Republicans in Pennsylvania would have shrunk by 1.7 percentage points, and the Democrats would have won the state by 0.5 percent. Likewise, the simulation indicates that the electoral impact would also have been sizable enough in Wisconsin and Michigan (2.2 and 1.8 points, respectively) to overturn the Electoral College results. It may therefore be correct that, without the impact of the massive trade shock, Trump would have lost.

But this outcome significance, based on a magnitude of several percentage points at best, should not hide the fact that the overwhelming majority of Americans voted in 2016 for the same party they had in 2012. After all, among voters who voted for one of the two major parties in both elections, 92 percent of those who voted for Barack Obama also voted for Hillary Clinton (according to a GfK survey described in Mutz 2018). Put differently, the effect of the trade shock had outcome significance and is therefore germane to any serious analysis of the 2016 elections. But if one's key interest is in explaining why people voted for Trump, the explanatory significance of the trade shock is peripheral. Instead, the overriding answer is long-standing partisan affiliation and the fact that Trump was the Republican nominee. (Green, Palmquist, and Schickler 2002 provides a useful summary of the evidence regarding the extent to which party identification forms early in people's lives and remains stable over time, largely resilient to temporary events.)

To illustrate how the distinction between outcome and explanatory significance applies to the discussion about the causes of populist support, it is useful to examine the estimated electoral effects of the aforementioned economic drivers across a broader set of cases. I make no attempt to provide an exhaustive review of the literature and instead focus here primarily on studies that examine the electoral impact of trade openness, given the outsized attention that the role of globalization has received in the discussion of populism. The next section focuses on economic and noneconomic connections between immigration and populism.

Most analyses examining the electoral impact of trade have utilized the empirical strategy pioneered by Autor, Dorn, and Hanson (2013). To identify the causal effect of the China shock, they exploit variation across industries and commuting zones in the level of local exposure to Chinese import competition, and they use data on Chinese exports to other high-income markets to construct an instrumental variable for exogenous changes in local import penetration.

Colantone and Stanig (2018a) apply this empirical strategy to the study of the effect of trade exposure on the Brexit vote in the United Kingdom. They find that a standard deviation increase in the strength of the import shock at the regional level led to an increase of 2 percentage points in support of the Leave option. Comparing regions at two extremes of the distribution in terms of exposure to the trade shock (tenth and ninetieth percentiles), they find that the predicted effect would be a 4.5 percentage point difference in support of the Leave option. Given that the referendum was decided by a 3.8 percentage point margin, these results imply that the impact of trade exposure was a nontrivial factor in the Leave campaign's victory—perhaps even a factor that tipped the balance toward Leave. Nonetheless, in

accounting for the overall 52 percent who voted Leave, the explanatory significance of this account is clearly limited. This fact, however, often gets lost in the popular discussion: for example, consider the *Washington Post*'s headline for an op-ed by the authors discussing these findings: "The Real Reason the U.K. Voted for Brexit? Jobs Lost to Chinese Competition" (Colantone and Stanig 2016).

Studies examining the effect of trade shocks in other countries report comparable effects. In France, an increase of one standard deviation in exposure to imports over the period 1995–2012 was associated with an effect that accounts for 7 percent of a standard deviation of the change in the vote share of the populist National Front party, or just under 3 percent of the party's overall vote share (Malgouyres 2017).[1] In Germany, a one standard deviation increase in a county's net import exposure to China and Eastern Europe saw its vote share for the extreme right grow by 0.12 percentage points (Dippel et al. 2017). This represents about 28 percent of the average per decade change in far-right voting in the period between 1987 and 2009. In a broader study analyzing variation in trade exposure across 198 regions of Europe, Colantone and Stanig (2018b) find that, ceteris paribus, voters in a region in Europe that lies at the seventy-fifth percentile of exposure to the China shock were 0.7 percentage points more likely to vote for a radical-right party than their counterparts in a region that was at the twenty-fifth percentile of exposure. Considering the baseline rate of support, this amounted to roughly a 15 percent increase in the probability of voting for the radical right.

Algan et al. (2017) analyze the impact of the Great Recession, particularly the rise in unemployment, on voting in Europe. They find that increases in unemployment (but not levels of unemployment) had a sizable effect on the Brexit vote in the United Kingdom, whereby a one standard deviation (1 percentage point) increase in the unemployment rate led to a 4.3 percentage point increase in support for the Leave option. In national elections, the estimated effect on support for populist parties was smaller, about one-quarter of the magnitude, but still notable.

To obtain an estimate of the effect of economic insecurity on the populist vote, most of these studies are regressing differences on differences, where the chief explanatory variable is the contemporaneous change in exposure to the economic shock at the geographic unit (or rather, an instrumental variable of that exposure). The model specification also includes controls for start-of-period economic and demographic characteristics of the region. This strategy has implications for the interpretation of these findings.

First, this strategy allows one to estimate the impact of changes in an economic condition (such as trade) on the change in support for populist candidates. But these estimates do not tell us how the level of economic insecurity (as might be induced by trade) affects the level of support for populist candidates. For example, in observing how the China shock affected support for a certain populist candidate,

[1] The bulk of the effect is concentrated in the years 2007 to 2012—that is, after the eruption of the financial crisis. Then the effect rises to 14.1 percent of a standard deviation, or 4.6 percent of the overall vote share for the National Front party.

we cannot say what share of the total vote for that candidate is caused by the impact of the overall level of trade on economic insecurity. (One can try to use the estimates from the effect of the trade shock on voting to extrapolate about the electoral effect of trade levels overall, but this requires making several strong assumptions. This perhaps explains why none of the studies described above attempted such a calculation.) The implication is that the estimates reported above may not be capturing the full effect of the economic cause in question. However, to change our conclusion about the limited explanatory significance of economic insecurity, the unmeasured effects need to be almost an order of magnitude larger than the effects reported in the aforementioned studies.

A second issue stems from the fact that the difference-in-differences strategy removes from the analysis all the important and stable differences across regions in levels of populist support. Yet these differences among regions represent the main variation in voting patterns (for example, states such as Oklahoma and Wyoming voted for Trump by about 30 points more than states such as California and Massachusetts, a gap observed also in the 2012 elections in the rate of support for the Republican candidate). While economic insecurity may explain some within-region variation in the temporal change in support for populism, it does a poor job in explaining the between-region variation in the level of populist votes. Since the variation between is much greater than the variation within, it seems problematic to argue that economic insecurity is central to understanding populism.

Analyses of individual-level data provide a similar picture: economic insecurity is positively associated with greater likelihood of support for the populists, but the magnitudes of the effects are limited. For example, Guiso et al. (2017) analyze survey data from 24 countries between 2002 and 2014 and measure economic insecurity using principal component analysis based on three items: unemployment in the past five years, reports of respondents claiming that they struggle to make ends meet, and employment in low-tech manufacturing. They find that a standard deviation in the insecurity measure is associated with a 0.3 percentage point increase in the likelihood of voting for a populist party, which represents 4.3 percent of the share of the overall populist vote (and rises to 7.4 percent when accounting for indirect effects of insecurity on political trust and fear of immigrants). The analysis finds that economic insecurity further enhances the populist vote share because economic insecurity causes people to abstain from voting at a higher rate, a pattern stronger among supporters of mainstream parties. This differential effect increases the overall impact of economic insecurity on the populist parties' vote share by an average of 6.6 percent.

Taken together, the effects of the economic factors studied above are pertinent for understanding populist success. In some cases, they may even have been decisive for the eventual electoral outcome. Moreover, one can readily imagine situations where the significance to the outcome refers to more than a marginal effect being decisive in an election. For example, it may refer to helping a populist candidate qualify for the second round of elections, as in the case of the National Front's Marine Le Pen in the 2017 election in France. It may also refer to when it becomes

politically impractical to form a governing coalition without a populist party, as in the case of the populist Five Star Movement in Italy in 2018. Or the outcome significance may refer to when a governing party is forced to make important policy concessions to populist demands: for example, the success of Germany's AfD (Alternative for Germany) in driving Chancellor Merkel to reverse her previous policy and instead to support a ban on wearing burqas in 2017. Nonetheless, even if we assume that some of the estimates are conservative, or that some of the economic causes described above had an additive effect, it seems fair to say that the explanatory significance of economic insecurity for the rise of populism is modest.

To be clear, most complex social phenomena are not caused by one factor alone. Widespread support for populism is no different in that respect. In addition to the economic factors discussed above, there are a host of other contributing factors—for example, anxiety about immigration and demographic shifts, disaffection with progressive cultural change, or opposition to EU integration—that underlie the appeal of populism. Thus, highlighting the limited explanatory significance of economic insecurity is not to dismiss its role as unimportant. Rather, it is to caution against the conventional wisdom forming around the idea that populism is inherently an outcome of growing economic insecurity.

Immigration as an Economic or Noneconomic Explanation of Populism

Immigration is often the signature issue of populist parties. Understanding its role in shaping public opinion is therefore key to the discussion of populism's mass appeal. While few would argue that immigration itself is often driven by an economic rationale, it is an open question whether the economic effects of immigration—real or perceived—are a major cause of populism. As noted, one possibility is that the appeal of populism stems from immigration's impact on native workers, by threatening their jobs or eroding their wages. The overall effects of immigration on the native population are still debated (for discussion, see Borjas 2003; Card 2009; Ottaviano and Peri 2012), but the key here is the perception by native citizens that immigrants pose an economic threat. Indeed, for quite some time, the finding that opposition to immigration is strongly and negatively correlated with education has been interpreted as evidence that low-skilled natives are concerned about labor market competition from immigrants (Scheve and Slaughter 2001; Mayda 2006).

Yet others have pointed to the correlation between education and immigration attitudes and posited that a sense of cultural threat is at the core of opposition to immigration, contending that lower levels of education also reflect higher levels of ethnocentrism and lower tolerance for outgroup members (Citrin et al. 1997; Kinder and Kam 2010). By this interpretation, opposition to immigration represents a broader concern many natives have about declining cultural homogeneity, which in most Western countries has traditionally meant the dominance of a white, Christian population.

Teasing out which of the factors underlie people's attitudes or cause them to vote the way they do is a notoriously tricky business. Simply asking voters to explain their vote choice is problematic, both because voters are often unaware of the factors influencing their decision and because they sometimes struggle to admit—either to themselves or to the interviewer—why they voted as they did. However, researchers have employed some innovative methods to get around this issue and draw stronger inferences. Much of the evidence comes from survey experiments, an increasingly popular method among social scientists. This method entails embedding into a survey different treatments with variation in the explanatory variable. In the most frequent setup, a sample of respondents is randomly divided into treatment and control groups that differ solely in the information they receive prior to being asked the same survey question. For example, respondents all read the same text about a struggling plant facing closure and 1,000 resulting layoffs, but each treatment group is given a different reason for the closure—international outsourcing, automation, or poor management—while the control group is not told of a reason. All respondents are then asked whether they support government intervention to stave off the plant closure.[2] With the experimenter able to control the random assignment of respondents into the different conditions, differences observed in the mean responses provided to the survey question can be directly tied to the differences in the information provided and have a causal interpretation.

Examples of treatments in a survey experiment may include asking a question in different versions that include or exclude a pertinent detail; asking the same conceptual question using different frames; or, in the case of internet surveys, presenting different images as part of the stimuli. Technological advances, initially in computer-assisted telephone interviewing and later with software for administering online surveys, have made it possible to administer such experiments with relative ease on very large, diverse, and geographically dispersed pools of respondents, while using complex designs and numerous conditions. Mutz (2011) provides an extensive treatment of these methods.

In the case of immigration, as with other sensitive issues, survey experiments can help alleviate problems of what is known as "social desirability bias." For example, people might worry that expressing negative attitudes on immigration would be seen as racially intolerant and thus may systematically underreport their opposition to it. People may also view economics-based arguments against immigration as more socially acceptable than ones couched in cultural terms and thus may overreport the former as the justification for their stance. Survey experiments help address such issues. Let me briefly describe several examples.

To address the first concern of people not revealing their real attitudes on immigration, one survey experimental method is a list experiment. In a study using this method, Janus (2010) randomly divided a national sample of US non-Hispanic whites into two groups and asked them to read a list of several statements. After

[2]This example is a simplified version of an experiment administered by Di Tella and Rodrik (2019).

reading the list, respondents in both groups were asked to report the *total number* of statements they "oppose or are against," without having to report their view on each specific statement. For the control group, the list included three statements on issues on which concerns with social desirability are unlikely to be a problem, such as whether or not they oppose "Professional athletes making millions of dollars per year." For the treatment group, the list contained the same three nonsensitive statements, but with an addition of a fourth statement: "Cutting off immigration to the United States." In this experiment, the difference in the mean number of statements reported by participants in the control group (1.77) and the mean number reported by participants in the treatment group (2.16) is attributable only to the additional sensitive item and to sampling error. Thus, subtracting the means and multiplying by 100 provides an estimate of the percentage of respondents opposed to the sensitive item.

In the experiment conducted above, 61 percent of respondents were not opposed to cutting off immigration into the United States. But when a different sample was asked the same question openly, the corresponding rate was 42 percent. This gap of 19 percentage points indicates that opposition to immigration among non-Hispanic whites is in fact far greater than polls using direct questioning reveal. The high (unreported) degree of opposition to immigration helps explain why populists in most Western countries focus on this issue with such tenacity.

As another example, consider the claim that native-born populations that oppose immigration are concerned about foreigners competing with them for jobs. A chief prediction of a model that assumes high substitutability between native and immigrant workers is that an influx of low-skilled immigrants will lower the wages or employment of low-skilled natives, while raising the wages of high-skilled natives (and the opposite effect in the case of an influx of high-skilled immigrants). The finding noted above that associates lower-educated natives with support for restrictive immigration policies is therefore consistent with the model's predictions. But rather than assume that respondents to questions about restricting immigration in general had low-skilled immigrants in mind, survey experiments allow researchers to prompt respondents with randomized scenarios that vary the characteristics of the immigrants in question. These experiments show that natives are not more likely to oppose immigrants with skills similar to their own. Moreover, individuals with higher levels of education consistently exhibit greater support for immigration of both high- and low-skilled individuals, a result that is inconsistent with key predictions of the model. These findings have been replicated in a wide range of countries (Hainmueller and Hiscox 2010; Valentino et al. 2017).

Furthermore, my collaborators and I find that workers employed in very different segments of the labor market, such as meat-packing, education, and finance—differing in terms of skill specificity, penetration by foreign labor, and value added per worker—share remarkably similar preferences in terms of the skill profile of the immigrants they are willing (or not) to accept (Hainmueller, Hiscox, and Margalit 2015). This finding does not sit well with a prediction that natives will be more opposed to immigrants with skill levels similar their own, or indeed with

any model that predicts that different segments of native workers will have different preferences regarding the desired type of immigrants.

The experimental studies indicate that when economic considerations do enter people's thinking about immigration, it is almost entirely in terms of its impact on broader society, not on one's pocketbook. Conjoint experiments, in which subjects are asked to evaluate hypothetical options with multiple, randomly varied attributes, can allow researchers to measure the relative importance assigned to different determinants in a multidimensional decision. For example, participants in the experiment are shown two profiles of candidates for immigration who differ in attributes such as their education, age, professional experience, and country of origin. The participants are then asked to evaluate the two immigrants and rate which, if any, they would support admitting into the country. By randomly assigning different characteristics to each immigrant profile, and by presenting respondents with multiple candidates to evaluate, researchers can then estimate how each feature influenced the respondents' evaluations (as well as potential interaction effects).

Results from such studies show that characteristics that speak to a candidate's earning potential and ability to integrate economically are influential considerations. Yet notably, these candidate evaluations hardly vary across respondents, irrespective of the respondent's own skill set or position in the labor market. Furthermore, the experiments reveal the importance of culture-related characteristics: holding constant a wide set of individual-level characteristics, immigrants' country of origin, and religion (particularly whether they are Muslim or not), as well as indicators of assimilation, also tends to have a large impact on native citizens' evaluations (Wright, Levy, and Citrin 2016; Bansak, Hainmueller, and Hangartner 2016).

One obvious concern with survey experiments is whether they are also indicative of respondents' real-life choices and behavior. In one conjoint experiment, researchers were actually able to assess the external validity of the findings in a fairly direct manner. Between 1970 and 2003, over 40 municipalities in Switzerland used referendums to decide on naturalization requests of immigrants. Before casting a ballot, native citizens received a printed leaflet with information about each candidate, which they then voted on. Applicants with a majority of "yes" votes were granted citizenship. Researchers were thus able to observe the exact information available to participants in the referendum when casting their ballots. Comparing the estimates of votes cast in the real referenda with an experimental paired-conjoint design indicates that on average, the estimates of the experimental method were very close (within 2 percentage points) to the behavioral benchmark (Hainmueller, Hangartner, and Yamamoto 2015). This finding suggests that for some questions, well-designed survey experiments can offer meaningful insight into real-world behavior.

Research has also looked into the claim that concerns over immigration's impact on public finance explain public attitudes on the issue, with mixed results. Observational studies using survey data from the 1990s from the United States and 17 other high-income countries find evidence to support this claim (Hanson, Scheve, and Slaughter 2007; Facchini and Mayda 2009). However, studies using data from the past two decades—both observational and experimental—do not find evidence that

individuals who shoulder a larger share of the costs of immigration are more likely to oppose it (Hainmueller and Hiscox 2010; Tingley 2012).

In contrast, experimental studies indicate that anxiety over changing demographics and a declining predominance of white people underlies part of natives' opposition to immigration. For example, a survey experiment in the United Kingdom varied the information it provided to participants about the skill mix of immigrants coming into the country, their region of origin, and the impact of immigration numbers on the long-term share of white Britons. The study finds that even when controlling for the information about skill mix and region of origin, the very mention of the immigrants' impact on the share of white Britons almost halves support for current immigration levels (reducing it by 17–22 percentage points to about 20 percent of the public) (Kaufmann 2018). Experiments conducted in the United States find a similar effect, in which prompting (or reminding) white Americans about the impending racial shift and future loss of their majority status magnifies their racial bias, particularly toward Hispanics, and increases support for restrictive immigration policies (Craig and Richeson 2014; Major, Blodorn, and Blascovich 2018).

It is worth noting that nonexperimental studies, with the well-known limitations of analyzing observational data, also consistently find that cultural factors are far stronger predictors of attitudes on immigration. For example, Card, Dustmann, and Preston (2012) analyze cross-national European survey data and estimate the relative importance respondents attach to economic concern over future wages and taxes, as opposed to "compositional" concerns about the impact of immigration on local culture and social life. Their conclusion is that compositional concerns are two to five times more important than economic concerns. Even in cases where economic factors were found to be statistically significant predictors of attitudes on immigration, the magnitude of the effects was a good deal smaller than the effects associated with cultural concerns and prejudices (Sniderman, Hagendoorn, and Prior 2004; Malhotra, Margalit, and Mo 2013).

Populist parties are often known for their vociferous opposition to immigration, and much of their appeal to voters is attributed to this stance. The research suggests that in Western countries, anti-immigration sentiments among natives center to a large degree on the social and cultural aspects. Where economic concerns do come into play, they rarely have to do with people's personal economic interests and mostly concern the way immigration affects society as a whole. Thus, while immigration is a salient concern for populist voters, economic insecurity directly related to immigration is not a key explanation for this concern.

The Cultural "Channel" and Economic Beliefs

For experienced analysts of public opinion data, the findings discussed so far—the low explanatory significance of economic insecurity and opposition to immigration not reflecting personal economic considerations—are not surprising. I shall briefly explain why, as the answer is pertinent for the main themes discussed here.

In much of the research examining individual preferences on a given policy, the starting point is a model of its distributive consequences, with the expectation being that those who gain from the policy will likely support it, while those who lose from the policy will oppose it. Yet this approach, intuitive as it may seem, often proves remarkably limited in explaining people's attitudes. Even when results are broadly consistent with the predictions of a model based on individual gains and losses, the share of variance explained is often decidedly low.

This issue repeatedly came up in my own research on the "losers of globalization," analyzing the characteristics of those who perceive themselves as harmed by trade openness and those more likely to favor protectionist trade measures (Margalit 2008, 2012). As I and others find, predictions based on occupational characteristics, employment status, and the vulnerability of one's industry to foreign competition have small effects (if any) and explain little of the variation in individual attitudes on international trade (Mansfield and Mutz 2009; Blonigen 2011; Rho and Tomz 2017). Researchers have thus concluded that a model that assumes voters' opinions about trade are shaped by their position in the labor market and the fortunes of their industry (as one might expect from a Ricardo–Viner specific factors model of international trade) is of little use in explaining mass attitudes on trade. A model that assumes voters' opinions on trade are shaped by labor endowments and skills (as one might expect in a Heckscher–Ohlin model of trade) fares only slightly better. But on closer examination, the better performance of this approach is almost entirely related to the fact that education is used as the proxy for skills. Indeed, education is the one "economic" factor that is robustly associated with trade attitudes, yet it of course also captures other potentially influential factors, such as individuals' levels of cosmopolitanism or ethnocentrism. Other attempts to apply newer models of trade and offshoring to explain public attitudes on trade-related questions produce similarly weak results (Blonigen and McGrew 2014).

The explanatory weakness of measures of personal economic circumstances is also evident in recent analyses of support for populist parties. As Gidron and Hall (2017) report in a study of vote choice in 20 developed democracies, even after throwing into the regression a wide array of economic predictors, the share of the variation explained is 0.07.[3] Another study of individual-level support for populist parties in six western European countries (Oesch 2008) finds that employment characteristics and sociodemographics exhibited a similarly weak empirical relationship with the populist vote (R^2 ranging from 0.019 in Switzerland to 0.078 in Norway). Some of the low explanatory power is probably due to attenuation bias resulting from measurement error. But this result is not merely an artifact of survey

[3]The share of variation explained is a problematic measure when the dependent variable is a binary outcome. But other, more suitable tests—such as ROC ("receiver operating characteristic") or precision-recall tests—also show a poor fit for these models. For example, when predicting whether an individual voted for the populist party (in 14 countries included in the European Social Survey) using a model with respondents' level of exposure to the import shock and a host of variables pertaining to employment status, the model produces an ROC area of 0.52. This is only slightly better than a random prediction.

design. It reflects a broader point, which is that people's understanding of issues such as immigration, trade openness, or EU market integration—frequent targets of populist ire—are shaped by more than just their economic impact on individuals. Specifically, public disaffection about those issues also reflects concerns related to their social and cultural consequences.

Indeed, an alternative explanation for widespread populist support views it as a backlash against cultural change (for a comprehensive discussion, see Inglehart and Norris 2016). On this view, long-term structural social developments—increased access to higher education, growing ethnic diversity, urbanization, more equal gender roles—have led to greater acceptance of diverse lifestyles, religions, and cultures. These changes, and the perceived displacement of traditional social values, have caused a sense of resentment among segments of the population in the West, particularly among white men, older people, conservatives, and those with less formal qualifications. Increased exposure to foreign influences that comes with globalization, and even more so the effects of waves of immigration, has exacerbated the sense of a cultural and demographic threat. As a result, formerly predominant majorities have felt their social standing erode and have become increasingly receptive to populist charges against a disconnected, cosmopolitan elite that has turned its back on them. They have also bought into the populist nostalgia for a "golden age" of cultural homogeneity, traditional values, and a strong national identity. Hard economic times undermine the perceived competence of the economic and political elites and thus help fuel the populist distrust in them. Yet by this account, adverse economic change is a contributing factor and possibly a trigger. However, is not the root cause of widespread populist support.

There's an obvious, and understandable, reluctance to accept such "soft" explanations. A cultural explanation of populism is hard to test quantitatively, let alone to identify causally. Yet that doesn't mean that a cultural explanation is incorrect. Indeed, some of the economics-centered studies cited above acknowledge the potential role of cultural concerns in explaining the populist vote but treat them as outside the purview of their analysis. Others contend that cultural concerns are simply a by-product of adverse economic changes. As one recent study put it: "Populism does not have a cultural cause, but rather an economic insecurity cause, with an important and traceable *cultural channel*" (Guiso et al. 2017, emphasis in original). I disagree. Subsuming of cultural concerns as part of an economic reaction wrongly dismisses the independent impact of cultural factors in driving support for populism. Moreover, it ignores evidence of a causal relationship that runs also in the opposite direction: namely, that cultural concerns and grievances shape people's beliefs about economic change and its adverse impact on their standing. Some of the economic issues that populists rail against reflect this process.

For example, people who worry about cultural homogeneity or changing ethnic composition of their communities are more likely to adopt the view that immigration has negative economic consequences (Sniderman and Hagendoorn

2007; Brader, Valentino, and Suhay 2008). Similarly, individuals who are anxious about the cultural aspects of globalization are more likely to believe that trade is economically harmful (Margalit 2012; for findings consistent with this view, see O'Rourke and Sinnott 2001; Mansfield and Mutz 2009). Using an experiment, I sought to bring some evidence to bear on the direction of causality. I found that when individuals, particularly the less educated, were exposed to a set of four questions designed to trigger preoccupation with cultural change—for example, whether or not they agree with the statement "our traditional way of life is getting lost"—they expressed a substantially more negative view about the impact of trade than a control group that wasn't exposed to the treatment. Other experimental work provides additional examples of ways in which cultural factors shape beliefs and attitudes about economic issues such as welfare, antipoverty policy, and health care (Gilens 2009; Tesler 2012).

Sociological and ethnographic work looking at communities supportive of the populist right provides a more vivid illustration of this causal pathway. These ethnographies—of the French working-class town of Riems (Eribon 2013), of rural communities in Wisconsin (Cramer 2016) and Louisiana (Hochschild 2016), and of declining industrial enclaves in Britain (Dagenham) and the United States (Youngstown, Ohio) (Gest 2016)—document compellingly the ways in which perceived threats to social status play out politically. In doing so, they show how cultural distance and estrangement from the dominant groups in society are intertwined with people's perception of being economically left behind. For example, these studies detail how people who live in rural areas often harbor deep cultural resentment toward political and economic elites for their perceived disregard, disrespect, or condescension. This resentment then often feeds certain beliefs about the economy, such as the idea that government resources are allocated unfairly, the notion that urban residents (and particularly minorities) get more than their fair share of resources, or the strong conviction that immigrants are a major drain on the government budget.

Thus, while economic change can be a source of grievance expressed along cultural lines, in the form of antipathy toward a certain ethnic group, it is also the other way around: cultural changes generate discontent around economic issues. Consequently, when populist politicians address issues such as immigration, trade, or rural-urban disparities, they tap into public disaffection that goes beyond voters' concern with the material impact of those issues.

With these studies and evidence in mind, two avenues for future research strike me as promising. The first is to develop a better understanding of the disaffection underlying the populist vote. The notion that the losers from economic change are the basis of populist support conceives of "losers" too literally and narrowly. As I argued, the grievances of constituencies voting for populists have a broader set of causes. Thus, an important avenue for research on populism is to investigate the way people form their beliefs about the impact of aforementioned issues that are often the targets of populist anger, such as globalization, immigration, and EU integration. What do people know about those issues, what information and news

sources do they rely upon in forming their beliefs, and what factors underlie their sense of being harmed by these changes? Addressing these questions is central to explaining the broad support base of populism.

A second avenue is to refine and to test more rigorously the cultural explanations of populism. Recent work in economics on social identity provides a useful example of how culture can be theorized as an independent variable in a way that lends itself to more systematic empirical investigation. For example, Shayo (2009, forthcoming) formalizes the way in which in-group bias and conformity to group norms, two key components of social identity, can be used to explain how cultural affinities account for a range of economic and political outcomes. These include the link between nationalism and redistribution (see also Holm 2016) or between nationalism and trade policy (Grossman and Helpman 2018). A similar approach can be usefully applied to study when cultural affinities and concerns are likely to generate support for populism.

Survey experiments can be a useful tool for testing predictions about the potency of cultural concerns in triggering support for populist candidates, as well as assessing which type of individuals are responsive to those cultural issues (those with low education levels? the economically insecure? residents of rural areas?). By also including treatments that center on economic insecurity, survey experiments can help assess the relative strength of cultural and economic issues in stirring populist sentiments across different segments of the electorate. Another empirical approach can be to study settings in which exposure to varying levels of cultural threat is exogenously determined, and assess its impact on voting outcomes. Such exposure can be due to quasi-random proximity to refugees' path of travel (Dinas et al. 2019), or to shocks such as World War I and the Immigration Acts of the 1920s, which affected both the volume and the type of immigration that settled in different geographic areas of the United States (Tabellini forthcoming). In the US case, Tabellini is able to exploit the uniquely large variation in the cultural background of the arriving immigrants (looking at dimensions such as religion and language) and finds that a populist-like political backlash was strongly and positively tied to the cultural distance between immigrants and natives. This occurred despite the fact that the economic impact of the migrants was neutral or positive. Brunner and Kuhn (2018) report a similar finding regarding the impact of cultural distance on the support of Swiss natives for the populist party SVP. Additional work of this kind can help assess the impact of both economic and cultural factors in shaping support for populism.

References

Acemoglu, Daron, David Autor, David Dorn, Gordon H. Hanson, and Brendan Price. 2016. "Import Competition and the Great US Employment Sag of the 2000s." *Journal of Labor Economics* 34 (S1): S141–98.

Algan, Yann, Sergei Guriev, Elias Papaioannou, and Evgenia Passari. 2017. "The European Trust Crisis and the Rise of Populism." *Brookings Papers on Economic Activity* 2017 (Fall): 309–400.

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103 (6): 2121–68.

Autor, David H., David Dorn, Gordon H. Hanson, and Kaveh Majlesi. 2017. "A Note on the Effect of Rising Trade Exposure on the 2016 Presidential Election." https://economics.mit.edu/files/12418.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review* 96 (2): 189–94.

Bansak, Kirk, Jens Hainmueller, and Dominik Hangartner. 2016. "How Economic, Humanitarian, and Religious Concerns Shape European Attitudes toward Asylum Seekers." *Science* 354 (6309): 217–22.

Blonigen, Bruce A. 2011. "Revisiting the Evidence on Trade Policy Preferences." *Journal of International Economics* 85 (1): 129–35.

Blonigen, Bruce A., and Jacob McGrew. 2014. "Task Routineness and Trade Policy Preferences." *Economics and Politics* 26 (3): 505–18.

Borjas, George J. 2003. "The Labor Demand Curve Is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market." *Quarterly Journal of Economics* 118 (4): 1335–74.

Brader, Ted, Nicholas Valentino, and Elizabeth Suhay. 2008. "Is It Immigration or the Immigrants? The Emotional Influence of Groups on Public Opinion and Political Action." *American Journal of Political Science* 52 (4): 959–78.

Brunner, Beatrice, and Andreas Kuhn. 2018. "Immigration, Cultural Distance and Natives' Attitudes towards Immigrants: Evidence from Swiss Voting Results." *Kyklos* 71 (1): 28–58.

Canovan, Margaret. 1981. *Populism.* London: Junction Books.

Card, David. 2009. "Immigration and Inequality." *American Economic Review* 99 (2): 1–21.

Card, David, Christian Dustmann, and Ian Preston. 2012. "Immigration, Wages, and Compositional Amenities." *Journal of the European Economic Association* 10 (1): 78–119.

Citrin, Jack, Donald P. Green, Christopher Muste, and Cara Wong. 1997. "Public Opinion toward Immigration Reform: The Role of Economic Motivations." *Journal of Politics* 59 (3): 858–81.

Colantone, Italo, and Piero Stanig. 2016. "The Real Reason the U.K. Voted for Brexit? Jobs Lost to Chinese Competition." *Washington Post,* July 7, 2016. https://www.washingtonpost.com/news/monkey-cage/wp/2016/07/07/the-real-reason-the-u-k-voted-for-brexit-economics-not-identity/.

Colantone, Italo, and Piero Stanig. 2018a. "Global Competition and Brexit." *American Political Science Review* 112 (2): 201–18.

Colantone, Italo, and Piero Stanig. 2018b. "The Trade Origins of Economic Nationalism: Import Competition and Voting Behavior in Western Europe." *American Journal of Political Science* 62 (4): 936–53.

Craig, Maureen A., and Jennifer A. Richeson. 2014. "More Diverse yet Less Tolerant? How the Increasingly Diverse Racial Landscape Affects White Americans' Racial Attitudes." *Personality and Social Psychology Bulletin* 40 (6): 750–61.

Cramer, Katherine J. 2016. *The Politics of Resentment: Rural Consciousness in Wisconsin and the Rise of Scott Walker.* Chicago: University of Chicago Press.

Di Tella, Rafael, and Dani Rodrik. 2019. "Labor Market Shocks and the Demand for Trade Protection: Evidence from Online Surveys." NBER Working Paper 25705.

Dinas, Elias, Konstantinos Matakos, Dimitrios Xefteris, and Dominik Hangartner. 2019. "Waking Up the Golden Dawn: Does Exposure to the Refugee Crisis Increase Support for Extreme-Right Parties?" *Political Analysis* 27 (2): 244–54.

Dippel, Christian, Robert Gold, Stephan Heblich, and Rodrigo Pinto. 2017. "Instrumental Variables and Causal Mechanisms: Unpacking the Effect of Trade on Workers and Voters." NBER Working Paper 23209.

Dustmann, Christian, Kristine Vasiljeva, and Anna Piil Damm. 2018. "Refugee Migration and Electoral Outcomes." *Review of Economic Studies* 86 (5): 2035–91.

Edo, Anthony, Yvonne Giesing, Jonathan Öztunc, and Panu Poutvaara. 2019. "Immigration and Electoral Support for the Far-Left and the Far-Right." *European Economic Review* 115 (1): 99–143.

Eribon, Didier. 2013. *Returning to Reims*. Cambridge, MA: MIT Press.

Facchini, Giovanni, and Anna Maria Mayda. 2009. "Does the Welfare State Affect Individual Attitudes toward Immigrants? Evidence across Countries." *Review of Economics and Statistics* 91 (2): 295–314.

Frey, Carl Benedikt, Thor Berger, and Chinchih Chen. 2018. "Political Machinery: Did Robots Swing the 2016 US Presidential Election?" *Oxford Review of Economic Policy* 34 (3): 418–42.

Gest, Justin. 2016. *The New Minority: White Working Class Politics in an Age of Immigration and Inequality*. New York: Oxford University Press.

Gidron, Noam, and Bart Bonikowski. 2013. "Varieties of Populism: Literature Review and Research Agenda." Weatherhead Center for International Affairs, Harvard University, Working Paper 13-0004.

Gidron, Noam, and Peter A. Hall. 2017. "The Politics of Social Status: Economic and Cultural Roots of the Populist Right." *British Journal of Sociology* 68 (S1): S57–84.

Gilens, Martin. 2009. *Why Americans Hate Welfare: Race, Media, and the Politics of Antipoverty Policy*. Chicago: University of Chicago Press.

Goos, Maarten, Alan Manning, and Anna Salomons. 2014. "Explaining Job Polarization: Routine-Biased Technological Change and Offshoring." *American Economic Review* 104 (8): 2509–26.

Green, Donald, Bradley Palmquist, and Eric Schickler. 2002. *Partisan Hearts and Minds: Political Parties and the Social Identities of Voters*. New Haven, CT: Yale University Press.

Grossman, Gene M., and Elhanan Helpman. 2018. "Identity Politics and Trade Policy." NBER Working Paper 25348.

Guiso, Luigi, Helios Herrera, Massimo Morelli, and Tommaso Sonno. 2017. "Demand and Supply of Populism." Innocenzo Gasparini Institute for Economic Research (IGIER), Bocconi University, Working Paper 610.

Hainmueller, Jens, Dominik Hangartner, and Teppei Yamamoto. 2015. "Validating Vignette and Conjoint Survey Experiments against Real-World Behavior." *PNAS* 112 (8): 2395–400.

Hainmueller, Jens, and Michael J. Hiscox. 2010. "Attitudes toward Highly Skilled and Low-Skilled Immigration: Evidence from a Survey Experiment." *American Political Science Review* 104 (1): 61–84.

Hainmueller, Jens, Michael J. Hiscox, and Yotam Margalit. 2015. "Do Concerns about Labor Market Competition Shape Attitudes toward Immigration? New Evidence." *Journal of International Economics* 97 (1): 193–207.

Halla, Martin, Alexander F. Wagner, and Josef Zweimüller. 2017. "Immigration and Voting for the Far Right." *Journal of the European Economic Association* 15 (6): 1341–85.

Hanson, Gordon H., Kenneth Scheve, and Matthew J. Slaughter. 2007. "Public Finance and Individual Preferences over Globalization Strategies." *Economics and Politics* 19 (1): 1–33.

Hochschild, Arlie Russell. 2016. *Strangers in Their Own Land: Anger and Mourning on the American Right*. New York: The New Press.

Holm, Joshua. 2016. "A Model of Redistribution under Social Identification in Heterogeneous Federations." *Journal of Public Economics* 143 (1): 39–48.

Inglehart, Ronald, and Pippa Norris. 2016. "Trump, Brexit, and the Rise of Populism: Economic Have-Nots and Cultural Backlash." Harvard Kennedy School Faculty Research Working Paper Series RWP16-026.

Janus, Alexander L. 2010. "The Influence of Social Desirability Pressures on Expressed Immigration Attitudes." Social Science Quarterly 91 (4): 928–46.

Kaufmann, Eric. 2018. "Why Culture Is More Important Than Skills: Understanding British Public Opinion on Immigration." *British Politics and Policy* (blog), London School of Economics. January 30, 2018. http://blogs.lse.ac.uk/politicsandpolicy/why-culture-is-more-important-than-skills-understanding-british-public-opinion-on-immigration.

Kinder, Donald R., and Cindy D. Kam. 2010. *Us against Them: Ethnocentric Foundations of American Opinion*. Chicago: University of Chicago Press.

Major, Brenda, Alison Blodorn, and Gregory Major Blascovich. 2018. "The Threat of Increasing Diversity: Why Many White Americans Support Trump in the 2016 Presidential Election." *Group Processes and Intergroup Relations* 21 (6): 931–40.

Malgouyres, Clément. 2017. "Trade Shocks and Far-Right Voting: Evidence from French Presidential Elections." European University Institute Working Paper RSCAS 2017/21.

Malhotra, Neil, Yotam Margalit, and Cecilia Hyunjung Mo. 2013. "Economic Explanations for Opposition to Immigration: Distinguishing between Prevalence and Conditional Impact." *American Journal of Political Science* 57 (2): 391–410.

Mansfield, Edward D., and Diana C. Mutz. 2009. "Support for Free Trade: Self-Interest, Sociotropic Politics, and Out-Group Anxiety." *International Organization* 63 (3): 425–57.

Margalit, Yotam. 2008. "Globalization's Losers: International Economic Integration and the Politics of Discontent." PhD diss., Stanford University.

Margalit, Yotam. 2012. "Lost in Globalization: International Economic Integration and the Sources of Popular Discontent." *International Studies Quarterly* 56 (3): 484–500.

Mayda, Anna Maria. 2006. "Who Is Against Immigration? A Cross-Country Investigation of Individual Attitudes toward Immigrants." *Review of Economics and Statistics* 88 (3): 510–30.

Mian, Atif, Amir Sufi, and Francesco Trebbi. 2014. "Resolving Debt Overhang: Political Constraints in the Aftermath of Financial Crises." *American Economic Journal: Macroeconomics* 6 (2): 1–28.

Mudde, Cas. 2004. "The Populist Zeitgeist." *Government and Opposition* 39 (4): 541–63.

Mutz, Diana C. 2011. *Population-Based Survey Experiments*. Princeton, NJ: Princeton University Press.

Mutz, Diana C. 2018. "Status Threat, Not Economic Hardship, Explains the 2016 Presidential Vote." *PNAS* 115 (19): E4330–39.

Oesch, Daniel. 2008. "Explaining Workers' Support for Right-Wing Populist Parties in Western Europe: Evidence from Austria, Belgium, France, Norway, and Switzerland." *International Political Science Review* 29 (3): 349–73.

O'Rourke, Kevin H., and Richard Sinnott. 2001. "The Determinants of Individual Trade Policy Preferences: International Survey Evidence." In *Brookings Trade Forum 2001*, edited by Susan M. Collins and Dani Rodrik, 157–96. Washington, DC: Brookings Institution Press.

Ottaviano, Gianmarco I. P., and Giovanni Peri. 2012. "Rethinking the Effect of Immigration on Wages." *Journal of the European Economic Association* 10 (1): 152–97.

Rho, Sungmin, and Michael Tomz. 2017. "Why Don't Trade Preferences Reflect Economic Self-Interest?" *International Organization* 71 (S1): S85–108.

Rodrik, Dani. 2018. "Populism and the Economics of Globalization." *Journal of International Business Policy* 1 (1–2): 12–33.

Roubini, Nouriel. 2016. "Globalization's Political Fault Lines." *Project Syndicate*, July 4, 2016. https://www.project-syndicate.org/commentary/globalization-political-fault-lines-by-nouriel-roubini-2016-07.

Scheve, Kenneth F., and Matthew J. Slaughter. 2001. "Labor Market Competition and Individual Preferences over Immigration Policy." *Review of Economics and Statistics* 83 (1): 133–45.

Shayo, Moses. 2009. "A Model of Social Identity with an Application to Political Economy: Nation, Class, and Redistribution." *American Political Science Review* 103 (2): 147–74.

Shayo, Moses. Forthcoming. "Social Identity and Economic Policy." *Annual Review of Economics*.

Sniderman, Paul M., and Louk Hagendoorn. 2007. *When Ways of Life Collide: Multiculturalism and Its Discontents in the Netherlands*. Princeton, NJ: Princeton University Press.

Sniderman, Paul M., Louk Hagendoorn, and Markus Prior. 2004. "Predisposing Factors and Situational Triggers: Exclusionary Reactions to Immigrant Minorities." *American Political Science Review* 98 (1): 35–49.

Tabellini, Marco. Forthcoming. "Gifts of the Immigrants, Woes of the Natives: Lessons from the Age of Mass Migration." *Review of Economic Studies*.

Tesler, Michael. 2012. "The Spillover of Racialization into Health Care: How President Obama Polarized Public Opinion by Racial Attitudes and Race." *American Journal of Political Science* 56 (3): 690–704.

Tingley, Dustin. 2012. "Public Finance and Immigration Preferences: A Lost Connection?" *Polity* 45 (1): 4–33.

Tomlinson, Jim. 2017. "Brexit, Globalisation, and De-industrialisation." VoxEU.org, April 21, 2017. https://voxeu.org/article/brexit-globalisation-and-de-industrialisation.

Valentino, Nicholas A., Stuart N. Soroka, Shanto Iyengar, Toril Aalberg, Raymond Duch, Marta Fraile, Kyu S. Hahn, Kasper M. Hansen, Allison Harell, Marc Helbling, Simon D. Jackman, and Tetsuro Kobayashi. 2017. "Economic and Cultural Drivers of Immigrant Support Worldwide." *British Journal of Political Science*. https://doi.org/10.1017/S000712341700031X.

Wright, Matthew, Morris Levy, and Jack Citrin. 2016. "Public Attitudes toward Immigration Policy across the Legal/Illegal Divide: The Role of Categorical and Attribute-Based Decision-Making." *Political Behavior* 38 (1): 229–53.

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What They Were Thinking Then: The Consequences for Macroeconomics during the Past 60 Years

George A. Akerlof

When I started graduate school in 1962 at the Massachusetts Institute of Technology, a particular version of Keynesian economics was ascendant, both within the field of economics and in the broader society. Just three years later (in December 1965), *Time* magazine put Keynes on the cover, even including a presumed endorsement from Milton Friedman: "[W]e are all Keynesians now." (More accurately, as Friedman [1966] quickly protested, he had offered only the Delphic pronouncement: "In one sense, we are all Keynesians now; in another, nobody is any longer a Keynesian.") *Time* was the country's most influential newsmagazine at the time. Its embrace of Keynes was especially noteworthy because the magazine had always emphatically supported "the free enterprise system," whereas Keynes and his disciples had long been accused of socialist leanings. At Harvard, for example, Alvin Hansen and his fellow Keynesians had been attacked by an alumni association called Veritas, for their alleged communism (Skousen 1992, 21; Dobbs 1960). With its cover-story endorsement of Keynes, *Time* about-faced on Keynes, while still sticking to its guns regarding free enterprise; now that aggregate demand management freed the economy from busts, free enterprise could be further empowered to provide a new era of prosperity. It appeared that the Keynesians had obtained a complete win.

The primary public policy lesson of Keynesian economics—that we now knew how to respond to economic downturns—had been a hard-won fight. It had been fought for decades, with high stakes: nothing less than the maintenance of full employment, rather than lapses into Great Depression. As I was beginning graduate

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school, Cambridge, Massachusetts, under the leadership of MIT's Paul Samuelson, had taken over from Cambridge, England, as the center for Keynesian economics. The adoption of this message was also extremely personal to me: its propagation was then, at age 22, my self-assigned life's mission. It continues to this very day: 57 years later.

This article begins with a review of the two main textbook approaches that had evolved by the early 1960s to incorporate the musings of Keynes: the Keynesian cross from Samuelson's (1948) introductory textbook and the complete, well fleshed-out model in Gardner Ackley's (1961) advanced macro textbook. This Keynesian-neoclassical synthesis followed a pattern set by Hicks (1937) by focusing on certain elements of Keynes, while setting aside others. Some potential weaknesses of the specific approach in these models were, at least vaguely, sensed at the time. For example, Hicks had, at least obliquely, mentioned the neglect of inflation expectations. In other cases, the model left out topics that Keynes had treated as important, such as the dangers of financial crises and the role of social norms in wage bargaining, and what these topics implied about the potential importance of multiple equilibria in macroeconomic outcomes. However, the Keynesian-neoclassical synthesis of the 1960s was flexible enough that it encouraged a large body of work. The article will show that this work was based on a style that I call "one-deviation-at-a-timism" (a phrase adapted from Caballero 2010). As I will demonstrate, one-deviation-at-a-time constraints have had real consequences for macroeconomics. For example, they have resulted in lack of attention to financial crashes as a macro topic; they have also resulted in the omission of plausible models with very different core conclusions regarding the effectiveness of macro stabilization.

My concerns can be expressed in the terminology of Thomas Kuhn (1962). What was the dominant paradigm for macroeconomics in the early 1960s? What were its vulnerabilities? What was the resistance to addressing these vulnerabilities? Do these vulnerabilities still remain? I shall address these questions regarding the field of macroeconomics from two intertwined perspectives: my perception of what they were thinking as I began graduate school at MIT in 1962, and my view as I look back on the developments in macroeconomics over the past 57 years.

Early 1960s: Macro at MIT and Acceptance of Keynes

Kuhn (1962) also tells us that the textbooks of a scientific field are fertile hunting ground for its paradigms. Macro at the MIT of 1962 was a tale of two textbooks. At the time, Paul Samuelson of MIT was the world's most famous living economist, known for his *Foundations of Economic Analysis* (Samuelson 1947) and for his numerous articles (Samuelson 1966), but especially for his bestselling introductory textbook (Samuelson 1948). Its early editions began with macroeconomics based on the keystone "Keynesian cross" diagram of Samuelson's invention (Pearce and Hoover 1995), which was the uncontested heart of macroeconomics at MIT. (As a reminder, the Keynesian cross plots income on the horizontal axis and

expenditures on the vertical axis. Equilibrium occurs where income and expenditures are equal—along a 45-degree line from the origin—but this equilibrium could occur either as a "deflationary gap" below full employment, or at full employment, or as an "inflationary gap" above full employment.) The analysis behind the figure explored the consequences of observing that, as Keynes (1936) had claimed, equilibrium income occurs where desired savings equals desired investment. Any difference between desired savings and desired investment would represent a gap between production and sales, which, in turn, is undesired inventory accumulation. Production then becomes a natural equilibrator: producers with unintended inventory *accumulations* will decrease production; those with unintended *decumulations* will increase production.

The policy response implicit within the model was that fiscal policy could be used to overcome a situation in which a high level of desired savings was leading to a macroeconomic equilibrium below full employment. Keynes had solved this problem by invoking income—a variable other than prices—as the major macroeconomic equilibrator. Thus, that $C + I + G$ "Keynesian cross" was the key response to doubts regarding the possibility of an unemployment equilibrium. At the same time, the model showed that increases in government spending, or decreases in taxes, could be expansionary. The great public policy question of the day—how to fight underemployment—had thus also been solved. This message, significantly homegrown at MIT, was revolutionary relative to the thinking of the early 1930s, when economists could reach no clear consensus regarding how to restore full employment.

While Samuelson's Keynesian cross diagram described the basic determinants of equilibrium income, economists had also felt it necessary to fill out the model so as also to include the determination of the aggregate price level, asset prices (as inverse to the interest rate), and wages. The determination of all three was in the standard model of the time, as well described in a second textbook, Ackley's (1961) *Macroeconomic Theory*.[1] The model was rooted in an aggregate-demand/aggregate-supply equilibrium. Aggregate demand was determined by the Keynesian IS-LM equilibrium. Aggregate demand had a downward slope with respect to price, because with a given money supply, lower prices would accommodate both higher real transactions and higher real "speculative demand." On the other side, aggregate supply had an upward slope with respect to the price level, because with a fixed money wage, at higher prices, competitive firms would find it profitable to put more labor to work. Equilibrium in the economy occurred at the price level and national income at which aggregate demand equaled aggregate supply. Wages were fixed at any moment in time, but they responded to aggregate demand according to a Phillips curve relationship: the lower the unemployment rate, the higher was nominal-wage growth.

[1] Ackley's primary academic affiliation during his career was the University of Michigan, but in the 1960s, his textbook took on added prominence from his role as a member of the Council of Economic Advisers from 1962 to 1964, and then as chair from 1964 to 1968.

By the time I came to MIT, this "model," which Samuelson called "the Keynesian-neoclassical synthesis" (Blanchard 1991), had become accepted wisdom. For MIT graduate students at this time, the state of macroeconomics conveyed to us was that the issue of macro stabilization had been resolved; it was no longer a desirable topic for theoretical research. Indeed, the first-term macro PhD class safely could be relegated to a faculty member outside of the field of macroeconomics, with strong reliance on the Ackley textbook.

Given that the adaptation of Keynes to include neoclassical supply had resolved the determination of the price level and asset prices (as inverse to the interest rate), it only remained to turn the model over to the econometricians. In the 1960s, their models would be applied to the task of "getting America moving again" after the high unemployment of the late 1950s. Samuelson and friends would be advisors to the new Kennedy administration. It was further understood among us graduate students that the ongoing research in business cycle macroeconomics was beyond our pay grade. At MIT, Albert Ando and Edwin Kuh were contributing to the large-scale Brookings model of the US economy (Duesenberry et al. 1965), but the collaborative nature of this research with high-level contributors from other universities and from Brookings posed a hurdle too high for us.

Instead, MIT graduate students with a macroeconomics bent flocked into growth theory: pushed by the presumed end of straight macro as researchable, while also being pulled by Robert Solow's recent research. That especially included the role of the "residual," rather than capital accumulation, as the main driver of productivity growth (Solow 1957).[2]

But proclamations of the end of macroeconomics were premature. As we would learn, that standard model failed to answer some fundamental questions.

The Keynesian-Neoclassical Synthesis and the Duty to Defend It

In summary, here's what they were thinking about macroeconomic stabilization and business cycles at MIT in the early 1960s. A hard and important problem, where a lack of understanding had led to the long continuation of the Great Depression, was now solved. In the form of the Keynesian-neoclassical synthesis, it offered a solution that could also inform policy even after the economy had recovered. Questioning the model then would be dangerous: it might divert the public, already misguided by their misunderstandings of economics, away from the expansionary fiscal policy needed to hold unemployment at bay.

I once saw this implicit, but rarely expressed, message stated openly. It took place in a seminar on money and banking, taught by Samuelson in spring 1964. His idiosyncratic teaching style was to ramble through class with his reflections of the

[2]It also included his modeling of capital of different quality: that capital of later vintage would be the carrier of economic growth, and that the usage of capital would be flexible at the time of construction (putty), but inflexible afterward (hard-baked clay) (Solow 1962a, b).

moment; at the end, usually running into overtime, he would give his take on the syllabus topic for the day. In one of his class-time ramblings, Samuelson told us of a special problem regarding the Phillips curve.

An article by him and Solow had plotted the rate of change of hourly earnings and unemployment by year for the US economy. They said that this plot gave the policy trade-off between inflation and unemployment. Zero inflation would entail about 5.5 percent unemployment; 4.5 percent inflation would result in unemployment of 3 percent (Samuelson and Solow 1960, 192–93). The heart of US aggregate macro policy was to choose the optimal trade-off between unemployment and inflation over this range.

But Samuelson alerted the class to a potential problem with this conventional wisdom. Maybe, he said—just maybe—with high levels of employment, inflationary wage and price changes that would occur would feed back into higher inflationary expectations. And, if those higher expectations themselves were added onto the wage (and price) changes, inflation would accelerate. Thus, the trade-off would not be between unemployment and a constant *level* of inflation; it would be between unemployment and the *acceleration* of inflation.

Samuelson revealed his own take on this proposition. Belief in it would result in contractionary policies: aimed at keeping inflation low, thereby resulting in high unemployment. Belief in this accelerationist theory, if it was erroneous, would then have a high cost. The decreased inflation would, mainly, just relieve a nuisance (who *really* cares very much if we pay high prices to ourselves?);[3] however, the resultant increases in unemployment would put people out of work, and production would be lower. Asymmetrically, if policymakers did not believe in the accelerationist theory—yet it turned out to be correct—the cost of that error would be slight. The higher inflation that resulted from the erroneous belief would cause only small losses in welfare (we were paying those high prices to ourselves), and furthermore, the loss from the high unemployment when inflation had to be prodded back to normal would be largely offset by the more than full employment from the times when inflation had been on the rise.

Then it happened. Just three and a half years later, Samuelson's chickens came home to roost. Milton Friedman (1968) would make this accelerationist argument the theme of his American Economic Association presidential address. Together with the stagflation that occurred shortly thereafter, this address exploded the field of macroeconomics. Later, Samuelson would publicly confess that he had lost sleep over this possibility. Here in the *Journal of Economic Perspectives*, Samuelson (1997, 156) wrote: "In Camelot [that is, Kennedy administration] counsels I was at first too pessimistic about the possibility of stagflation ahead. . . . Alas, by 1965 and for 15 years, my fears proved all too prescient."

[3] Of course, this is not taking into account Friedman's (1969) concerns that inflation would act like a tax on the use of money, with consequent deadweight losses in welfare. Rightly or wrongly, those losses were viewed as small relative to the reduction in welfare from higher unemployment.

As I look back on it now, I see that in that class-time musing, Samuelson had entrusted us students with the major unspoken secret of the Temple of Keynesian Macroeconomics. He had also revealed the ill consequences that would occur if that secret became known. No graduate student at MIT took on the accelerationist view of the Phillips curve as a research topic. For us students in the Temple, that would have been unthinkable: it was our moral duty to keep the secret entrusted to us. So on to growth theory, where little damage could be done, for example, by proofs that there was no steady state for an economy without Cobb–Douglas production functions and without labor-augmenting technical change, which was the subject of my first (joint) paper (G. Akerlof and Nordhaus 1967). But that turn to growth theory was an unfortunate choice, because the Keynesian-neoclassical synthesis was not the end of macroeconomics. Much fundamental work remained to be done.

The seeds of the macro of the 1960s, with its sins of omission, can even be seen as early as the immediate, Big Bang aftermath of the publication of *The General Theory* (Keynes 1936). In his famous review, "Mr. Keynes and the 'Classics,'" John Hicks (1937) introduced the IS-LM analysis that would set the tone for the incorporation of Keynes into mainstream economics. The overtone of that essay is the concept of IS-LM analysis, which Hicks called his "little apparatus." But "Mr. Keynes and the 'Classics'" also had an undertone: that Keynes had overclaimed the originality and generality of his work. Hicks's second sentence says that Keynes had written a "*Dunciad*"—that is, Keynes had called his fellow economists "dunces." Hicks (1937, 147) said that those fellow economists were "bewildered," because they had not understood that they ascribed to the beliefs attributed to them in *The General Theory*. For example, while Keynes claimed that he had disproved Say's law, he offered no example of any contemporary economist who was such a dunce as to have this belief. Even so, Keynes was correct, Hicks argued, because Say's law was implicit in the standard economic theory of the time—that is, as long as all economic equilibria were attained with only prices as the equilibrators of supply and demand, an underemployment equilibrium was impossible. Thus, Hicks (1937) is effectively claiming that the dunces of the economics profession were only in disagreement with Keynes insofar as they had not yet seen the special cases described by his "little apparatus" of IS-LM. His rescue mission would empower those maligned economics professor dunces to take the IS-LM jewel home, as a useful ornament to their classical macro models.

The addition of classical supply of output to the model had further advantages from a research perspective. It could be easily nested within a general equilibrium model. Such models are, by nature, fractal—in the sense that they keep the same form, irrespective of the number of markets.[4] This fractal form allowed the econometricians—in due course with their computers—to go to town. The Keynesian-neoclassical model was easily expandable to many-equation, many-sector models of the economy. Furthermore, this model could be seasoned with bells

[4]This meaning of "fractal" is from http://mathworld.wolfram.com/fractal.html.

and whistles, such as monopolistic competition, monopsonistic labor supply, and staggered contracts, according to taste. Time-series models such as ARMA (autoregressive moving average) or ARIMA (autoregressive integrated moving average) models were waiting in the wings to add elegant dynamics that appeared to have considerable generality. As a further merit, this model also had a unique equilibrium, so that its comparative statics was also unique.

The range of possible extensions of the Keynesian-neoclassical synthesis has then encouraged a research agenda of "one deviation at a time" and looking at how such deviations shifted the equilibrium. At the same time, it has also discouraged non-neoclassical thinking, which would require more fundamental changes to the model.

Financial Crashes and the Economy

In the push to assure acceptance of the dominant-paradigm Keynesian-neoclassical synthesis, a major macroeconomic question was left unresolved: what is the basic reason for very hard times that especially require fiscal or monetary stimulus? Keynesians such as Hicks (1950), Kaldor (1940), and Samuelson (1939) offered answers to that question—based on small deviations from the standard framework—with dynamic multiplier-accelerator models of investment and savings.

But in chapter 12 of *The General Theory*, on "the state of long-term expectation," Keynes (1936) had suggested a very different analysis of boom and bust: those bad times result largely from financial fragility. Famously, in that chapter, Keynes (1936, 140) analogized stock prices to the outcomes of a newspaper beauty competition. Entrants to that contest would choose the most attractive faces from a batch of photographs—with prizes awarded not to those who picked the most attractive by some external standard, but instead to those who chose the faces picked by the greatest number of *other* contestants. The outcomes of such a contest did not necessarily depend on the "fundamentals"—that is, individual views regarding the faces. Instead, contestants would be trying to deduce what other contestants would be taking into account about what others were also thinking.

Again, we can look to Hicks (1937) in "Mr. Keynes and the 'Classics'" as the harbinger regarding how mainstream economics would handle these verbal musings in *The General Theory*. The first sentence of that article says: "IT WILL BE ADMITTED [capitalization in the original] by the least charitable reader that the entertainment value of Mr. Keynes' *General Theory of Employment* is considerably enhanced by its satiric aspect." Those opening words were not just an odd aside: on the contrary, Hicks's major purpose was the rescue of IS-LM from *The General Theory*'s mess-heap of "satiric entertainment." That first sentence was thus a dog-whistle warning sign against paying much attention to those ruminations from Keynes on such topics as beauty contests.

But Keynes (1936) had included the beauty contest metaphor for a very good reason, which would differentiate his original approach from the neoclassical

synthesis versions of the Keynesian model that emerged. The realm of possible (Nash) equilibria in the beauty contest is truly remarkable. Any "point" in that beauty contest—that is, any one of the faces—could be an equilibrium. The equilibrium that was reached would not just depend upon fundamentals regarding which was the "prettiest" (Keynes 1936, 140) face. *Every one* of the faces could be a (Nash) equilibrium. It all depended on how others thought that others would vote.

In concert with modern game theory, finance theorists have evolved a sophisticated understanding of why Keynes's beauty contest is central to the theory of financial crash.[5] A very simple game (adapted from Atkeson 2001)[6] describes the skeleton of such models. In this game players have two choices: to continue to hold an asset or to sell it. With economic conditions sufficiently strong, the incentives to hold may be so strong that it pays to do so, even if everyone else sells. In this case, there is only one equilibrium: everyone holds, and the price of the asset remains high. With economic conditions at the opposite extreme, the incentives to hold may be so weak that it pays to sell, even if everyone else keeps it. Again, there is only one equilibrium: but this time everyone sells. But between these two extremes, in such a game, there is the possibility of an intermediate range with a threshold level of holders. If the number of holders exceeds the threshold, it pays to hold; if that number is below the threshold, it pays to sell. If such a model describes asset markets, financial equilibria are likely to be fragile for two reasons. First, within the intermediate region, there may be chain-reaction changes—from above the threshold to below—in people's expectations regarding whether others will hold or sell. Second, the economic environment may change, which drives the model from the safe, always-hold region into the fragile region of sometimes hold/sometimes sell (depending on the threshold).

Three examples illustrate the centrality of the preceding skeleton for leading models of financial crash: bank runs, fire sales with collateralized loans, and currency speculations. In a *bank run* model (like that of Diamond and Dybvig 1983), if only the usual transactors are making withdrawals, there is not much reason to line up at the bank. But if others are lining up out of fears of its insolvency, there is reason to rush to be among those first in line to retrieve one's deposit. In models of *fire sale crashes with collateralized loans* (Shleifer and Vishny 1997, 2011),[7] short-term lenders hold collateral from leveraged borrowers. Absent a decline in the value of the collateral, the borrowers do not have special need to sell it. But once such declines have begun, forced sales can trigger a vicious cycle of further declines in asset values and further forced sales. In models of *currency speculation* (as in Morris and Shin 1998),

[5]These models especially involve the role of credit, whose role in the business cycle had been earlier emphasized by Minsky (1975). Credit often involves the following feature: if I give credit to a firm, I am better off (safer) if you also give it credit, and vice versa. As explained further below, this feature of credit plays a major role in financial crash, since it can engender chain reactions both in the buildup and then in the withdrawal of credit.

[6]Atkeson, in turn, is commenting on Morris and Shin (2001).

[7]In exactly the same spirit, but with rather different modeling, Kiyotaki and Moore (1997) have shown how debt and collateral can amplify the effects of productivity shocks.

the payoff to withdrawal into a foreign currency is negative if other speculators do not make that move. However, the payoff to such withdrawal to a foreign currency is likely quite high if a large number of speculators also withdraw.

Each of these three examples of financial crash shares a crucial feature: those who continue to hold a position, or to withdraw from that position, are positively related to the numbers of those who take the same action. But such representation of financial markets had no substantial place in mainstream macroeconomics in the period leading up to the Great Recession. In the aftermath of the 2008 crash, Ricardo Caballero (2010, in this journal) explained why macroeconomists had not predicted it. He said that macroeconomists had a modeling aesthetic based variously on either dynamic stochastic general equilibrium or neo-Keynesian models, and while researchers permitted themselves to depart from such baseline models, they allowed themselves only one deviation at a time. I agree.

But as the preceding description shows, standard models of financial crash differ fundamentally from the standard macro models. Equilibria of those "neoclassical synthesis" models are stable at the point where aggregate demand equals aggregate supply. A small (ε) shift in aggregate demand, or in aggregate supply, produces a small (proportional to ε) shift in the equilibrium. On the contrary, again following Atkeson (2001), the skeleton crash models have the opposite behavior in the region of interest (that is, in the region where the crash occurs). In that region, a small decrease in the number of those who hold their financial assets, or a small increase in the number of those who sell (or perhaps just wish to sell) their financial assets, can produce a crash. These two types of model, then, typically do not fit well together. On the one side, the neoclassical models tend to have unique equilibria. On the other side, multiple equilibria are natural in beauty contest models. Keynes's example is especially stark, as any one of the "faces"—that is any "point" in the competition—could be an equilibrium. The two types of model thus do not easily nest each other.

Between modern macroeconomic models and the models of financial crash, the incentive structures are also correspondingly different. In dynamic stochastic general equilibrium or neo-Keynesian models, I want you to have the *opposite* behavior from myself. If there is an additional supplier, I am more likely to make a purchase because I can buy at a lower price; correspondingly, if there are additional demanders, I am more likely to become a supplier, because I can sell at a higher price. But in contrast, in the models of financial crash, additional sellers of assets cause not additional buyers but rather additional sellers. Figuratively, they too join the line to withdraw their money at the bank; they too make a fire sale of their collateral; or they too dump their currency to take advantage of the devaluation that is increasingly likely as the number of others who are dumping increases. It is thus difficult, if not impossible, to produce an aesthetically pleasing model that combines the two types of equilibrium. Such a model would be the equivalent of chicken ice cream.

This takes us back to *what they were thinking* in that primordial time when *The General Theory* was being adopted as the core of macroeconomics, which is also the

time when major mechanisms for describing financial crashes were removed from macroeconomists' deck of cards. The macroeconomics of financial crash was sent off for adoption to the field of corporate finance. There it languished, as a mostly ignored stepchild. Thus, Jean Tirole (2010) included this topic in his hefty summary of *Corporate Finance*—but only in the grab-bag last section, on "Macroeconomics and the Political Economy of Corporate Finance" (469).

After the banking reforms of the 1930s, such a division of labor between macroeconomics and finance may have been reasonable, as long as banks dominated the financial system. In this case, the major threats to financial stability would come from bank runs—and those bank runs had been rendered unlikely by the advent of deposit insurance. If depositors suspected their bank might be insolvent, deposit insurance greatly reduced their incentives to be first in line to make their withdrawals. Perhaps equally important, the supervision of banks that protected the Federal Deposit Insurance Corporation offered a further bulwark against bank runs, because it greatly reduced the chances of an insolvency.[8] In this context, little damage could be done by macro models lacking the details of the financial system.

But exclusion of such detail (with the attendant possibility of financial crash) from standard macroeconomics *could* be a problem in a different context: if the financial system changed in fundamental ways. That was exactly the topic of Rajan's (2005) Jackson Hole talk, "Has Financial Development Made the World Riskier?" which *did* predict the crash of 2008 as it actually happened. In terms of the skeletal model, had that "financial development" beyond a well-supervised banking system with deposit insurance driven the financial system out of the safe region of always-hold? In September 2008, the answer to Rajan's question became clear: "yes, it had."

This is a case where the path taken by macroeconomics after the publication of *The General Theory*, from the Hicks (1937) review up through the 1960s, turned out to have serious consequences. For example, the discussions about the costs and benefits regarding financial deregulation in the 1990s gave far-from-sufficient weight to the macroeconomic risks of financial crash.

Limited Perspective on the Role of Inflationary Expectations

This article has already touched on the vulnerability of the Keynesian-neoclassical synthesis to considerations of inflationary expectations. Following Friedman (1968) and also Phelps (1967, 1968), it quickly became conventional wisdom that the only "theoretically correct" representations of wage bargains added inflationary expectations one-to-one into wage adjustments.[9] In that case, monetary policy could, at most, stabilize the economy around a single unemployment rate, the NAIRU (the

[8] Additionally, the Federal Reserve had powers to make loans to banks (and even nonbanks) under pressure, as long as they could provide sufficient collateral.

[9] In algebraic terms, Phillips curves would *only* be of the form $\dot{w}/w = f(u) + \pi^e$, where $\dot{w}/w$ is the rate of change of wages, u is the unemployment rate, and π^e is the expected rate of inflation.

nonaccelerating inflation rate of unemployment). A few years later, Lucas (1972, 1973) and Sargent (1973) would go yet further: if those inflationary expectations, in addition, were formed according to rational expectations, systematic monetary policies could not even be used for stabilization, because expected changes in the money supply would be exactly offset by equal percentage changes in prices. With the removal of some of the extreme assumptions in the Lucas and Sargent models, New Keynesian models with just a bit of nominal rigidity—for example, with staggered nominal-wage (or nominal-price) setting—monetary policy could be stabilizing, but it still would have at most very small effect (mathematically second-order) on average employment over a business cycle.[10]

These results again show the vulnerability of the early 1960s version of the Keynesian-neoclassical synthesis. According to that *Time* cover story back in 1965, aggregate demand management permanently raised average employment by selectively ironing out business cycle downturns. By the late 1970s and after, there was a question: how much bathwater had been drained from the Keynesian tub?

But that takes us again to Caballero's (2010) question: did macroeconomists' one-deviation-at-a-timism surrender too much, this time in regard to accelerationist modeling? Were they too quick to accede to Friedman's (1968) argument that Phillips curves would automatically be augmented one-for-one by inflationary expectations? A paper by Robert Akerlof (2016) provides the basis for revisiting this question;[11] it gives a general explanation of why dual equilibria are common in the enforcement of a norm. In one of the two dual equilibria, the norm is generally obeyed, and it is enforced. Why is it enforced in this equilibrium? With most people following the norm, as they do *in this equilibrium*, a violation would identify a violator as an unusual, "unreasonable," "bad" person, and so the violator would be punished. The prospect of such punishment enforces the norm. In contrast, in the other equilibrium, the norm is not obeyed, and it is not enforced. Why is it not enforced? Because most people *in this other equilibrium* violate the norm, a violator is not identified as an exceptional, "unreasonable" person. Since most other people behave in the exact same way, the violation will be excused. Thus, the norm will not be enforced.

The preceding line of argument can be adapted to show why there are also likely to be dual equilibria regarding cost-of-living adjustments (COLAs) in the labor market. In one of the two equilibria, most employers are giving COLAs. Employees who are taking cues from workers' treatment in other firms will then have special reason to be aggrieved if their employer does not give them a COLA: not only has their employer denied them something they deserve, the employer is also revealed to be "unreasonable." In this equilibrium, employers have a special incentive to

[10] According to Lucas (2003), the gains in average employment from stabilization in such New Keynesian models are mathematically second-order. His simulations, in which the gains in employment from stabilization were economically insignificant in size, bore out the relevance of that observation.

[11] Anderlini and Terlizzese (2017) have also, rather similarly, described dual equilibria, regarding levels of trust.

grant a COLA: they will want to prevent the morale consequences from appearing "unreasonable." In contrast, in another equilibrium, in which COLAs are granted by very few firms, employers will not have the preceding incentive to grant COLAs. Why not? Employees, seeing that most other firms are not giving COLAs, will be likely to excuse a similar denial by their own employer. After all, in this case, their employer, who is just behaving like most other employers, does not stand out as "unreasonable."

It turns out that considerable evidence accords with predictions of the dual-equilibrium model. Especially, there seem to be times when cost-of-living adjustments are generally granted (typically when inflation is high), and times when COLAs are generally denied (typically when inflation is low). As a first bit of evidence, as inflation increased in the United States over the 1960s and 1970s, the fraction of union workers covered by contracts with formal COLAs rose from approximately 22 percent in 1966 to 61 percent in 1976; then, as inflation receded, with the recession of 1981–1982, this fraction declined rapidly, back to 22 percent in 1995 (Ragan and Bratsberg 2000, 304, 306 [fig. 1]). This variation in COLA contracts contrasts with the prediction of the standard accelerationist models, in which COLAs are uniformly one-to-one with both high and low inflation.

A paper by me, William Dickens, and George Perry (G. Akerlof, Dickens, and Perry 2000) offers a second bit of evidence of times with general grant of cost-of-living adjustments and also times of general denial. Across many specifications of regressions of wages against unemployment and lagged inflation, the average sum of the coefficients on lagged inflation was 0.25 when inflation was low, which contrasts with an average sum of 0.82 when inflation was high (23). The low-inflation samples were for quarters when average inflation had been less than 3 percent in the previous five years; the high-inflation samples, for quarters when inflation had been in excess of 4 percent (22).[12]

The theory also offers a possible explanation for the direction of switches in equilibrium between times of high and low inflation.[13] For example, a switch from a no-cost-of-living-adjustment equilibrium to a COLA equilibrium will occur if, no matter what other employers do, workers' anger at their own employers' failure to give COLAs is sufficient to enforce the norm. It is plausible such a level of anger will occur if inflation is sufficiently high and if unemployment is sufficiently low. The direct cost to employees of denial of a COLA increases proportionately as inflation rises,[14] and workers' anger is also more likely to be stoked the lower is

[12] Price changes regressed likewise on unemployment and lagged inflation show similar but less dramatic differences: in this case, the average sum of coefficients on lagged inflation was 0.60 at low inflation and 0.95 at high inflation (G. Akerlof, Dickens, and Perry 2000, 23). Results are similar when the inflation variable is survey-reported inflation expectations.

[13] In work in progress, Jeffrey Butler and I are building a model with this property.

[14] So too the gain to employers from denial of the COLA increases proportionately with inflation. But, quite plausibly, the employees' anger, with the consequent costs they inflict on their employers, increases more with inflation than these gains to the employers. If inflation is very low, the employees are likely to ignore denial of a COLA, but as inflation increases, their anger (and consequent punishment of their

unemployment (so that their employer is doing them less of a favor by giving them a job). A similar argument explains why the equilibrium will switch in the opposite direction if inflation is sufficiently low and unemployment is sufficiently high.

Furthermore, there is an episode in US macroeconomic history when economic policy seemingly engineered a switch from an equilibrium with cost-of-living adjustments to an equilibrium without them. But it took a recession with very tight monetary policy and with very high unemployment to accomplish the change. Throughout the 1960s and 1970s, inflation escalated, as the Federal Reserve's employment targets were unrealistically high. Then, finally, in the early 1980s, Federal Reserve Chair Paul Volcker decided that enough was enough (Orphanides and Williams 2013). But the reversion to low inflation did not occur easily. In the recession of 1981–1982 that ensued, unemployment rose to 10.6 percent, and the grant of COLAs, as we have seen in the case of formal union contracts, very much moderated. Of course, there are other possible causes for the decline, including the onset of permanent threat to US manufacturing jobs, deunionization of the private sector, and the collapse of oil prices. Suggestive that there was a switch of equilibrium, a period of high employment and nonaccelerating inflation followed.[15] That period is called the "Great Moderation."

Going back to the earlier discussion, relative to the approach of Samuelson and Solow (1960), the dual-equilibrium model gives a new view of optimal macro policy. For them, macro policy entailed making the best choice in the trade-off between inflation and unemployment, as indicated by their estimated Phillips curve. The dual-equilibrium model gives a more nuanced view: more generally, the optimal policy is to choose such a trade-off, but with a further constraint. Inflation and employment should be kept below levels that will cause the migration of the equilibrium from denial of cost-of-living adjustments to one in which they are commonly granted.

The preceding discussion of cost-of-living adjustments to wages—when they are granted, when they are denied—is, of course very special. Of course, there are many other possible norms regarding wage setting, including many other possible norms regarding COLAs. But even if the example is only illustrative, it is also the tip of an iceberg, because it suggests more general questions: What is the role of norms

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employer) is likely to increase more than proportionately. In contrast, it is likely that the benefit to the employer from the money gain from the denial will be strictly proportional to its cost to him. With these assumptions, sufficiently high inflation, *all else equal*, will result in enforcement of the norm. But the level of employment—whether high or low—can also have overriding influence on enforcement of the COLA norm.

[15] The dual-equilibrium model of the role of inflationary expectations then takes us back to the criticism by Lucas (2003) discussed above in footnote 10: that stabilization policies will result in only second-order increases in *average* employment—even in New Keynesian models. But there can be first-order increases in average employment if there are dual equilibria. In this model, stabilization will result in first-order increases in employment if it prevents shifts from a deny-COLA to a grant-COLA equilibrium. The reason is simple. We have seen, with the example of the 1981–1982 recession, that it took very high unemployment to drive the equilibrium back to one in which COLAs were rare. For that to occur, unemployment had to rise so high that workers would accept the denial of a perk that had become common practice.

in wage setting? And among the many different possible norms, what will be the possibilities of multiple equilibria? In chapter 2 of *The General Theory,* Keynes (1936) was emphatic that norms of wage setting—especially including nominal, rather than just real, considerations—play major roles in such bargains. Macroeconomists' quick adoption of the accelerationists' arguments that inflationary expectations uniformly impact wage and price changes one-for-one is thus another symptom of the dismissal of Keynes's "satiric entertainment." It was also another example of macroeconomists' adherence to one-deviation-at-a-timism, and their antipathy to multiple beauty-contest equilibria. Much important work in this area remains to be done.

Summary

The adaptation of *The General Theory* into the Keynesian-neoclassical synthesis neglected multiple vulnerabilities of the resultant model. Of course, there were reasons for this adaptation, prominently including a desire to build a professional consensus in support of activist Keynesian fiscal policy. By creating a model with an aggregate supply side that was classical in nature, and that allowed plentiful opportunities for economists to practice one-deviation-at-a-time analysis, support was indeed bolstered for Keynesian policy. But Keynesian economists became overly attached to *their* paradigm. They were dismissive of anomalous observations that indicated the need for new, more nuanced economic thinking.

The Keynesian-neoclassical synthesis that had emerged by the early 1960s put constraints on macroeconomics. Foremost, it divorced macroeconomists from working on financial stability. Luckily, after the crash of 2008, the prior work of finance economists has been belatedly acknowledged, and the subfield of macro stability has also emerged as quite possibly *the most* vibrant research frontier in economics.[16] Nevertheless, macroprudential concerns remain as back matter in the textbooks. Correspondingly, macroprudential policy is undervalued in the councils of government. Yet its importance remains, given the likelihood of another crash. In these consequential ways, macroeconomists' dismissal of "satiric entertainment" in the decades after *The General Theory* still lives with us. If there is blame to be faced, I confess that it should be placed on me as much as on anyone else. I tried, but I too was one of those macroeconomists.

■ *I thank Jeffrey Butler, Robert Johnson, Hui Tong, and Janet Yellen for invaluable comments.*

[16] As one indicator, see the Symposium on Financial Stability Regulation in the Winter 2019 issue of this journal. Even the briefest summary of the excellent work in this field would more than double the length of this essay.

References

Ackley, Gardner. 1961. *Macroeconomic Theory*. New York: Macmillan.

Akerlof, George A., William T. Dickens, and George L. Perry. 2000. "Near-Rational Wage and Price Setting and the Long-Run Phillips Curve." *Brookings Papers on Economic Activity* 2000 (1): 1–60.

Akerlof, George A., and William D. Nordhaus. 1967. "Balanced Growth—A Razor's Edge?" *International Economic Review* 8 (3): 343–48.

Akerlof, Robert. 2016. "Anger and Enforcement." *Journal of Economic Behavior and Organization* 126 (Part B): 110–24.

Anderlini, Luca, and Daniele Terlizzese. 2017. "Equilibrium Trust." *Games and Economic Behavior* 102 (1): 624–44.

Atkeson, Andrew. 2001. "Comment on Morris and Shin's 'Rethinking Multiple Equilibria in Macroeconomic Modeling.'" *NBER Macroeconomics Annual* 15 (1): 162–71.

Blanchard, Olivier Jean. 1991. "Neoclassical Synthesis." In *The World of Economics*, edited by John Eatwell, Murray Milgate, and Peter Newman, 504–10. London: Palgrave Macmillan.

Caballero, Ricardo J. 2010. "Macroeconomics after the Crisis: Time to Deal with the Pretense-of-Knowledge Syndrome." *Journal of Economic Perspectives* 24 (4): 85–102.

Diamond, Douglas W., and Philip H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91 (3): 401–19.

Dobbs, Zygmund. 1960. *Keynes at Harvard: Economic Deception as a Political Credo*. New York: Veritas Foundation.

Duesenberry, James S., Gary Fromm, Lawrence R. Klein, and Edwin Kuh, eds. 1965. *The Brookings Quarterly Econometric Model of the United States*. Chicago: Rand McNally.

Friedman, Milton. 1966. "Letter: Friedman and Keynes." *Time*, February 4, 1966, 13.

Friedman, Milton. 1968. "The Role of Monetary Policy." *American Economic Review* 58 (1): 1–17.

Friedman, Milton. 1969. "The Optimum Quantity of Money." In *The Optimum Quantity of Money*, 1–50. Chicago: Aldine.

Hicks, John R. 1937. "Mr. Keynes and the 'Classics'; a Suggested Interpretation." *Econometrica* 5 (2): 147–59.

Hicks, John R. 1950. *A Contribution to the Theory of the Trade Cycle*. Oxford, UK: Clarendon Press.

Kaldor, Nicholas. 1940. "A Model of the Trade Cycle." *Economic Journal* 50 (197): 78–92.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest, and Money*. London: Macmillan.

Kiyotaki, Nobuhiro, and John Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105 (2): 211–48.

Kuhn, Thomas S. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Lucas, Robert E. Jr. 1972. "Expectations and the Neutrality of Money." *Journal of Economic Theory* 4 (2): 103–24.

Lucas, Robert E. Jr. 1973. "Some International Evidence on Output-Inflation Tradeoffs." *American Economic Review* 63 (3): 326–34.

Lucas, Robert E. Jr. 2003. "Macroeconomic Priorities." *American Economic Review* 93 (1): 1–14.

Minsky, Hyman P. 1975. *John Maynard Keynes*. New York: Columbia University Press.

Morris, Stephen, and Hyun Song Shin. 1998. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." *American Economic Review* 88 (3): 587–97.

Morris, Stephen, and Hyun Song Shin. 2001. "Rethinking Multiple Equilibria in Macroeconomic Modeling." *NBER Macroeconomics Annual* 15 (1): 139–61.

Orphanides, Athanasios, and John C. Williams. 2013. "Monetary Policy Mistakes and the Evolution of Inflation Expectations." In *The Great Inflation: The Rebirth of Modern Central Banking*, edited by Michael D. Bordo and Athanasios Orphanides, 255–88. Chicago: University of Chicago Press.

Pearce, Kerry A., and Kevin D. Hoover. 1995. "After the Revolution: Paul Samuelson and the Textbook Keynesian Model." In *New Perspectives on Keynes*, edited by Allin F. Cottrell and Michael S. Lawlor, 183–216. Durham, NC: Duke University Press.

Phelps, Edmund S. 1967. "Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time." *Economica*, n.s., 34 (135): 254–81.

Phelps, Edmund S. 1968. "Money-Wage Dynamics and Labor-Market Equilibrium." *Journal of Political Economy* 76 (4, Part 2): 678–711.

Ragan, James F. Jr., and Bernt Bratsberg. 2000. "Un-COLA: Why Have Cost-of-Living Clauses Disappeared from Union Contracts and Will They Return?" *Southern Economic Journal* 67 (2): 304–24.

Rajan, Raghuram G. 2005. "Has Financial Development Made the World Riskier?" In *2005 Economic Policy Symposium Proceedings*, 313–69. Jackson Hole, WY: Federal Reserve Bank of Kansas City. https://www.kansascityfed.org/publicat/sympos/2005/pdf/Rajan2005.pdf.

Samuelson, Paul A. 1939. "Interactions between the Multiplier Analysis and the Principle of Acceleration." *Review of Economics and Statistics* 21 (2): 75–78.

Samuelson, Paul A. 1947. *Foundations of Economic Analysis*. Cambridge, MA: Harvard University Press.

Samuelson, Paul A. 1948. *Economics, an Introductory Analysis*. New York: McGraw-Hill.

Samuelson, Paul A. 1966. *The Collected Scientific Papers of Paul A. Samuelson*. Cambridge, MA: MIT Press.

Samuelson, Paul A. 1997. "Credo of a Lucky Textbook Author." *Journal of Economic Perspectives* 11 (2): 153–60.

Samuelson, Paul A., and Robert M. Solow. 1960. "Analytical Aspects of Anti-Inflation Policy." *American Economic Review* 50 (2): 177–94.

Sargent, Thomas J. 1973. "Rational Expectations, the Real Rate of Interest, and the Natural Rate of Unemployment." *Brookings Papers on Economic Activity* 1973 (2): 429–80.

Shleifer, Andrei, and Robert W. Vishny. 1997. "The Limits of Arbitrage." *Journal of Finance* 5 (1): 35–55.

Shleifer, Andrei, and Robert W. Vishny. 2011. "Fire Sales in Finance and Macroeconomics." *Journal of Economic Perspectives* 25 (1): 29–48.

Skousen, Mark, ed. 1992. *Dissent on Keynes: A Critical Appraisal of Keynesian Economics*. New York: Praeger.

Solow, Robert M. 1957. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics* 39 (3): 312–20.

Solow, Robert M. 1962a. "Substitution and Fixed Proportions in the Theory of Capital." *Review of Economic Studies* 29 (3): 207–18.

Solow, Robert M. 1962b. "Technical Progress, Capital Formation, and Economic Growth." *American Economic Review* 52 (2): 76–86.

Tirole, Jean. 2010. *The Theory of Corporate Finance*. Princeton, NJ: Princeton University Press.

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The Impact of the 2018 Tariffs on Prices and Welfare

Mary Amiti, Stephen J. Redding, and David E. Weinstein

It is common for US presidents to introduce protectionist measures early in their first terms. In 1971, Richard Nixon imposed a 10 percent tariff ("surcharge") on dutiable imports; in 1977, Jimmy Carter placed a quota on shoe imports; in 1981, Ronald Reagan pressured the Japanese government to implement a "voluntary export restraint" agreement limiting the exports of Japanese automobiles to the United States; in 2002, George W. Bush imposed tariffs on steel; and in 2009, Barack Obama placed 35 percent tariffs on Chinese tires. Only George H. W. Bush and Bill Clinton seem to have resisted the pattern, with Bill Clinton actually *liberalizing* trade in his first year by signing the North American Free Trade Agreement in 1993. These examples of past unilateral US tariffs have frequently been the subject of complaints to the World Trade Organization by US trading partners.

The Trump administration followed this precedent seeking trade protection early in its first term, although it has done so with more breadth and force than episodes like the tire tariffs of 2009 or the steel tariffs of 2002. For example, the Trump administration has sought to renegotiate existing free trade agreements, like the North American Free Trade Agreement with Canada and Mexico and the

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US-Korea Free Trade Agreement. The Trump administration also withdrew from the negotiations for the Trans-Pacific Partnership, which, renamed as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, has now taken effect for the eleven countries that remained in the negotiations.

Even more notable, the United States imposed tariffs on $283 billion of US imports in 2018, with rates ranging between 10 and 50 percent. As with earlier presidential administrations, the Trump administration did not wait for authorization from the dispute settlement process of the World Trade Organization before imposing these tariffs but instead offered various US-based legal justifications. For example, Section 201 of the Trade Act of 1974, which allows protection if an import surge is a substantial cause of serious injury to an industry, was invoked for tariffs on imported washing machines and solar panels. Section 232 of the Trade Expansion Act of 1962, which allows for protection when imports threaten to impair national security, was invoked for imposing tariffs on imported steel and aluminum. Section 301 of the Trade Act of 1974, which allows the United States to impose tariffs if a trading partner is deemed to have violated a trade agreement or engages in unreasonable practices that burden US commerce, was invoked for tariffs on US imports from China.

In response to these US tariffs, China, the European Union, Russia, Canada, Turkey, Mexico, Switzerland, Norway, India, and Korea have all filed cases against the United States at the World Trade Organization. Additionally, many countries retaliated against the US actions by applying tariffs of their own. In April 2018, China began by levying tariffs on $3.3 billion of US exports of steel, aluminum, food, and agricultural products, followed by tariffs on $50 billion of US exports in July and August, and on another $60 billion of US exports in September. The European Union, Mexico, Russia, and Turkey also began levying retaliatory tariffs on US exports. All told, these retaliatory tariffs averaged 16 percent on approximately $121 billion of US exports. Such tit-for-tat sequences of imposing tariffs are typically characterized as a "trade war," a term that we adopt throughout.

In this article, we show how the economic implications of these changes in policy stance can be evaluated with conventional and straightforward economic models, together with empirically based estimates for key parameters. We begin in the next section by introducing the conventional conceptual framework for assessing the impact of trade policy, with a focus on tariffs because they are by far the most prominent form of import protection. We show that the extent to which the incidence of these tariffs falls on domestic versus foreign agents depends crucially on what happens to the price charged by foreign exporters.

The tariffs introduced by the Trump administration during 2018 have stimulated a burgeoning literature on their economic effects, including Fajgelbaum et al. (2019), Flaaen, Hortaçsu, and Tintelnot (2019), and Cavallo et al. (2019). In this article, we use these 2018 tariffs as a natural experiment to illustrate the conventional conceptual framework. Specifically, we offer some estimates of the effects of tariffs on prices and quantities of imports, and thus of associated deadweight losses. We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax

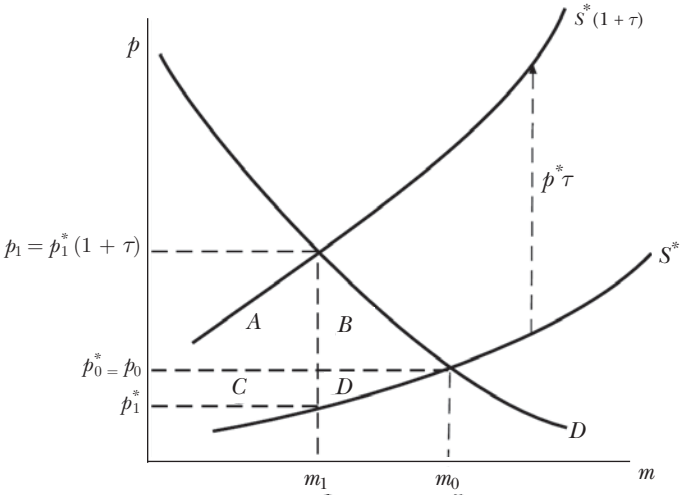
costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers. Throughout the discussion, we also offer some comparisons of our quantitative results and methodological approach to other studies of the effects of tariffs.

Conventional Theory of Price Impacts of Tariffs

The conventional framework for evaluating the effects of tariffs on prices and welfare is a partial equilibrium model of import demand and export supply with a perfectly competitive market structure. In Figure 1, the horizontal axis plots the quantity of home imports (m), and the vertical axis corresponds to import prices (p) and foreign exporter prices (p^*). The foreign export supply curve (S^*) rises with prices, which reflects the fact that higher prices induce foreign producers to increase production and foreign consumers to decrease consumption. In contrast, home import demand (D) falls with prices, which captures the fact that higher prices also reduce demand by domestic consumers and increase production by domestic firms. In the absence of tariffs, markets will clear with an equilibrium price ($p_0 = p_0^*$) that equalizes import demand and export supply when imports equal m_0.

Within this framework, an ad valorem tariff on imports of τ raises the cost of the imported good in the domestic market from p^* to $p^*(1 + \tau)$. As a result of this higher price, domestic consumers cut back demand for imports to m_1. At this import level, there is a wedge between the prices charged by foreign producers (p_1^*) and the prices paid by domestic consumers (p_1) that equals the per unit tariff being collected ($p_1^*\tau$). Home consumers lose welfare represented by regions $A + B$, with the rectangular region A reflecting the higher prices paid on the imports purchased and the triangular region B capturing the deadweight welfare loss (reduction in real income) from the distortion of domestic production and consumption decisions. The home government gains the rectangular region $A + C$ in tariff revenue. Because rectangle A represents a transfer from consumers to the government, whether the tariff benefits the country as a whole depends on the sign of $C - B$. This amount can be thought of as the difference between the gain in a country's "terms of trade" (its ability to extract rents from foreign producers by forcing them to drive their prices down in order to continue exporting to the home market) and the deadweight welfare loss given by B. The foreign country clearly loses in this setup, since an amount of their

Figure 1
Impact of a Tariff on Prices



Source: Authors.
Note: Horizontal axis shows the quantity of imports; vertical axis displays the price of the good; D corresponds to the import demand curve; S^* represents the export supply curve.

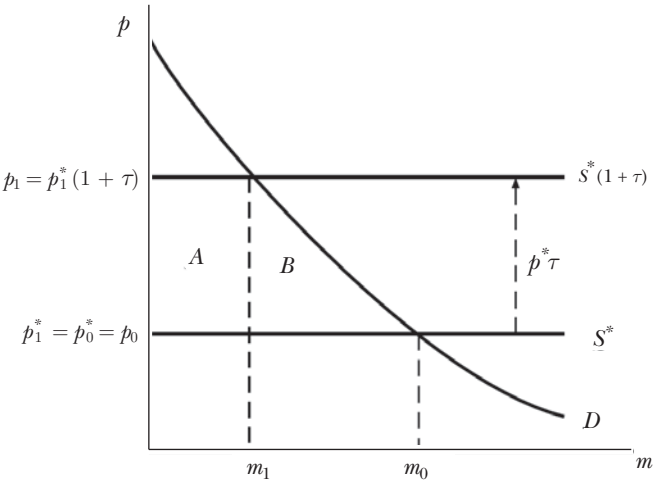
producer surplus, equal to C, is transferred in the form of tariff revenue to the home government, and the triangular region D constitutes the deadweight welfare loss from the distortion of foreign production and consumption decisions.

A clarifying special case of the impact of tariffs on prices and welfare comes when exports are supplied perfectly elastically and so the export supply curve is horizontal, as shown in Figure 2. In this case, the imposition of a foreign tariff will have no effect on foreign prices. This means that the home country will necessarily lose, because region C is zero and hence there is no term of trade gain—leaving the home country with only the welfare loss due to the distortion of domestic production and consumption decisions. Therefore, Figures 1 and 2 illustrate that the welfare effects of a tariff depend crucially on how steep the export supply curve is.

This conventional approach can be used to obtain a quantitative estimate of the effect of the import tariff on welfare. If we assume that the import demand curve has a constant slope and approximate region B by a triangle, we can then calculate the deadweight welfare loss if we know the value of imports after the imposition of tariffs, the tariff rate, and the percentage change in the quantity of imports in response to the tariff.[1]

[1] In algebraic terms, the height of this triangle is given by $p_1^* \tau$ and its base is given by $m_0 - m_1$. The deadweight welfare loss is then given by $\frac{1}{2} p_1^* \tau(m_0 - m_1) = \frac{1}{2} (p_1^* m_1)\tau(m_0 - m_1)/m_1$, where $p_1^* m_1$ is the value of imports after the imposition of tariffs, τ is the tariff rate, and $(m_0 - m_1)/m_0$ is the percentage change in the quantity of imports due to the imposition of the tariffs.

Figure 2
Impact of a Tariff on Prices with Perfectly Elastic Export Supply



Source: Authors.
Note: Horizontal axis shows the quantity of imports; vertical axis displays the price of the good; *D* corresponds to the import demand curve; S^* represents the export supply curve.

Although we will focus on tariffs as by far the most important protectionist trade policy, these same techniques can be used to examine the effects of quantitative restrictions on imports, such as quotas and voluntary export restraints.[2] Under perfect competition, a quota that restricts imports to the same amount as under a tariff has exactly the same effects on prices, quantities, government revenue, and welfare as the tariff, as long as the home government auctions the licenses to import under the quota competitively. In Figure 1, home consumers lose region $A + B$, and the home government gains region $A + C$ from sales of the quota licenses, leaving a net effect on home welfare of area $C - B$. Therefore, if quota licenses are auctioned competitively, the net effect of the quota on home welfare (like the net effect of the tariff on home welfare) depends on the extent to which there is an improvement in the terms of trade (area *C*). In contrast, if the home government gives these import licenses to foreign firms for free, or if foreign firms voluntarily restrict their exports under a voluntary export restraint, the home government receives no

[2]Governments influence international trade through eight main policy instruments: import taxes (tariffs), export taxes, export subsidies, import subsidies, antidumping actions, quantitative restrictions (in the form of import quotas or export restraints), and standards protection. Of these instruments, export taxes are explicitly prohibited by the US Constitution and import subsidies are rare; the majority of interventions come in the form of tariffs, quantitative restraints, antidumping actions, and standards protection. Of these, tariffs are by far the most common. As argued in the seminal history of US trade policy in Irwin (2017), governments have traditionally used these tariffs for three main objectives: (1) raising revenue, (2) restricting imports to protect domestic producers from foreign competition, and (3) negotiating reciprocity agreements to reduce trade barriers and expand exports.

revenue. In this case, the quota or voluntary export restraint is necessarily welfare reducing, regardless of what happens to the terms of trade, with the net effect on home welfare equal to the loss of consumers of region $A + B$.

Finally, in order to simplify the exposition, we have undertaken all of this analysis starting from zero import protection (free trade), but a directly analogous analysis can be carried out starting from an initial positive value for import protection.

How Did Tariffs Affect US Prices?

We now use the tariffs introduced by the Trump administration during 2018 to illustrate the predictions of the conventional model for prices and import values. In the next section, we use this conventional approach to estimate the impact of the 2018 tariffs on welfare.

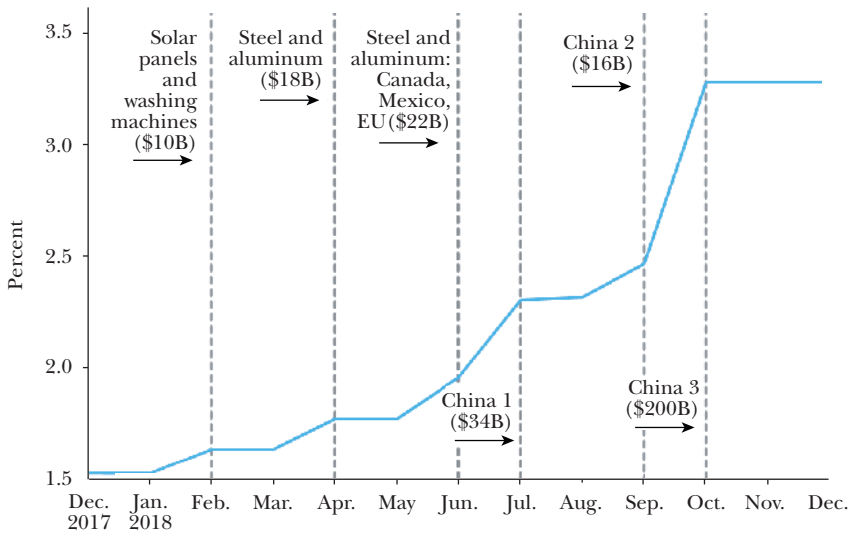
There are several advantages to using the Trump administration's trade war to examine the effects of tariffs on prices and welfare. Because President Trump's election was a surprise to many observers, it is unlikely that the tariffs were anticipated in the affected industries. Although the extent to which the tariff changes were a surprise could have changed over time as the trade war unfolded, Fajgelbaum et al. (2019) find little evidence of pre-trends in the affected industries. In addition, the Trump administration's tariffs are large enough to create meaningful variation across products, time, and countries, which makes it relatively straightforward to discern their effects using conventional datasets.

Figure 3 shows that the 2018 US tariffs were introduced in six main waves throughout the year.[3] Starting in January 2018, the first wave of tariffs imposed import duties of 30 percent on solar panels and duties of 20–50 percent on washing machines. These two product categories accounted for approximately $10 billion of imports and created a modest uptick in US average tariff rates, as one can see in the figure. The second wave of tariffs was implemented in March 2018 on $18 billion of steel and aluminum imports. In this wave, aluminum imports were hit with 10 percent tariffs, and a 25 percent tariff was applied to steel imports. The low value of imports covered by the second wave stems from the fact that at least initially, many countries, such as Canada, Mexico, and the countries in the European Union, were exempt. This exemption ended as the third wave of tariffs was imposed on $22 billion of imports from these countries in June 2018.

These early waves of tariffs were dwarfed in size by the China-specific tariffs that began in July and were rolled out in three waves. The first tranche of 25 percent tariffs on $34 billion of imports began in July 2018 (wave 4), followed by a second tranche of 25 percent tariffs on another $16 billion of Chinese imports in August 2018 (wave 5). Finally, another tranche of 10 percent tariffs on an additional $200 billion

[3]We do not count the imposition of aluminum tariffs on $0.1 billion of imports from South Korea on May 1 and $1.2 billion of Turkish imports on August 13, 2018, as separate tariff "waves" given their small magnitudes. However, they are included in the overall analysis.

Figure 3
Average Tariff Rates



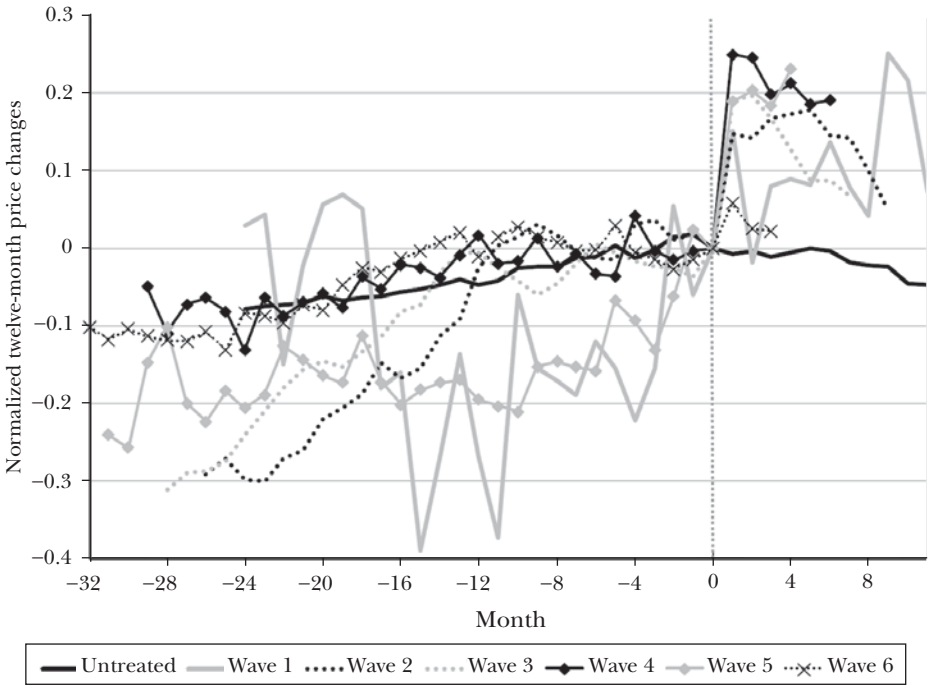
Source: US Census Bureau; US Trade Representative (USTR); US International Trade Commission (USITC); authors' calculations.
Note: Tariffs on the ten-digit Harmonized Tariff Schedule (HTS10) product code by country, weighted by 2017 annual import value. Dashed vertical lines indicate the implementation of each of the six major waves of new tariffs during 2018; tariffs implemented after the fifteenth of the month counted for the subsequent month. Three tranches of tariffs were imposed on China, designated by 1, 2, and 3.

of Chinese imports was imposed at the end of September 2018 (wave 6). Moreover, there was substantial uncertainty about the direction of US trade policy, with the US declaring a postponement on raising the tariffs on wave 6 goods to 25 percent in early December before raising them to this level in May 2019. Figure 3 shows average tariff rates, which include the 62 percent of US imports that continued to enter duty free. However, the fraction of US imports facing duties of over 10 percent rose from 3.5 percent in December 2017 to 10.6 percent by October 2018.

We can obtain a sense of how the tariffs are being passed through into domestic prices by considering what has happened to the prices paid by US importers.[4] US customs data report the foreign export values and quantities of imports by source country at the ten-digit level of Harmonized Tariff Schedule (known as HTS10) data. These data break up monthly US imports from each country into approximately 16,000 narrowly defined categories.

[4]In principle, one could trace the impact of changes in prices paid by US importers through to the Consumer Price Index, but it is difficult to match trade data with Consumer Price Index data in a comprehensive manner.

Figure 4
Twelve-Month Proportional Change in Import Prices by Tariff Wave



Source: US Census Bureau; US Trade Representative (USTR); US International Trade Commission (USITC); authors' calculations.
Note: Proportional change in an import share–weighted average of twelve-month relative changes in US import unit values inclusive of tariffs (import values divided by import quantities) for each tariff wave and for unaffected countries and products. Proportional changes for each wave are normalized to equal zero in the month prior to the introduction of the tariff; for the untreated month, zero is defined as in the first tariff wave. Tariff waves are defined in the section "How Did Tariffs Affect US Prices?"

By dividing the import values by the quantities, one can compute unit values at a very disaggregated level: for example, "baseball and softball gloves and mitts made in China." Importantly, unit values are computed before tariffs are applied, so they correspond to foreign export prices. If we multiply these unit values by the duty rates, available from the US International Trade Commission, we can compute tariff-inclusive import prices. These tariff-inclusive prices provide detailed evidence on what has been happening to US prices as a result of the 2018 tariffs.

Figure 4 illustrates the overall patterns. The zero on the horizontal axis refers to the month before each of the six tariff waves started. We subtract the price change in the month before the tariff was implemented from each price change, so a zero on the vertical axis corresponds to a price change that equals its value before the tariffs were implemented. The price changes shown for each wave refer only to the imports for the specific goods and countries affected by that wave of tariffs and are weighted for each good according to its relative importance in imports. Thus, one

can see how prices for the goods involved in all six waves were changing both before and after the tariffs. We also do this for the "untreated" set of goods and countries—that is, those goods and countries that faced no tariff changes in 2018—to have a sense of the baseline movement in prices. For this group, the zero month is the date of the first tariff wave.[5] We drop petroleum imports from all plots and tables because of the volatility of these prices.

Several important patterns emerge from Figure 4. First, the "untreated" prices for sectors not subject to tariffs are fairly flat, which suggests that whatever price movements we observe in protected sectors are likely due to the tariffs. Second, we see large increases in prices of goods that were subject to tariffs, with unit values typically rising from 10 to 30 percent in the wake of the tariffs. These numbers are comparable in magnitude to the tariffs that were applied, which suggests that much of the tariffs were passed on almost immediately to US importers and consumers. Finally, although there seems to be some pre-trend in prices for the specific goods hit in waves 1 and 5, there does not appear to be a pre-trend for the goods in any of the other waves, which is consistent with a belief that the price increases that we observe are likely due to the fact that much of the tariffs have been passed on to importers. The impact of the tariffs on the prices of imports could be larger than suggested by these figures if the tariffs also raised prices for untreated goods in response to the higher tariffs imposed on their competitors.

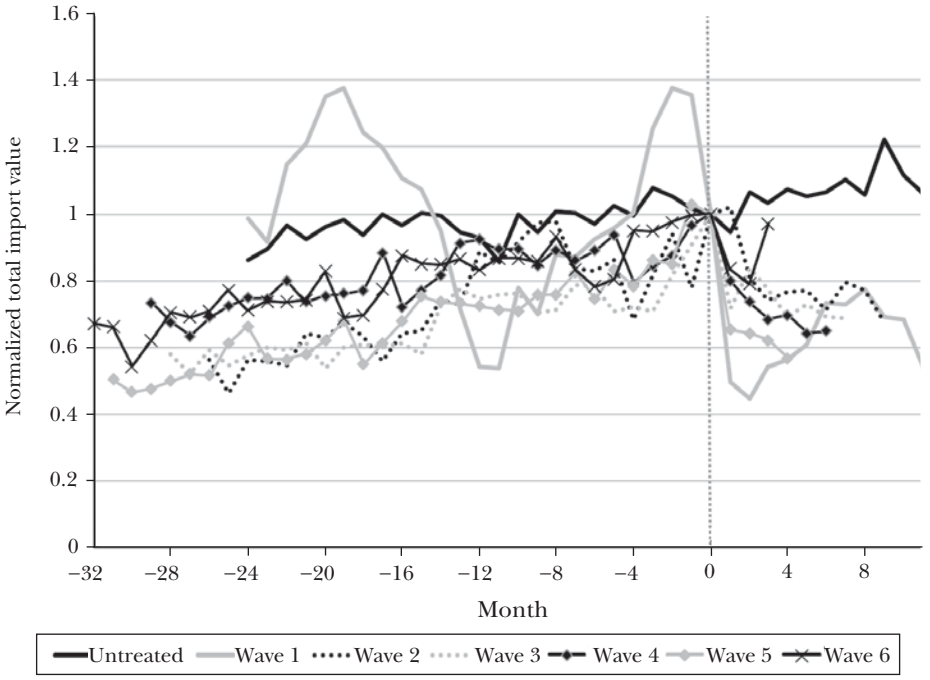
Figure 5 repeats the same plot using the total value of imports instead of unit values, which gives us insight into quantities of imports. In this plot, we normalize the import value in month zero to be one for all goods, so the import values are all relative to imports in the last month before the tariffs were applied. The figure shows a big surge in imports in the wave 1 products, washing machines and solar panels, prior to the imposition of tariffs, which was likely caused by importers moving forward import orders in order to obtain products before the imposition of the tariffs. For the remaining goods, it appears that on average their import levels were rising a little faster than for unaffected goods in the months prior to the imposition of the tariffs. In all cases, import values declined sharply after the imposition of the tariffs, typically falling 25 to 30 percent after the imposition of the tariffs. This

[5] Specifically, if we denote the unit value (price) of an HTS10 good i from country j in month t by p_{ijt}, we can compute the twelve-month relative change in prices for that good and country as $\hat{p}_{ijt} \equiv (p_{ijt}/p_{ij,t-12})$. In working with these price relatives for each good, we difference out any constant choice of units for each good. We work with twelve-month relative changes to avoid seasonality in the unit values. Letting w denote the set of HTS10-country varieties affected by a tariff change, we compute a price index for each wave as the following weighted average of these price relatives:

$$\hat{p}_{wt} \equiv \prod_{i,j \in w} (\hat{p}_{ijt})^{(s_{ij}^w)},$$

where s_{ij}^w is the logarithmic mean of the import shares from country j in sector i in the relevant months from 2017 and 2018 among all HTS10 imports in the categories affected by tariff wave w. Our use of the logarithmic mean import shares as weights ensures that we weight the price change for each good according to its relative importance in imports and that this price index corresponds to a Sato–Vartia price index that is exact for the constant elasticity of substitution demand system. We express these price indexes as proportional changes by subtracting one—that is, $(\hat{p}_{wt} - 1)$.

Figure 5
Total Import Values by Tariff Wave



Source: US Census Bureau; US Trade Representative (USTR); US International Trade Commission (USITC); authors' calculations.
Note: Twelve-month proportional changes in the value of US imports by tariff wave and for unaffected countries and products. Each series is normalized to the value one in the month prior to the introduction of the tariff; for the untreated month, zero is defined as in the first tariff wave. Tariff waves are defined in the section "How Did Tariffs Affect US Prices?"

drop is particularly striking given that imports for unaffected sectors and countries *rose* by about 10 percent over the same period, where this rise could in part reflect some import substitution from affected to unaffected countries and products in response to tariff changes.

Estimating Welfare Losses of Higher Import Tariffs

As we discussed above, a key first step to estimating the welfare effect of tariffs requires an estimate of how the price received by foreign exporters moves in response to a tariff increase. We examine these effects by returning to our data on import quantities and values. Specifically, we use observations at the HTS10-country level for specific products imported during each month, for the period January 2017 to December 2018. All variables refer to the twelve-month change, expressed in logs. The regressions described here include fixed effects at the product level

Table 1
Impact of US Tariffs on Importing

	log change foreign exporter prices *(1)*	*log change import quantities* *(2)*	*log change import quantities* *(3)*	*log change import values* *(4)*	*log change import values* *(5)*
	$\Delta \ln(p_{ijt})$	$\Delta \ln(m_{ijt})$	$\Delta \ln(m_{ijt})$	$\Delta \ln(p_{ijt} \times m_{ijt})$	$\Delta \ln(p_{ijt} \times m_{ijt})$
log change tariff	–0.012	–1.310***	–5.890***	–1.424***	–6.364***
$\Delta \ln(1 + Tariff_{ijt})$	(0.023)	(0.090)	(0.590)	(0.086)	(0.773)
N	1,647,617	1,647,617	3,318,912	2,487,370	4,461,376
R^2	0.021	0.024	0.099	0.012	0.102

Source: US Census Bureau; US Trade Representative (USTR); US International Trade Commission (USITC); authors' calculations.

Note: Observations are at the HTS10-country-month level for the period January 2017 to December 2018. Variables are in twelve-month log change. All columns include HTS10 product fixed effects and country × year fixed effects. The dependent variable in column 1 is the log change of prices (before US duties are applied) charged by foreign exporters. The dependent variables in columns 2 and 3 are the log change and the change in the inverse hyperbolic sine of US import quantities, respectively. The dependent variables in column 5 are the log change and the change in the inverse hyperbolic sine of US import values. We use the inverse of the hyperbolic sine transformation, $\log[x + (x^2 + 1)^{0.5}]$, to be able to estimate changes when import quantities or values are zero in t or $t - 12$. Columns 1–3 drop any observations with a ratio of unit values in t relative to $t - 12$ greater than 3 or less than 1/3. Standard errors reported in parentheses are clustered at the HTS eight-digit level, because import tariffs for some goods only vary at the HTS eight-digit level. For additional details of the regression and full results, see the online Appendix available with this article at the *Journal of Economic Perspectives* website.

*, **, and *** indicate significance levels of $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

and the country-month level. We treat the Trump administration's tariffs as exogenous and assume that they are uncorrelated with unobserved shocks to unit values. Under this assumption, the estimated coefficient in this regression captures the impact of the tariffs on the prices received by foreign exporters.

Table 1 shows some results. In column 1, we regress the change in the log import unit value (measured without including the tariff change) over a twelve-month period on the change in one plus the applied tariff on imports over the same period. We obtain an estimate of tariffs on unit values of –0.012, which suggests that the tariff changes had little to no impact on the prices received by foreign exporters. Moreover, the coefficient is estimated precisely, because the standard error of this estimate is 0.023, so we can reject the hypothesis that there is a substantial impact of tariffs on exporter prices. Thus, it appears that the supply elasticity of exports, at least in the short run, is close to perfectly elastic (as portrayed in Figure 2), which means close to all of the cost of the 2018 US tariffs was borne (so far) by US consumers and importers.

The finding that the Trump administration's tariff changes have been almost entirely passed through into domestic prices, leaving exporter prices unchanged, is consistent with the findings from different estimation methodologies in Fajgelbaum et al. (2019) and Cavallo et al. (2019). However, it is also surprising. The literature

on exchange-rate shocks typically finds an elasticity of import prices with respect to exchange-rate shocks of closer to one-half, as surveyed in Goldberg and Knetter (1997). For example, Gopinath, Itskhoki, and Rigobon (2010) estimate an elasticity of about 30 percent for the United States. Furthermore, the estimated export supply elasticities for a number of countries in Broda, Limão, and Weinstein (2008) imply upward-sloping export supply curves. Therefore, a conventional demand and supply framework would predict some adjustment in exporter prices in response to US tariffs.[6]

There are a number of possible reasons for the difference between these two sets of results. First, we are working with monthly data and looking at the impact of tariffs over just a few months, while others such as Broda, Limão, and Weinstein (2008) are often estimating these elasticities at an annual frequency. It is possible that export prices are sticky in the short run, so if we were to look at the impact of these tariffs over longer periods—years rather than months—we would see exporters drop their prices in response to the tariffs. Second, US trade policy in 2018 may have been associated with an especially high degree of uncertainty. Past changes in tariff policy were largely long term in nature, with little uncertainty about what tariffs would be applied a few months in the future. In the face of uncertainty about whether tariffs against China would, say, be lifted, remain at 10 percent, or rise to 25 percent, exporters may have decided not to lower prices because they feared they could not raise them again if the tariffs were lifted. However, this point about uncertainty also applies to exchange rate shocks, and hence the finding of complete pass-through of the 2018 tariffs into US prices remains somewhat of a puzzle.

In column 2 of Table 1, we replace the dependent variable with the twelve-month change in imported quantities. Under the assumption that the Trump administration's tariffs are exogenous, and using our finding that there is no offsetting change in the prices received by foreign exporters, we can interpret the estimated coefficient on the tariff change as the import demand elasticity. Here we see that a 1 percent increase in tariffs is associated with a 1.3 percent decrease in the import quantities. This decline is much smaller than the declines we observed in Figure 5, because prohibitive tariffs result in import quantities of zero that are dropped from the regression. As a fix for this problem, we rerun the regression replacing the log of the quantity change with the inverse hyperbolic sine, which has a defined value for cases in which import quantities are zero.[7] The results from this exercise are reported in column 3. As one can see from this specification, including the trade flows that go to zero results in a substantially higher estimate of the impact of tariffs on trade flows. We estimate that a 1 percent increase in tariffs is associated with a 6 percent

[6] Much of the existing literature on the pass-through of cost shocks into prices focuses on exchange rate shocks (for example, Amiti, Itskhoki, and Konings 2014). However, De Loecker et al. (2016) examine the effect of lower tariffs in India, while Edmond, Midrigan, and Xu (2015) consider the effects using Taiwanese data. Amiti et al. (2017) estimate the effect of China lowering its own tariffs on the US manufacturing price indexes.

[7] The inverse hyperbolic sine of some variable, x, is given by $\ln[x + (x^2 + 1)^{0.5}]$. It equals 0 when $x = 0$, and its slope tracks that of $\ln x$ more closely than $\ln(1 + x)$ when x is small.

fall in import quantities. This estimate is very much in line with standard estimates of trade elasticities, which lie within the range of 4 to 8, as, for example, in Broda and Weinstein (2006), Eaton and Kortum (2002), and Simonovska and Waugh (2014).[8]

In columns 4 and 5 of Table 1, we repeat this exercise using import values as the dependent variable, where these import values are again measured without including the tariff. We now have far more observations, because import values are more frequently reported than import quantities. We find quantitatively similar results for values as for quantities, which is consistent with our earlier finding of no discernible effect on the prices received by foreign exporters. If we multiply the tariff changes by this elasticity estimate, we find that the 2018 US tariffs through wave 6 reduced US imports in the affected HTS10 categories relative to those in the unaffected categories by about 52 percent, which is in line with the steep relative drops in imports that we saw in Figure 5. US total imports probably fell by much less than this, because some of the declines in protected sectors were offset by increases in exports from countries not subject to tariffs. If we multiply the coefficient on the tariff change in column 5 by the tariff change in each sector and then sum across sectors, the *relative* decline in imports from affected sectors amounts to $132 billion in imports on an annual basis.

Importantly, this *relative* decline in imports affected by tariffs is consistent with any aggregate movement in imports as long as the imports of the affected sectors fell by $132 billion more than those of the unaffected sectors. However, the estimate does imply a substantial shock to global supply chains, because it means that at least $132 billion of trade was redirected as a result of the import tariffs. This potentially could imply very large costs for US multinationals (and Chinese exporters) who have made irreversible investments in China. Indeed, given that Lovely and Liang (2018) found that in sectors such as machinery, electrical equipment, appliances, and computer and electronic products the share of exports from China that were made from non-Chinese firms ranged from 59 to 86 percent, it is reasonable to conjecture that US firms may be forced to write off investments in China as their Chinese factories become uncompetitive and new facilities need to be opened elsewhere.

We can use these estimates of the impact of the import tariffs on prices and quantities to obtain an estimate of the deadweight welfare loss from the tariff, using the framework shown in Figures 1 and 2. Under the assumption that the import demand curve has a constant slope, we can compute the deadweight welfare loss in area B using the formula for the area of a 90-degree-angled triangle, which equals one-half times the height times the width of the triangle. The height of the triangle is the size of the tariff (τp_1^*), which is observed in the data. The width of the triangle is the change in imports due to the tariff ($m_0 - m_1$), which we estimate using the coefficient from the quantity regression in column 3 of Table 1.[9] We compute the

[8] We find a similar pattern of results if we augment the specifications in Table 1 with a full set of fixed effects for Harmonized System two-digit (HS2)-sector-year, with marginally smaller coefficients in absolute value.

[9] In particular, the deadweight welfare loss (the area of the right triangle B in Figures 1 and 2) can be rewritten as $\frac{1}{2}\,(p_1^*\ m_1)\tau(m_0 - m_1)/m_1$. Using the coefficient estimates from the regressions in Table 1, negative one times the coefficient in the quantity regression (β) multiplied by the change in tariff

Table 2
Deadweight Welfare Loss and Tariff Revenue
(current prices in billions of dollars)

Month (2018)	*Deadweight loss (1)*	*Tariff revenue (2)*	*Total cost to importers (3)*
January	0	0	0
February	0.1	0.1	0.2
March	0.1	0.1	0.2
April	0.3	0.4	0.7
May	0.2	0.4	0.6
June	0.4	0.7	1.2
July	0.9	1.4	2.4
August	0.9	1.4	2.3
September	1.0	1.6	2.6
October	1.5	3.2	4.6
November	1.4	3.0	4.4
December	1.4	3.2	4.7
Total	8.2	15.6	23.8

Note: Column 3 is the sum of columns 1 and 2; see the text for the details of these calculations.

value of these deadweight losses for each month in 2018. As shown in Table 2, these losses mounted steadily over the year, as each wave of tariffs affected additional countries and products, and increased substantially after the imposition of the wave 6 tariffs on $200 billion of Chinese exports. By December, these deadweight welfare losses reached $1.4 billion per month. Over the course of 2018, the cumulative deadweight losses amounted to $8.2 billion.

We can also compare these deadweight losses to the value of the tariff revenue raised, which was $15.6 billion for the twelve months of 2018. Given that we find no effect of the tariffs on the prices received by foreign exporters, this tariff revenue is a pure transfer from domestic consumers to the government. If we assume that the US government uses the tariff revenue to generate social welfare benefits equal to the tax burden, the reduction in welfare from the tariff for the economy as a whole is captured by the deadweight loss, while the cost to the consumer and importer equals the sum of the deadweight welfare loss and the tariff revenue transferred to the government. If we were instead to assume that the US government does not generate social welfare benefits equal to the tax payments they receive, the losses to taxpayers could rise by as much as the full value of their tariff payments.

As we mentioned above, this approach to calculating the costs of the tariffs makes a number of simplifying assumptions, including partial equilibrium and perfect competition, and treats the tariffs introduced by the Trump administration as an exogenous shock. Fajgelbaum et al. (2019) offer a more complete treatment

$\ln((1+\tau_t)/(1+\tau_{t-12}))$ tells us the percentage change in imports due to the imposition of the tariff, or $-\beta\ln((1+\tau_t)/(1+\tau_{t-12})) = -\ln(m_1/m_0) \approx (m_0 - m_1)/m_1$. Using this estimate, the deadweight loss can be measured by $-\frac{1}{2}(p_1^* m_1)\tau\beta\ln((1+\tau_t)/(1+\tau_{t-12}))$.

of the welfare effects of these tariffs using a demand system that allows for three tiers of substitution: among varieties of an imported product, among import products, and among imported and domestic aggregates. However, neither our regression specification nor that in Fajgelbaum et al. provides a method to estimate possible effects of tariffs that are common across all foreign trade partners and products (including effects on US wages), which runs the risk that these approaches may miss the way in which tariffs affect the terms of trade.

We can offer several ways to put our estimated welfare losses into perspective. As one comparison, Caliendo and Parro (2015) undertake a general equilibrium analysis of the US welfare gain from tariff reductions under the North American Free Trade Agreement and find that it amounts to 0.08 percent of GDP or about $1.4 billion per month—which is about the same as our estimate of the monthly deadweight loss from the Trump administration tariffs in December 2018.

An alternative benchmark might be obtained by considering what a policy success might look like. In 2017, China paid the United States $8.3 billion in royalties for US intellectual property (Santacreu and Peake 2019). If we assume that a successful trade negotiation would increase the royalties that China pays by 25 percent, it would take four years of these higher royalties to pay off the deadweight welfare loss from the 2018 trade war. Alternatively, if we were to think that a successful outcome from the trade war would be the creation of 35,400 manufacturing jobs—matching the decline in the number of jobs in the steel and aluminum industry in the past ten years—then the deadweight welfare loss per job saved is $232,000, which is almost four times the annual wage of a steel worker of $52,500. These benchmarks suggest that the costs of the trade war are quite large relative to optimistic estimates of any gains that are likely to be achieved.

Effects of Retaliatory Tariffs on US Exporters

Of course, these estimates do not take into account the fact that foreign countries have placed retaliatory tariffs on approximately $121 billion of US exports. These tariffs have hit US agricultural exports as well as exports of steel, automobiles, and consumer goods.

In Table 3, we estimate the same specifications as in Table 1, but using US export data instead of import data. Thus, the unit values we construct are for exports by US firms for each HTS10 product (before applying the foreign tariffs). We are again using monthly data, this time on exports of specific products to each country from January 2017 to December 2018.

Column 1 of Table 3 shows that there also appears to be no decline in US export prices in response to foreign tariffs, which implies that consumers and importers in foreign countries are bearing the full cost of their retaliatory tariffs. However, this does not mean that US exporters are not being affected by the retaliatory tariffs. As we can see in the last column of the table, the elasticity of US export values with respect to foreign tariffs is −3.9, which means that a 1 percent increase in foreign

Table 3
Impact of Foreign Tariffs on US Exporting

	log change US export prices *(1)*	*log change foreign import quantities* *(2)*	*log change foreign import quantities* *(3)*	*log change foreign import values* *(4)*	*log change foreign import values* *(5)*
	$\Delta \ln(p_{ijt}^{US})$	$\Delta \ln(x_{ijt}^{US})$	$\Delta \ln(x_{ijt}^{US})$	$\Delta \ln(p_{ijt}^{US} \times x_{ijt}^{US})$	$\Delta \ln(p_{ijt}^{US} \times x_{ijt}^{US})$
log change tariff	0.077**	–1.233***	–3.498***	–1.134***	–3.942***
$\Delta \ln(1 + Tariff_{ijt})$	(0.034)	(0.146)	(0.710)	(0.130)	(0.827)
N	1,320,495	1,320,495	2,784,226	2,191,243	3,930,620
R^2	0.014	0.011	0.076	0.013	0.072

Note: Observations are at the HTS10-country-month level for the period January 2017 to December 2018. Variables are in twelve-month log change. All columns include HTS10 product fixed effects and country-year fixed effects. Columns 1–3 drop any observations with a ratio of unit values in t relative to $t-12$ greater than 3 or less than 1/3. The dependent variable in column 1 is the log change of prices (excluding the tariff) charged by US exporters. The dependent variables in columns 2 and 3 are the log change and the change in the inverse hyperbolic sine of foreign import quantities (US export quantities). The dependent variables in column 4 and 5 are the log change and the change in the inverse hyperbolic sine of foreign import values (US export values). We use the inverse of the hyperbolic sine transformation $\log[x + (x^2 + 1)^{0.5}]$ to be able to estimate changes when import quantities or values are zero in t or $t-12$. Standard errors reported in parentheses are clustered at the Harmonized System six-digit (HS6) level, because foreign export tariffs vary at the HS6 level. For additional details of the regression and full results, see the online Appendix available with this article at the *Journal of Economic Perspectives* website.
*, **, and *** indicate significance levels of $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

tariffs is associated with a 3.9 percent decline in the value of US exports. In other words, by the end of 2018, foreign retaliatory tariffs were also costing US exporters approximately $2.4 billion per month in lost exports. Once again, to the extent that US firms have to find new export markets or switch to offshore production to avoid paying the tariffs, it is likely that the retaliatory tariffs are associated with substantial shifts in supply chains and possibly large depreciations in capital equipment based in the United States.

Summing together our estimates for lost exports and imports, we find that by December 2018, approximately $15.3 billion of trade ($4.3 billion of exports and $11 billion of imports) per month was being redirected as a result of the tariffs, which amounts to $183 billion of redirected trade on an annual basis.

The Impact of Tariffs on US Domestic Producer Prices

Tariffs may also affect markups for domestic firms. A large body of empirical work has demonstrated that as foreign firms enter a market, prices and markups of domestic firms fall in response. Amiti, Itskhoki, and Konings (forthcoming) have developed this idea further in a setup that takes into account how trade can affect domestic prices through increased competition in domestic firms' output markets as well as through firms' intermediate input costs. In their framework, a firm's price

changes can be written as a log-linear relationship that depends on marginal cost changes and changes in the prices of the firm's competitors.

While we do not have access to firm-level price data, we do have access to detailed industry-level data for the Producer Price Index—specifically, North American Industry Classification System data disaggregated at the six-digit level (NAICS6)—so we can run analogous regressions at the industry level. These data contain information on the prices being charged by domestic producers. We merge these data with input-output tables to identify which products are used in each industry. We refer to the weighted-average tariffs protecting the output in any industry as "output tariffs," and the weighted-average tariffs applied to an industry's inputs as the "input tariffs" because they reflect the additional costs that producers in a given sector face when tariffs raise their input price.[10] We thus obtain a measure for each NAICS6 category of the output tariff on final goods and the import tariff on intermediate inputs. We expect that output tariffs have a bigger effect on producer prices in sectors in which imports account for a larger share of domestic sales. Therefore, we adjust our output tariff measure by the share of imports in domestic consumption. Similarly, we expect that input tariffs have a larger impact on producer prices in sectors in which imported intermediate inputs account for a larger share of total variable costs. Therefore, we adjust our input tariff measure by the share of imported intermediate inputs in total variable costs.[11]

In Table 4, we present regressions of the twelve-month change in the Producer Price Index in each of the NAICS6 industries on these adjusted output and input tariffs (a calculation that builds on Amiti, Heise, and Kwicklis 2019). We find that the 2018 US tariffs increased the prices charged by US producers through both of these channels. First, we obtain a coefficient of 1.9 on the weighted input tariff. This coefficient implies that for the average firm that imports 15 percent of its variable costs, a 10 percent higher input tariff causes it to raise its own prices by 2.9 percent (that is, $1.9 \times 0.15 \times 0.10 \times 100$). This tariff pass-through into domestic producer prices is incomplete, because higher input costs often cause firms to reduce markups and absorb some of the higher costs in lower profits. Despite this adjustment in markups,

[10] To link these data to the trade data, we matched the Producer Price Index for every NAICS6 sector to the HTS10 codes associated with that NAICS6 sector using the concordance in Pierce and Schott (2012). For any output sector i, we then took an import weighted average of the tariff changes in that sector, using 2017 annual import shares by country-HTS10. Mathematically, the output tariff for NAICS6 sector k in month t is given by $Output\ Tariff_{kt} = \sum_{i \in k} \sum_j s_{ijk}\, \tau_{ijt}$, where i denotes an HTS10 category; j indexes exporters; s_{ijk} is the 2017 value of any HTS10 export value from country j divided by the total imports in the HTS10 sectors within k; and τ_{ijt} is the ad valorem tariff rate on goods in category i from country j in month t. We also have $Input\ Tariff_{kt} = \sum_{\ell \in k} w_{\ell k}\ (Output\ Tariff_{kt})$, where $w_{\ell k}$ is the value of inputs from sector ℓ used by firms in NAICS6 sector k based on the US 2007 input-output table divided by the sum of total intermediate input and labor costs in sector k.

[11] Formally, we weight the output tariffs by $Import\ Share_k \equiv m_k/(d_k + m_k - x_k)$, where m_k, d_k, and x_k are imports, domestic shipments, and exports in sector k. We weight the import tariffs by $Import\ Intensity_k \equiv M_k/(N_k + W_k)$, where M_k, N_k, and W_k are imports of intermediates, total material costs, and labor costs in sector k.

Table 4
Impact of Import Tariffs on Non-Oil Merchandise Producer Price Index (PPI)

Dependent variable: $\Delta log(PPI_{it})$	*Twelve-month change*
A: Regression coefficients	
Input Import Intensity$_i \times \Delta\ln(1 + Input\ Tariff_{it})$	1.867***
	(0.697)
Import Share$_i \times \Delta\ln(1 + Output\ Tariff_{it})$	0.402**
	(0.198)
Fixed effects: industry and time	Yes
B: Implied aggregate effects	
Input tariff effect	0.856
Output tariff effect	0.174
Total effect	1.030
N	8,088
Number of industries	337
R^2	0.521

Note: The dependent variable is the twelve-month change in $\log(PPI)$, while the tariffs are entered as the twelve-month changes in $\log(1 + Tariff_{it})$. The sample period is monthly data from January 2017 to December 2018. The denominator in the input import intensity is the sum of material inputs and the wage bill. Standard errors, clustered at the Bureau of Economic Analysis input-output level, are reported in parentheses.

*, **, and *** indicate significance levels of $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

there is a clear cost-push channel of the tariffs that causes domestic producer prices to rise because their input costs have risen.

We also see a clear markup or competition effect of tariffs in the coefficient on output tariffs. The coefficient of 0.4 on the adjusted output tariff change implies that in a typical sector in which 25 percent of all domestic sales are by foreign firms, a 10 percent tariff is associated with a 1 percent increase in domestic producer prices over twelve months. In other words, domestic producers raise their prices when their foreign competitors are forced to raise prices due to higher tariffs.

In panel B of Table 4, we provide some sense of the economic magnitude of these effects. In particular, we multiply the actual tariff increases by the coefficients from panel A to obtain a back-of-the-envelope estimate of the impact of the tariffs on domestic producer prices in manufacturing. This calculation is clearly a partial equilibrium exercise, because we implicitly assume that the changes in tariffs have no impact on sectors that do not use imports directly affected by the tariffs. This assumption could be violated for a number of reasons, including, for example, any effect of the changes in tariffs on aggregate wages. With these caveats in mind, we estimate that US domestic prices were 1 percent higher in manufacturing industries in 2018 as a result of the

new tariffs. These findings are in line with the evidence of the procompetitive effects of international trade in reducing domestic prices in Feenstra and Weinstein (2017).

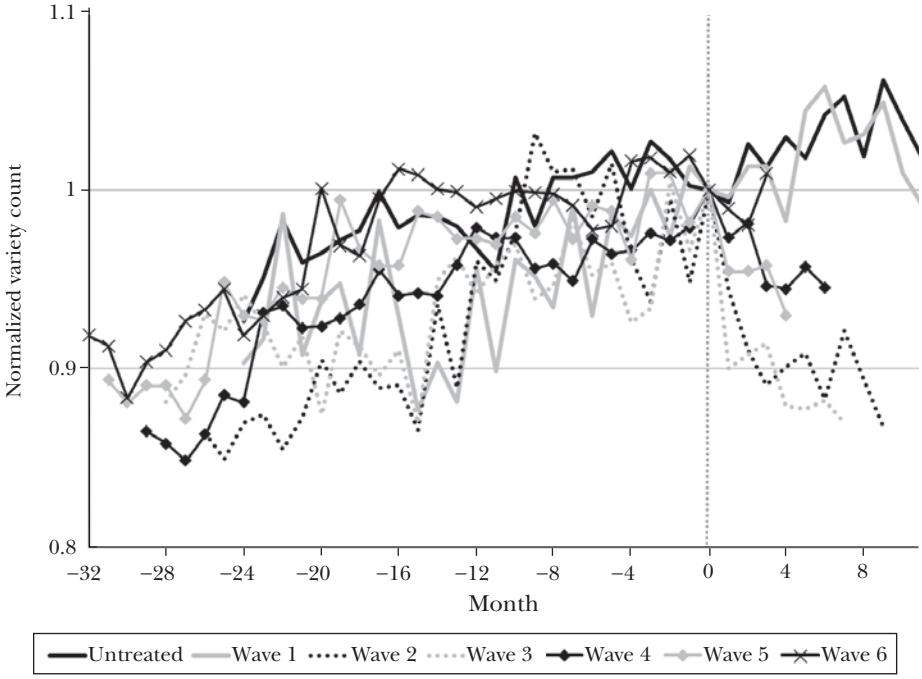
Assessing the Impact of Tariffs on Imported Varieties

The standard textbook model of losses from tariffs is based on the assumption that imported and domestic varieties of goods are perfect substitutes. But realistically, the products produced in one country may be imperfect substitutes for those produced in other countries. Indeed, one distinguishing feature of "new trade theory" is its emphasis on how increases in trade barriers can reduce welfare by restricting the range of varieties that consumers are able to purchase. In these models, consumers benefit from trade liberalization because it gives them access to varieties of products—French wine, Colombian coffee, and Hungarian paprika—that might not be purchased if trade barriers were higher. If trade liberalization is associated with increases in varieties, one might well wonder whether the 2018 tariffs have resulted in a reduction in imported varieties, and if so, what the welfare costs of these variety losses have been.

Figure 6 presents some evidence on how the trade war has influenced imported varieties, where we define a variety as an HTS10-country code (for example, French red wine). For each set of HTS10-country codes that were affected by a particular wave of tariffs, we compute a count of the number of varieties imported. We use the same normalization as before, so month zero corresponds to the last month before the new tariffs were implemented, and we normalize the number of varieties within the set of HTS10 codes in each tariff wave to be one in month zero. We see that for the three years prior to the imposition of these tariffs, all the categories of goods typically experienced increases in the number of varieties. However, the imposition of the tariffs is associated with sharp drops in the number of imported varieties entering the United States in all sectors, except in wave 1, which affected only a small number of product codes (washing machines and solar panels). These results suggest that some of the tariffs were prohibitive, reducing imports of certain goods from certain countries to zero.

Starting with Feenstra (1994), economists have developed tools to measure how costly it is to reduce access to some varieties even when the prices of remaining varieties are unchanged. The key insight is that for some widely used classes of preferences we can divide the cost of consumption into two components. The first is a "common-goods" component, which captures price changes for the set of goods that exist in both time periods, and the second is a "variety adjustment," which captures the fact that whenever a good exits a sample, we can think of it as if its price rose so much that it became prohibitively expensive. Similarly, the variety adjustment accounts for the fact that whenever a good enters the sample, it is as if its price fell from some prohibitively high level to a level at which consumers are willing to purchase the product (for discussion, see also Broda and Weinstein 2006, 2010; Redding and Weinstein 2016, 2017).

Figure 6
Number of Varieties by Tariff Wave



Source: US Census Bureau; US Trade Representative (USTR); US International Trade Commission (USITC); authors' calculations.
Note: Twelve-month proportional changes in the number of import varieties, defined as an HTS10-country code, by tariff wave and for unaffected products. Each series is normalized to the value one in the month prior to the introduction of the tariff; for the untreated month, zero is defined as in the first tariff wave. Tariff waves are defined in the section "How Did Tariffs Affect US Prices?"

While the algebra for deriving these expressions can be somewhat involved, the intuition is straightforward. For many demand systems, the value of any variety of a good comes down to two terms. First, we need to know how substitutable a good is with other goods. The elasticity of substitution matters because consumers are more likely to appreciate being able to purchase new differentiated goods (like French red wine) than highly substitutable ones (French wheat). Thus, all things equal, tariffs that cause varieties of differentiated products to disappear are likely to be more costly than tariffs that cause varieties of homogeneous products to disappear. We define varieties as HTS10-country codes (like French red wine) and assume an elasticity of substitution between these varieties of 6, which, as discussed above, is a standard value in the international trade literature and is in line with our estimates from Table 1.

Second, the quality of a product relative to its cost also matters. In many common demand systems, the market share of a product is a sufficient statistic for a product's quality relative to its price because any increase in quality or reduction

in price will increase a product's market share by an amount determined by the demand system. In other words, products with low quality relative to their price will have low market shares, and products with high quality relative to their cost will have high market shares. For example, the market success of German beer relative to Chinese beer in the US market tells us that US consumers as a group think that spending a given amount of money on a bottle of German beer yields more utility than spending the same amount on a Chinese beer. Operationally, this means that the entry or exit of a variety with a large market share is going to have a much bigger impact on consumer welfare than the entry or exit of a product with a small market share. Therefore, we combine the market share of entering and exiting varieties with our assumed elasticity of substitution of 6 to compute the contribution of the entry and exit of varieties to changes in welfare over time.

Existing studies have found these effects of entry and exit on welfare to be substantial. Using a demand system with a constant elasticity of substitution between varieties and data on US imports from 1972 to 2001, Broda and Weinstein (2006) estimate the value to US consumers of the observed expansion in import variety to be 2.6 percent of GDP. Using a more flexible demand system that allows for procompetitive effects of international trade on domestic prices, Feenstra and Weinstein (2017) estimate that international trade raised US welfare by 0.9 percent between 1992 and 2005, with product variety contributing one-half of that total. In the case of the tariffs introduced by the Trump administration, the decline in variety, while clearly visible in Figure 6, is much more modest than the secular growth in US import variety over time.[12] When variety is taken into account, the effect of tariffs on prices is larger than the simple pass-through regressions suggest, but the effect of less variety in terms of higher prices is probably less than one-tenth of the overall rise in prices caused by the higher tariffs.

Conclusion

Conventional trade models provide a powerful framework for understanding how tariffs affect prices, quantities, and welfare. We find that the US import tariffs were almost completely passed through into US domestic prices in 2018, so that the entire incidence of the tariffs fell on domestic consumers and importers up to now, with no impact so far on the prices received by foreign exporters.

The deleterious impacts of the tariffs imposed by the Trump administration in 2018 have been largely in line with what one might have predicted on the basis of a simple supply and demand framework. During 2018, prices of US-made intermediate and final goods rose significantly in sectors affected by the tariffs relative to unaffected sectors, and the US economy experienced large changes to its supply-chain

[12] In the online Appendix available with this article at the *Journal of Economic Perspectives* website, we derive the key expression for the common variety price index and the variety adjustment for entry and exit and provide an illustrative regression showing the magnitude of the decrease in variety.

network, reductions in the availability of imported varieties, and complete pass-through of the tariffs into domestic prices of imported goods. We estimate the cumulative deadweight welfare cost (reduction in real income) from the US tariffs to be around $8.2 billion during 2018, with an additional cost of $14 billion to domestic consumers and importers in the form of tariff revenues transferred to the government. The deadweight welfare costs alone reached $1.4 billion per month by December 2018. These estimates are in line with the findings of a growing number of studies of the 2018 tariffs, including Fajgelbaum et al. (2019), Flaaen, Hortaçsu and Tintelnot (2019), and Cavallo et al. (2019).

Our estimates are likely to be a conservative measure of the losses from the tariff increases of 2018 for several reasons. Reductions in the range of varieties available for consumption should also be taken into account. The redirection or loss of trade may require firms to incur fixed costs in reorganizing their global supply chains (such as the creation of new production facilities). We have also omitted the potentially considerable costs of policy uncertainty, as emphasized by Handley and Limão (2017) and Pierce and Schott (2016). These costs of higher uncertainty may be reflected in the substantial falls in US and Chinese equity markets around the time of some of the most important trade policy announcements.

On the other hand, the absence of terms of trade effects in the 2018 data remains a puzzle, especially in light of prior work on exchange rate pass-through and export supply curves. If we start to see foreign firms absorbing more of the tariff duties, we may see the costs of these tariffs fall in future years. Understanding why the United States bore virtually all of the cost of its 2018 import tariffs is therefore likely to be a topic for much future research.

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References

Amiti, Mary, Mi Dai, Robert C. Feenstra, and John Romalis. 2017. "How Did China's WTO Entry Affect U.S. Prices?" NBER Working Paper 23487.

Amiti, Mary, Sebastian Heise, and Noah Kwicklis. 2019. "The Impact of Import Tariffs on U.S. Domestic Prices." *Liberty Street Economics* (blog), Federal Reserve Bank of New York. January 4, 2019. https://libertystreeteconomics.newyorkfed.org/2019/01/the-impact-of-import-tariffs-on-us-domestic-prices.html.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. 2014. "Importers, Exporters, and Exchange Rate Disconnect." *American Economic Review* 104 (7): 1942–78.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. Forthcoming. "International Shocks, Variable Markups and Domestic Prices." *Review of Economic Studies.*

Amiti, Mary, Stephen J. Redding, and David E. Weinstein. 2019. "The Impact of the 2018 Trade War on U.S. Prices and Welfare." Center for Economic and Policy Research Discussion Paper 13564.

Broda, Christian, Nuno Limão, and David E. Weinstein. 2008. "Optimal Tariffs and Market Power: The Evidence." *American Economic Review* 98 (5): 2032–65.

Broda, Christian, and David E. Weinstein. 2006. "Globalization and the Gains from Variety." *Quarterly Journal of Economics* 121 (2): 541–85.

Broda, Christian, and David E. Weinstein. 2010. "Product Creation and Destruction: Evidence and Price Implications." *American Economic Review* 100 (3): 691–723.

Caliendo, Lorenzo, and Fernando Parro. 2015. "Estimates of the Trade and Welfare Effects of NAFTA." *Review of Economic Studies* 82 (1): 1–44.

Cavallo, Alberto, Gita Gopinath, Brent Neiman, and Jenny Tang. 2019. "Tariff Passthrough at the Border and at the Store: Evidence from US Trade Policy." https://www.hbs.edu/faculty/Pages/item.aspx?num=56201.

De Loecker, Jan, Pinelopi K. Goldberg, Amit K. Khandelwal, and Nina Pavcnik. 2016. "Prices, Markups, and Trade Reform." *Econometrica* 84 (2): 445–510.

Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica* 70 (5): 1741–79.

Edmond, Chris, Virgiliu Midrigan, and Daniel Yi Xu. 2015. "Competition, Markups, and the Gains from International Trade." *American Economic Review* 105 (10): 3183–221.

Fajgelbaum, Pablo D., Pinelopi K. Goldberg, Patrick J. Kennedy, and Amit K. Khandelwal. 2019. "The Return to Protectionism." NBER Working Paper 25638.

Feenstra, Robert C. 1994. "New Product Varieties and the Measurement of International Prices." *American Economic Review* 84 (1): 157–77.

Feenstra, Robert C., and David E. Weinstein. 2017. "Globalization, Markups, and US Welfare." *Journal of Political Economy* 125 (4): 1040–74.

Flaaen, Aaron B., Ali Hortaçsu, and Felix Tintelnot. 2019. "The Production Relocation and Price Effects of U.S. Trade Policy: The Case of Washing Machines." NBER Working Paper 25767.

Goldberg, Pinelopi Koujianou, and Michael M. Knetter. 1997. "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35 (3): 1243–72.

Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon. 2010. "Currency Choice and Exchange Rate Pass-Through." *American Economic Review* 100 (1): 304–36.

Handley, Kyle, and Nuno Limão. 2017. "Policy Uncertainty, Trade, and Welfare: Theory and Evidence for China and the United States." *American Economic Review* 107 (9): 2731–83.

Irwin, Douglas A. 2017. *Clashing over Commerce: A History of US Trade Policy.* Chicago: University of Chicago Press.

Lovely, Mary E., and Yang Liang. 2018. "Trump Tariffs Primarily Hit Multinational Supply Chains, Harm US Technology Competitiveness." Petersen Institute Policy Brief 18-12.

Pierce, Justin R., and Peter K. Schott. 2012. "A Concordance between Ten-Digit U.S. Harmonized System Codes and SIC/NAICS Product Classes and Industries." *Journal of Economic and Social Measurement* 37 (1–2): 61–96.

Pierce, Justin R., and Peter K. Schott. 2016. "The Surprisingly Swift Decline of US Manufacturing Employment." *American Economic Review* 106 (7): 1632–62.

Redding, Stephen J., and David E. Weinstein. 2016. "Measuring Aggregate Price Indexes with Taste Shocks: Theory and Evidence for CES Preferences." NBER Working Paper 22479.

Redding, Stephen J., and David E. Weinstein. 2017. "Aggregating from Micro to Macro Patterns of Trade." NBER Working Paper 24051.

Santacreu, Ana Maria, and Makenzie Peake. 2019. "A Closer Look at China's Supposed Misappropriation of US Intellectual Property." Economic Synopses, Federal Reserve Bank of St. Louis. February 8, 2019. https://research.stlouisfed.org/publications/economic-synopses/2019/02/08/a-closer-look-at-chinas-supposed-misappropriation-of-u-s-intellectual-property.

Simonovska, Ina, and Michael E. Waugh. 2014. "The Elasticity of Trade: Estimates and Evidence." *Journal of International Economics* 92 (1): 34–50.

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Retrospectives
Tragedy of the Commons after 50 Years

Brett M. Frischmann, Alain Marciano, and Giovanni Battista Ramello

This feature addresses the history of economic terms and ideas. The hope is to deepen the workaday dialogue of economists, while perhaps also casting new light on ongoing questions. If you have suggestions for future topics or authors, please contact Joseph Persky, Professor of Economics, University of Illinois, Chicago, at jpersky@uic.edu.

Introduction

Garrett Hardin's (1968) "The Tragedy of the Commons" has been incredibly influential in biology, ecology, and various social sciences, including economics. It has become a totemic reference to which tributes are regularly paid (for examples, see Feeny et al. 1990; Bajema 1991; Burger and Gochfeld 1998; Boyd et al. 2018). But "tragedy of the commons" has been transmuted into little more than a useful catchphrase, as if it were synonymous with free-rider problems endemic to public or collective goods. This obfuscates the usefulness of the concept of how a commons can function for the governance of shared resources. In this essay, we revisit Hardin's

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article 50 years after it was written to clarify, set the record straight, and explore its relevance in the twenty-first century.

We first remind readers that Hardin drew on both biological and economic theories of how competition worked and that he stressed the pressure that population growth would place on environmental resources. His narrative was very much in the public eye. After all, Paul Ehrlich's book *The Population Bomb* was a best seller in 1968. We describe Hardin's famous allegory of how sheepherders are likely to overexploit a commons, which had a significant impact on how subsequent generations understood the phenomenon. Yet, perhaps surprisingly, few economists engaged with Hardin's paper in the decade following its publication. To our knowledge, no economists paid much attention to the biological or economic arguments behind Hardin's essay, nor to his argument that the tragedy of the commons required government-imposed limits on births. It took some time before the tragedy of the commons spread among economists, and then it was typically as a quick mention in the background of a discussion of providing public goods.

However, Elinor and Vincent Ostrom were more insightful. In particular, Elinor Ostrom dedicated much of her career to demonstrating how commons in the real world had not led and do not inevitably lead to tragic ruin, as Hardin had insisted. In 2009, she received the Nobel Prize in Economics because she "challenged the conventional wisdom by demonstrating how local property can be successfully managed by local commons without any regulation by central authorities or privatization."[1] In retrospect, and in the context of the work by Elinor and Vincent Ostrom, we can see that Hardin's famous sheepherder allegory failed to make two key conceptual distinctions: the allegory conflated the idea of a scarce resource with the governance of that resource, and it further conflated open access with commons, despite significant differences in those forms of governance. We will clarify these distinctions and thus explore the limitations of Hardin's view. Unfortunately, Hardin's distorted perspective on the commons often persists to this day in economic discussions. Thus, we discuss some applications and extensions of research on commons, including infrastructure, knowledge, and other issues. Interdisciplinary scholars have identified an expanding set of shared resources for which commons governance may effectively address social dilemmas.

Hardin's "Tragedy of the Commons"

Garrett Hardin (1915–2003) is well known in biology for his work on evolution and natural selection. He spent most of his career at the University of California, Santa Barbara, where he arrived in 1946 and stayed until his retirement in 1978. Hardin was also prominent as a public intellectual. He contributed to magazines, gave popular lectures, appeared on television and radio, and testified before many

[1]For background material on Elinor Ostrom's Nobel Prize, see https://www.nobelprize.org/prizes/economic-sciences/2009/ostrom/facts.

congressional committees. In both his academic and nonacademic work, Hardin emphasized the need to control population growth. His "Tragedy of the Commons" essay is his most famous attempt to make his case, but it was neither the first nor the last attempt (as emphasized by Oakes 2016). A prominent early effort along these lines, "The Competitive Exclusion Principle," appeared in *Science* magazine in 1960. In that article, Hardin (1960, 1292, emphasis in original) stated that "*complete competition cannot coexist*," explaining:

> (i) [I]f two noninterbreeding populations "do the same thing"—that is, occupy precisely the same ecological niche in Elton's sense—and (ii) if they are "sympatric"—that is, if they occupy the same geographic territory—and (iii) if population *A* multiplies even the least bit faster than population *B*, then ultimately *A* will completely displace *B*, which will become extinct.

Anticipating Michael Ghiselin's (1974) bioeconomics and Edward O. Wilson's (1975) sociobiology, Hardin combined, extrapolated, and generalized a result that he had found in biology and economics. In 1960, Hardin first anchored his competitive exclusion principle, also known as Gause's principle. Specifically, Russian evolutionist Georgii Gause (1932) had shown in a series of experiments involving yeast and paramecia that when different species live in a shared environment and use similar resources, one species will tend to drive out the others. Hardin (1960, 1293) acknowledged the principle was hard to "prove or disprove" empirically, but further argued that "[t]he 'truth' of the principle is and can be established only by theory."

Second, Hardin (1960, 1295) thought it was "possible" that principle "originated in economic thought." Thus, as another source of inspiration for the claim that competition would destroy itself, he cited "the French mathematician" Joseph Bertrand. Commenting on Cournot's duopoly model, Bertrand (as quoted in Hardin 1960, 1295–96) noted that if

> one of the competitors will lower his price in order to attract the buyers to himself, and that the other, trying to regain them, will set his price still lower . . . there is no limit to the lowering of the price. Whatever common price might be initially adopted, if one of the competitors were to lower the price unilaterally he would thereby attract the totality of the business to himself.

Hardin (1960, 1296) thus stated baldly: "Any competitor knows that unrestrained competition will ultimately result in but one victor," in part because unrestricted companies will form cartels or use intellectual property to block competitors. In international trade, Hardin argued, his proposed competition exclusion principles meant that the world would need to reconsider tariffs and trade barriers, to prevent one country from being the victor that drives all others from the market.

Of course, just as many biologists of the time were engaged in controversy over the actual reach of the competitive exclusion principle, many economists then and

now would take issue with the claim that all competition tends to monopoly. Even at the time, Gordon Tullock (1960, 95) stressed that Hardin's article "contains an error in economics. From the principle that complete competitors cannot coexist he deduces the development of monopolies." Tullock argued: "If the principle has any application to economics at all, it would indicate that one type of economic enterprise might, by multiplication of its members, replace another, but this would not lead to monopoly."

In Hardin's "Tragedy of the Commons" essay, instead of focusing on biological competitors with a fixed set of resources and similar needs, he added another dimension: the stress that population growth inevitably placed on environmental resources—"the world available to the terrestrial population is finite" (Hardin 1968, 1243). That was also the case with other natural resources, such as oceans, which people tend to think as "inexhaustible" (1245); national parks, about which he remarked "there is only one Yosemite Valley" (1245); air and rivers; and even "airwaves of radio and television" (1249). Scarcity was the origin of the economic, ecological, and social problem.

In what is probably the most-quoted portion of the essay (at least in classes in economics!), Hardin (1968, 1244) proposed a sheepherder allegory to understand the basic motivation at work:

> Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. . . .
>
> As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility *to me* of adding one more animal to my herd?" This utility has one negative and one positive component.
>
> 1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.
>
> 2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of −1.
>
> Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another. . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

In Hardin's (1968, 1245) view, individuals acted vis-à-vis the world and its resources as if they were "independent, rational, free-enterprisers," as if their action

had no impact on them, as if Adam Smith's invisible hand had actually worked and "decisions reached individually will, in fact, be the best decisions for an entire society" (1244). Rationally, such behavior was perfectly understandable: "Each man," explained Hardin, "is locked into a system that compels him to increase his herd without limit" (1244) or "a system of 'fouling our own nest'" (1245). The consequence was unavoidable. Because of the ongoing increase in population and humanity's shared use of the global commons, "the per capita share of the world's goods must steadily decrease" (1243), which would generate "misery" (1243) and "ruin" (1244).

At its core, Hardin's (1968) tragedy, captured in his sheepherder analogy, illustrates a rather standard economics problem of interdependence, which involves issues of collective goods or external effects. After early analyses by Pigou (1920) and Knight (1924), these problems had received more attention and had been more frequently discussed in the mid- to late 1950s with the works of Samuelson (1954), Bator (1958), and Coase (1960) (for an overview, see Marciano and Medema 2015). Hardin offered quick and casual references to Adam Smith and Thomas Malthus, but he did not refer to any of the modern economists who had contributed to the study of how to deal with situations involving interdependence. Hardin also neglected prior work in economics that dealt with commons (for example, Gordon 1954 on fisheries).

Indeed, Hardin's (1968) sheepherder allegory strikingly echoed the view Samuelson advanced in 1954: namely, that the economic problem of inefficient resource allocation does not come from the interdependence of resources but rather from the tendency of self-interested individuals to engage in free riding—the "hope to snatch some selfish benefit," in Samuelson's (1954, 389) words. For Hardin, the problem resided more in the *freedom* to use a resource rather than in the characteristics of the resource itself; significantly, he titled one of the sections of his article "Tragedy of Freedom in a Commons" (Hardin 1968, 1244).

To avoid the tragedy, Hardin argued for governance to constrain consumption and ensure sustainability. His advice was simple: stop making resources open to all. He pointed out that this step had already been taken with "food gathering, enclosing farm land and restricting pastures and hunting and fishing areas" (Hardin 1968, 1248). It should also be done, in Hardin's view, with "commons as a place for waste disposal" and with "pollution by automobiles, factories, insecticide sprayers, fertilizing operations, and atomic energy installations," as well as with "the commons in matters of pleasure," restricting, for instance, "the propagation of sound waves . . . in the public medium"—what he called "mindless music." All this would imply coercion, "the infringements on somebody's personal liberty." But in Hardin's view, it was the illusion and appearance of freedom associated with the philosophy of open access to resources that was actually coercive: "Individuals locked into the logic of the commons are free only to bring on universal ruin."

Hardin's (1968) primary focus and attack in his "Tragedy of the Commons" essay was on rising human populations: indeed, the subtitle of the article is "The Population Problem Has No Technical Solution; It Requires a Fundamental Extension in Morality." Hardin (1968, 1246) argued that the "freedom to breed" is

"intolerable." He rejected appeals to conscience: "[A]n appeal to independently acting consciences selects for the disappearance of all conscience in the long run, and an increase in anxiety in the short" (1248). He insisted upon mutual coercion as the approach: "Coercion is a dirty word to most liberals now, but it need not forever be so" (1247). He referred to the United Nations' Universal Declaration of Human Rights, which held that all choices about the size of families should be made by families. Hardin responded: "It is painful to have to deny categorically the validity of this right; denying it, one feels as uncomfortable as a resident of Salem, Massachusetts, who denied the reality of witches in the 17th century" (1246).[2]

Hardin (1968) recognized two solutions to the tragedy of the commons: government regulation and privatization. Both solutions rely on collective action through government to introduce constraints on resource consumption. The approaches differ substantially in terms of the manner in which ongoing (month-to-month, day-to-day, minute-to-minute) resource allocation decisions are made. Government can constrain consumption by directly managing or regulating resource use. Alternatively, government can establish a system of private property rights delineating ownership of the resources. The former presumes government will consider the aggregate effects and manage resource use efficiently over time, and the latter presumes well-defined private property rights will facilitate market exchanges and thereby lead to an efficient allocation of access and use rights and, consequently, efficient resource management over time. In the case of population growth, Hardin's essay does not explicitly contemplate a privatization approach (like a transferable right for any adult to be the biological parent to one child). Government regulation of population is necessary, Hardin (1968, 1248) claimed: "Freedom to breed will bring ruin to all."

Early Interpretation and Incorporation within Economics

Hardin's (1968) article attracted a reasonable degree of public attention, but most economists did not much refer to Hardin. The few who did argued that Hardin was cited for having coined an interesting expression for what economists already knew. For example, in one of the first references made by an economist to Hardin, Dales (1975, 495) explained that because of the difficulties in assigning property rights, "the expected outcome followed—overuse, congestion, premature depletion, or extinction, depending on the particular characteristics of the case—and

[2]As Bajema (1991) notes, Hardin was often willing to "break social taboos." Along with calling for government-mandated population control, he signed with 51 others a *Wall Street Journal* op-ed called "Mainstream Science on Intelligence," written by Linda Gottfredson ([1994] 1997), that discussed average racial-ethnic differences in intelligence measured in terms of IQ. Another striking example is his 1974 essay, "Living in a Lifeboat," in which he again insisted on the need to control population growth and asserted that the problem of "Christian-Marxist" idealism is that "the sharing ethics . . . leads to the tragedy of the commons" (Hardin 1974, 562).

the value of the resource dropped toward zero. 'The tragedy of the commons,' to use Hardin's apt phrase, unfolded inexorably." Along the same lines, a few years later, one read that "[w]ithout private property, society will experience the 'tragedy of the commons'—ownership by all actually means ownership by none" (Carroll, Ciscil, and Chisholm 1979, 607). At the beginning of the 1980s, a few economists discussed again the problem of fisheries, with a similar tone. For instance, Johnson and Libecap (1982) referred to a series of articles on fisheries as common-property resources, and they mentioned Hardin's 1968 article only in passing, as if it were a necessary reference.[3]

But over time, the "Tragedy of the Commons" article became one among many that formed "the large literature" devoted to "common-property management" (Thiesenhusen 1991, 18). In the economics literature, it was no longer distinguished from the articles written by economists themselves, and Hardin was put on the same footing as the economists who had worked on property rights. He was thus cited as a scholar defending a neoclassical "perspective" (Carroll, Ciscil, and Chisholm 1979) or "paradigm" (Swaney 1981) and lumped together with Coase (1960) and Demsetz (1967), despite their very different perspectives and approaches. The context of Hardin's (1968) work, with its focus on overpopulation and advocacy of mandatory government control over population growth, largely faded away.

The Ostroms

Elinor and Vincent Ostrom noted as early as 1971 that "Garrett Hardin had indicated that these strategies [such as free riding] give rise to 'the tragedy of the commons' where increased individual effort leaves everyone worse off" (V. Ostrom and E. Ostrom 1971, 207). In 1973, Vincent Ostrom referred to Hardin and described the tragedy as follows (V. Ostrom 1973, 210–11):

> Individualistic decision making applied to common-property resources will inexorably result in tragedy unless the structure of decision-making arrangements can be modified to enable persons to act jointly in relation to those resources as a common property. Potential recourse to coercive measures will also be necessary to preclude a hold-out strategy and regulate patterns of use among all users. Unrestricted individualistic decision-making in relation to common-property resources or public goods will lead to the competitive dynamic of a negative-sum game: the greater the individual effort, the worse off people become.

[3] One set of writers even supposed that Hardin had "documented more fully" the problem of overexploitation (Balachandran, Fisher, and Stanley 1989, 261), which is obviously an exaggeration: Hardin had given no more than a few examples. Furthermore, despite Hardin's depiction, commons existed and were successfully managed in various ways in medieval England and many other parts of the world for a very long time (Dahlman 1980; Buck Cox 1985; Bannon 2017).

These references were not different from those of most economists at that time. But the Ostroms, and especially Elinor, disagreed with Hardin. In an interview with Levi (2010), she recounted that the first time she heard Hardin she "was somewhat taken aback" because her and Vincent's work proved Hardin was wrong.[4]

Elinor Ostrom and other social scientists challenged the frame set by Hardin by asking two foundational sets of questions: First, how well does the tragedy of the commons allegory describe reality? Is it a useful theory for making predictions about real-world behavior of individuals sharing common-pool resources? Does it describe a normal or exceptional situation? Does it provide a useful basis for choosing or designing regulatory solutions? Second, does the binary choice between government command-and-control regulation and private property–enabled markets reflect the full range of options? Are there alternative (bottom-up) institutions and/or means for collective action (Frischmann 2013, 390)?

To answer the first set of questions, it may be *convenient* to work within the confines of Hardin's sheepherder allegory, because doing so makes analysis tractable. As Elinor Ostrom explained (E. Ostrom 2007, 15183):

> Situations characterized by [Hardin's] assumptions, in which individuals independently make anonymous decisions and primarily focus on their own immediate payoffs, do tend to overharvest open-access resources. Researchers have repeatedly generated a "tragedy of the commons" in experimental laboratories when subjects make independent and anonymous decisions in a common-pool resource setting.

The allegory, however, is reductionist and distorting. It includes a series of assumptions with respect to both resources and resource management that severely limits its generalizability. Simply put, Hardin's description of the tragedy of the commons ruled out—by assumption—the possibility that people might communicate and find ways to cooperate. Again, as Elinor Ostrom explained (E. Ostrom 2007, 15183):

> Making one small change . . . in the structure of laboratory experiments, a change that is predicted by game theory to make no difference in the predicted outcome, has repeatedly had major impacts on interactions and outcomes. Simply enabling subjects to engage in face-to-face communication between decision rounds enables them to approach socially optimal harvesting levels rather than severely overharvesting the commons. In the face-to-face discussions, participants tend to discuss what they all should do and build norms to encourage conformance.

Elinor Ostrom also criticized reliance on the rational actor model at the heart of Hardin's allegory when analyzing collective action and social dilemmas (E. Ostrom

[4]For more details on Elinor Ostrom's framework, useful starting points are Aligica and Boettke (2009) and Tarko (2017).

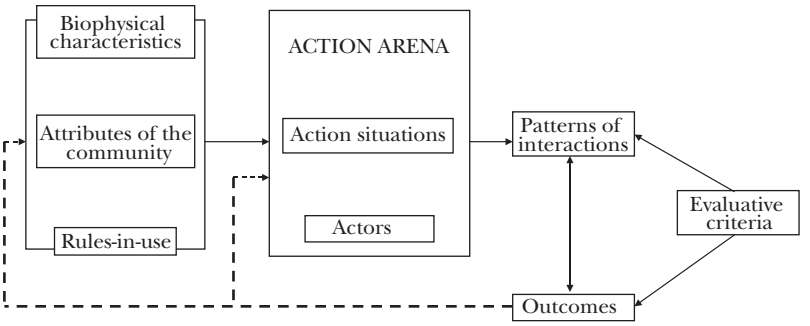
2000). After establishing a series of "well-substantiated facts" about human behavior based on extensive fieldwork, she concluded: "I believe that one is forced by these well-substantiated facts to adopt a more eclectic (and classical) view of human behavior" (E. Ostrom 2000, 141). She then developed a "second-generation model of rationality" in which humans are "complex, fallible learners who seek to do as well as they can given the constraints that they face and who are able to learn heuristics, norms, rules, and how to craft rules to improve achieved outcomes" (E. Ostrom 1998, 9). The second-generation model of rationality predicts that reciprocity, reputation, and trust as "core relationships" can lead to increased net benefits (13). This theoretical model identifies "individual attributes" that are particularly important in explaining behavior in social dilemmas. These attributes include "[1] the expectations individuals have about others' behavior (trust), [2] the norms individuals learn from socialization and life's experiences (reciprocity), and [3] the identities individuals create that project their intentions and norms (reputation)" (14).

Thus, Elinor Ostrom (1990) rebelled against the distorting reductionism that Hardin's essay represented—and Hardin was hardly the only culprit. Donning the analytical straitjacket would "lead the analyst to miss what is most important and focus on what is least relevant" (Frischmann 2013, 390). This was especially true when approaching the second set of questions and the feasibility of institutional solutions besides private property–enabled markets and government command-and-control regulation. Commons governance was ignored as a solution because it was presumed to be *the* problem that inevitably leads to ruin.

To explore alternative institutional arrangements, Elinor and Vincent Ostrom, and their colleagues both at the Workshop in Political Theory and Policy Analysis at Indiana University and around the world, advocated "to combine formal approaches, fieldwork and experiments in order to 'penetrate' social reality rather than to use formal techniques to 'distance' ourselves from it" (V. Ostrom, quoted in Aligica 2009, 5). Thus, in the three decades that followed publication of Hardin's "Tragedy," they engaged in rigorous, interdisciplinary social science to diagnose social dilemmas and to understand the commons as a mode of governing access to and use of shared resources. This approach stressed context and was grounded in empirical study. Systematic studies of real communities demonstrated that commons governance works in some contexts and fails in others (E. Ostrom 1990, 2005). Communities may develop their own governance institutions, but communities are still embedded in government and market systems. Recognizing that governance institutions vary across communities and contexts, Elinor Ostrom and colleagues developed a framework illustrated in Figure 1—the Institutional Analysis and Development (IAD) framework (for explanation, useful starting points are Kiser and Ostrom 1982; E. Ostrom 1986, 1994)—that could be used to analyze institutional arrangements and capture their diversity.[5] To quote Elinor Ostrom, "[t]he IAD

[5]The Social Ecological Systems and Governing Knowledge Commons frameworks build upon the IAD framework (E. Ostrom 2007; Frischmann, Madison, and Strandburg 2014). All three frameworks enable systematic institutional analysis.

Figure 1
Institutional Analysis and Development (IAD) Framework



Source: Adapted from Hess and Ostrom (2007, 44).

framework is designed to enable scholars to analyze systems that are composed of a cluster of variables, each of which can then be unpacked multiple times depending on the question of immediate interest" (E. Ostrom 2010, 646).

Because these clusters of variables are interrelated, researchers can start at the left with the external variables, at the center with the action arena, or at the right with the outcomes. The external variables affect actors and action situations, which "generate patterns of interactions and outcomes that are evaluated by participants in the action situation (and potentially by scholars) and feed back on both the external variables and the action situations" and the actors (E. Ostrom 2010, 647). The many detailed examples using the Institutional Analysis and Development framework are beyond the scope of this paper. As one brief example, consider a lobster fishery. The tragedy of the commons allegory makes assumptions about the biophysical characteristics (depletable), community (independent, self-interested rational actors), and rules-in-use (every fisherman for himself); also, it assumes the only actors are the fishermen and the only relevant collective action problem is the prediction of ruinous competition. Viewed through the IAD lens, the empirical shortcomings of Hardin's allegory become clear: lobsters are not purely depletable; as a biological matter, they can reproduce and replenish stocks. The relevant community involves more than just the fishermen. Communication and cooperation are feasible. The rules-in-use are more nuanced than everyone for himself (for detailed examination, see Acheson 2003).

Recognizing that people often can cooperate effectively and build institutions to enable sustainable use of shared resources focused scholarly attention on complexity, context, communities, and institutions. This broader field of vision brought informal institutions into view and encouraged their systematic study, and it also improved our understanding of formal institutions by revealing the many ways that government, market, and community institutions depend on one another to be successful. Figuring out how best to successfully cooperate in governing ourselves

and our shared environments remains one of the core questions studied in law, economics, political science, sociology, and many other related fields today.

Two Key Conceptual Mistakes That Further Muddle Hardin's Special Case

As the work of Elinor Ostrom and many others makes clear, the assumptions made in Hardin's (1968) "Tragedy of the Commons" article, highlighted by the sheepherder allegory, limit his analysis to a special case. In this section, we go one step further, explaining why Hardin made two basic conceptual mistakes that further distort the usefulness of his case.

First, Hardin confused resources with governance. In his sheepherding allegory, for example, the relevant resource is a pasture, and the relevant governance is open-access sharing: as the allegory begins, "Picture a pasture open to all." To describe commons as the resource subject to tragedy is a category error. Commons are *not*, and should not be conflated with, resources. They are neither common-pool resources nor public goods; these types of sharable goods may, however, be governed as or within commons. Instead, commons are a form of resource governance where members of a community share resources on terms set by the community. Thus, commons "applies to resources, and involves a group or community of people, but commons does not denote the resources, the community, a place, or a thing. Commons [are] the institutional arrangement of these elements" (Frischmann, Madison, and Strandburg 2014, 2). Unfortunately, many people describe a commons a shared resource subject to tragedy. This perpetuates Hardin's conceptual mistake.

Second, Hardin conflated two different governance systems. He used the term "commons," but he limited his analysis to the consequences of *only one* mode of governance, open-access sharing. Yet these are quite different, and the differences matter (Frischmann 2012, 8). *Open access* implies no ownership or property rights. No individual or institution has the right to exclude others from the resource. Hence, all who want access can get access, typically for free. By comparison, *commons* involve some form of communal ownership (community property rights, public property rights, joint ownership rights). As a consequence, access to the resource is restricted to the members of the relevant community, under more or less restrictive conditions, and nonmembers can be excluded. In other words, *open access* differs from *commons* in several ways: in terms of *ownership* (none versus communal/group), *definition of community* (public at large versus a more narrowly defined and circumscribed group with some boundary between members and nonmembers), and *degree of exclusion* (none versus exclusion of nonmembers).

These distinctions are important for understanding different institutions and how social arrangements operate at different scales. By making the assumptions that he did, Hardin (1968) locked himself into the analysis of a special case and significantly underestimated the power of commons as an efficient form of governance.

Extensions: Infrastructure and Knowledge

The tragic dilemma at the core of Hardin's allegory has been identified and discussed for a wide range of different resources. Much of the early work focused on natural resources like fisheries and other typically common-pool resources. It has also received renewed attention in immigration debates (for example, Normadin and Valles 2015). But not surprisingly, the dilemma arises with many human-made resources too. Some are common-pool resources subject to congestion and potential deterioration like roads and other infrastructure, while others are public goods subject to free-rider concerns like ideas and other knowledge resources. In these settings, there can also be an inclination toward a Hardin-style bias to believe that the relevant collective action problems (1) can be diagnosed in terms of ruinous competition and (2) can be addressed only by direct government mandates and/or government-enforced property rights. Such bias leads analysts to undervalue the usefulness and workability of commons governance over these resources by the relevant community. Here, we offer a brief and selective discussion of these topics, with an emphasis on how interdisciplinary research in these areas is moving past the basic tragedy of the commons model.

Infrastructure Commons

Infrastructure resources are often managed in an openly accessible manner that gives rise to possibilities that economists have likened to Hardin's tragedy of the commons.[6] For example, individual users rationally use toll-free highways at a rate and in a manner that maximizes private gains but disregards the effects on other users or, more generally, the sustainability of the resource. If each individual acts in such a fashion, aggregate consumption may lead to congestion costs from crowding, increased waiting time in queues, slower service, pollution, noise, reduced quality of service due to increased interruptions of service, and accelerated depreciation and depletion of the shared infrastructure (Frischmann 2012).

The basic economic model of congestion, like Hardin's (1968) tragedy of the commons, assumes homogeneous uses (Vickrey 1969; Arnott, de Palma, and Lindsey 1993). The shared meadow is used for grazing sheep (not for grazing other animals or for other activities); the shared highway is used to complete trips (in more or less identical vehicles). When considering homogeneous use, economists utilize a congestion cost function that relates the marginal social cost of resource use (like feeding sheep or completing a trip) to utilization rates (traffic) and resource capacity (like acreage or number of lanes). Such congestion is called "anonymous crowding," because the determinants of crowding are utilization and facility size, and attributes of individual users play no part in the equation (Cornes and Sandler 1996, 355). However, complications arise as heterogeneous users and uses are incorporated into economic models (Cornes and Sandler 1996): for example, variance

[6] Unlike Hardin's pasture, most infrastructure resources are human-made, and that gives rise to a host of supply-side issues, which we leave aside for the sake of brevity.

in capacity consumption rates and cross-crowding between uses. To illustrate cross-crowding, Frischmann (2012) extends Hardin's sheepherder allegory to include different livestock, assuming sheep, donkeys, and buffalo graze differently and also positing that "sheep and buffalo . . . fight each other." For roadways, a similar extension might involve cars, mass-transit buses, and trucks.

Heterogeneity affects the analysis of costs and benefits and is relevant to diagnosing congestion problems and comparing solutions. When crowding is no longer anonymous, discriminating among uses becomes a regulatory option to consider. In addition, a standard response of modern economists to congestion would be to use some form of congestion pricing to encourage users with heterogenous values of traveling by car at certain times to sort themselves—a policy choice that goes unconsidered in Hardin (1968).

There is also a case that certain infrastructural resources ought to be managed openly, because doing so may generate public goods and positive externalities or positive scale returns—greater social value with greater use of the resource (Frischmann 2012; Frischmann and Hogendorn 2015). Rose (1986) called this the "comedy of the commons." Rose (1986, 769–70) used road systems to illustrate and explained how commerce enabled by roads is an

> interactive practice whose exponential returns to increasing participation run on without limit. . . . Through ever-expanding commerce, the nation becomes ever-wealthier, and hence trade and commerce routes must be held open to the public, even if contrary to private interest. Instead of worrying that too many people will engage in commerce, we worry that too few will undertake the effort.

Commerce generates private value that is captured by participants in economic transactions, as buyers and sellers exchange goods and services, but it also generates social value that is not easily observed and captured by participants. Examples include the value associated with traveling to visit friends and relatives or traveling for recreation, as well as the value of widespread attendance at civic events—knowledge exchange, socialization, and acculturation. If open travel creates positive externalities, society may find diverse ways to take this into account as it considers how to manage access to roads. Frischmann (2012) extends the point to a variety of other infrastructural resources, ranging from basic research to the internet.

The Public Domain and Knowledge Commons

The connection from intellectual property to the tragedy of the commons has been made explicit by a number of writers. Carrol, Ciscil, and Chisholm (1979, 611) appear the first to refer to copyright law as a means for dealing with the tragedy that seems to also plague intellectual commons. Yet ideas are public goods, not common-pool resources. Thus, using and overusing ideas (or works of art) may, in special cases, reduce their value (Landes and Posner 2003, 487) but does not congest or deplete them. Unconstrained consumption seems good—*the more, the merrier* (Rose 1986; see also Merton 1988)—and even just (as discussed in Gosseries,

Marciano, and Strowel 2008) rather than bad or wrong. If an intellectual resource, such as an idea, is openly accessible to all, then everyone who can profitably make use of it will do so. But there's a catch. Ideas are products of human intellect; they require investment of time, effort, and capital. Unconstrained consumption by free riders presents a risk for potential investors, who may struggle to recover a sufficient return on their investment and may underinvest as a result. Thus, tragic underproduction of intellectual resources appears to be a social dilemma that mirrors Hardin's tragedy of the commons. Avoiding cultural, technological, and scientific stagnation seems to require collective action.

Many approaching this problem assume Hardin's (1968) two options: direct government intervention (via public funding) or privatization (via intellectual property–enabled markets). To be clear, government funding and intellectual property are incredibly important drivers of socially valuable knowledge production. However, one can make a case that much or even most of humanity's intellectual resources have been generated and shared within open-access and community-based commons, often without government subsidy and outside of intellectual property–mediated markets. The free-rider allegory myopically presumes tragedy, leading people to believe that free riding is necessarily harmful and needs to be eliminated (Lemley 2005). In fact, the opposite is often true. Free riding is pervasive and is often a beneficial feature, rather than a bug, of our economic, cultural, and social systems (Ramello 2011; Frischmann 2012; Lobel 2013). Since at least Schumpeter (1934), the creative process has been likened to a recombinant process in which (open) access to previously created knowledge plays a crucial role, fueling progress and driving the combinatorial process of knowledge accumulation that fosters economic growth. This perspective emphasizes the positive externalities characterizing knowledge production and the role of commons governance (Weitzman 1998; Marchese et al. 2019), including the role of the knowledge commons and rules governing the public domain.

Knowledge commons refers to the institutionalized community governance of the sharing and, in many cases, creation and curation of a wide range of intellectual and cultural resources (Frischmann, Madison, and Strandburg 2014). Examples include the scientific research commons, including data, literature, and research materials (Reichman, Uhlir, and Dedeurwaerdere 2016); intellectual property pools (Madison, Frischmann, and Strandburg 2010); open-source computer software projects (Schweik and English 2012); Wikipedia (Hoffman and Mehra 2009; Safner 2016); "jamband" fan communities (Schultz 2006); and highly specialized technical knowledge like the Cornish steam engine (Nuvolari 2004). Using the Ostrom-inspired Governing Knowledge Commons framework, case studies examine many governance issues, including interactions with intellectual property, government subsidies, and regulation (Frischmann, Madison, and Strandburg 2014; Strandburg, Frischmann, and Madison 2017; Sanfilippo, Frischmann, and Strandburg forthcoming). For example, rare disease research consortia must address numerous governance challenges, including allocating research funding, authorship credit, and other rivalrous resources; overcoming

potential "anticommons"[7] dilemmas arising from researchers' incentives to hoard access to patients and their data; maintaining privacy, security, and the trust of patients and their families; reducing transaction costs of cooperation between widely dispersed researchers; and managing interactions with outsiders, such as pharmaceutical companies.

Other researchers have focused on the governance of the public domain, which is the incredibly capacious set of ideas, facts, and many other intellectual resources that are openly accessible by default to everyone (Litman 1990; see also Posner 2005). As an example of work in this area, a rich legal literature explores categories related to public domain, such as the semi-commons constructed within intellectual property systems and the creative commons constructed with intellectual property licenses (for a detailed survey, see Benkler 2014).

Social demand for trusted governance of shared knowledge resources, ranging from medical data to algorithmically generated intelligence, is growing (Frischmann and Selinger 2018), even as public trust in governments and markets as sources of governance seems tenuous. Now, more than ever, we need to explore whether, when, and how commons governance can scale.

Conclusion

Hardin's (1968) ultimate legacy is not really about his analysis of the tragedy of the commons, which was relatively trivial given already available economic tools, nor is it about his analysis of commons, which focused only on a narrow special case. Hardin contributed a catchphrase that caught the prevailing winds of public discourse and drew attention to the governance of shared resources. In the end, Elinor Ostrom's interdisciplinary, international, and systematic analysis of commons governance is and should be the abiding legacy of the tragedy of the commons.

[7] Michael Heller (1998) coined the term "anticommons." He argued that too much private property could lead to underuse and waste of resources, with effects as tragic as the lack of property rights described by Hardin (1968). Heller and Rebecca Eisenberg explored the potential tragedy of the anticommons in biomedical research (Heller and Eisenberg 1998). Buchanan and Yoon (2000) developed a formal economic model of anticommons. The anticommons concept may offer a justification for fair use and other copyright exceptions (Depoorter and Parisi 2002; Parisi, Schulz, and Depoorter 2005).

References

Acheson, James M. 2003. *Capturing the Commons: Devising Institutions to Manage the Maine Lobster Industry*. Hanover, NH: University Press of New England.

Aligica, Paul Dragos. 2009. "Rethinking Institutional Analysis: Interviews with Vincent and Elinor Ostrom." Mercatus Center, George Mason University, Research Paper. https://www.mercatus.org/publication/rethinking-institutional-analysis-interviews-vincent-and-elinor-ostrom.

Aligica, Paul Dragos, and Peter J. Boettke. 2009. *Challenging Institutional Analysis and Development: The Bloomington School*. Abingdon, UK: Routledge.

Arnott, Richard, André de Palma, and Robin Lindsey. 1993. "A Structural Model of Peak-Period Congestion: A Traffic Bottleneck with Elastic Demand." *American Economic Review* 83 (1): 161–79.

Bajema, Carl Jay. 1991. "Garrett James Hardin: Ecologist, Educator, Ethicist, and Environmentalist." *Population and Environment* 12 (3): 193–212.

Balachandran, Chandra S., Peter F. Fisher, and Michael A. Stanley. 1989. "An Expert System Approach to Rural Development: A Prototype (TIHSO)." *Journal of Developing Areas* 23 (2): 259–70.

Bannon, Cynthia. 2017. "Fresh Water in Roman Law: Rights and Policy." *Journal of Roman Law* 107 (1): 60–89.

Bator, Francis M. 1958. "The Anatomy of Market Failure." *Quarterly Journal of Economics* 72 (3): 351–79.

Benkler, Yochai. 2014. "Between Spanish Huertas and the Open Road: A Tale of Two Commons?" Chap. 3 in *Governing Knowledge Commons*, edited by Brett M. Frischmann, Michael J. Madison, and Katherine J. Strandburg. Oxford: Oxford University Press.

Boyd, Robert, Peter J. Richerson, Ruth Meinzen-Dick, Tine De Moor, Matthew O. Jackson, Kristina M. Gjerde, Harriet Harden-Davies, Brett M. Frischmann, Michael J. Madison, Katherine J. Strandburg, Angela R. McLean, and Christopher Dye. 2018. "Tragedy Revisited." *Science* 362 (6420): 1236–41.

Buchanan, James M., and Yong J. Yoon. 2000. "Symmetric Tragedies: Commons and Anticommons." *Journal of Law and Economics* 43 (1): 1–14.

Buck Cox, Susan Jane. 1985. "No Tragedy on the Commons." *Environmental Ethics* 7 (1): 49–61.

Burger, Joanna, and Michael Gochfeld. 1998. "The Tragedy of the Commons 30 Years Later." *Environment* 40 (10): 4–13.

Carroll, Thomas M., David H. Ciscil, and Roger K. Chisholm. 1979. "The Market as a Commons: An Unconventional View of Property Rights." *Journal of Economic Issues* 13 (2): 605–27.

Coase, Ronald H. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3 (1): 1–44.

Cornes, Richard, and Todd Sandler. 1996. *The Theory of Externalities, Public Goods and Club Goods*. New York: Cambridge University Press.

Dahlman, Carl J. 1980. *The Open Field System and Beyond: A Property Rights Analysis of an Economic Institution*. Cambridge: Cambridge University Press.

Dales, J. H. 1975. "Beyond the Marketplace." *Canadian Journal of Economics* 8 (4): 483–503.

Demsetz, Harold. 1967. "Toward a Theory of Property Rights." *American Economic Review* 57 (2): 347–59.

Depoorter, Ben, and Francesco Parisi. 2002. "Fair Use and Copyright Protection: A Price Theory Explanation." *International Review of Law and Economics* 21 (4): 453–73.

Feeny, David, Fikret Berkes, Bonnie J. McCay, and James M. Acheson. 1990. "The Tragedy of the Commons: Twenty-Two Years Later." *Human Ecology* 18 (1): 1–19.

Frischmann, Brett M. 2012. *Infrastructure: The Social Value of Shared Resources*. Oxford: Oxford University Press.

Frischmann, Brett M. 2013. "Two Enduring Lessons from Elinor Ostrom." *Journal of Institutional Economics* 9 (4): 387–406.

Frischmann, Brett M., and Christiaan Hogendorn. 2015. "Retrospectives: The Marginal Cost Controversy." *Journal of Economic Perspectives* 29 (1): 193–206.

Frischmann, Brett M., Michael J. Madison, and Katherine J. Strandburg, eds. 2014. *Governing Knowledge Commons*. Oxford: Oxford University Press.

Frischmann, Brett M., and Evan Selinger. 2018. *Re-engineering Humanity*. Cambridge: Cambridge University Press.

Gause, G. F. 1932. "Experimental Studies on the Struggle for Existence." *Journal of Experimental Biology* 9 (1): 389–402.

Ghiselin, Michael T. 1974. *The Economy of Nature and the Evolution of Sex*. Berkeley: University of California Press.

Gordon, H. Scott. 1954. "The Economic Theory of a Common-Property Resource: The Fishery." *Journal of Political Economy* 62 (2): 124–42.

Gosseries, Axel, Alain Marciano, and Alain Strowel, eds. 2008. *Intellectual Property Rights and Theories of Justice*. London: Palgrave McMillan.

Gottfredson, Linda S. (1994) 1997. "Mainstream Science on Intelligence." *Wall Street Journal*, December 13, 1994. Reprint, "Mainstream Science on Intelligence: An Editorial With 52 Signatories, History, and Bibliography." *Intelligence* 24 (1): 13–23.

Hardin, Garrett. 1960. "The Competitive Exclusion Principle." *Science* 131 (3409): 1292–97.

Hardin, Garrett. 1968. "The Tragedy of the Commons." *Science* 162 (3859): 1243–48.

Hardin, Garrett. 1974. "Living on a Lifeboat." *BioScience* 24 (10): 561–68.

Heller, Michael A. 1998. "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets." *Harvard Law Review* 111 (3): 621–88.

Heller, Michael A., and Rebecca S. Eisenberg. 1998. "Can Patents Deter Innovation? The Anticommons in Biomedical Research." *Science* 280 (5364): 698–701.

Hess, Charlotte. 2012. "The Unfolding of the Knowledge Commons." *St. Anthony's International Review* 8 (1): 13–24.

Hess, Charlotte, and Elinor Ostrom. 2007. "A Framework for Analyzing the Knowledge Commons." In *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, 41–81. Cambridge, MA: MIT Press.

Hoffman, David A., and Salil K. Mehra. 2009. "Wikitruth through Wikiorder." *Emory Law Journal* 59 (1): 151–210.

Johnson, Ronald N., and Gary D. Libecap. 1982. "Contracting Problems and Regulation: The Case of Fishery." *American Economic Review* 72 (5): 1005–22.

Kiser, Larry L., and Elinor Ostrom. 1982. "The Three Worlds of Action: A Metatheoretical Synthesis of Institutional Approaches." In *Strategies of Political Inquiry*, edited by Elinor Ostrom, 179–222. Beverly Hills, CA: Sage.

Knight, F. H. 1924. "Some Fallacies in the Interpretation of Social Cost." *Quarterly Journal of Economics* 38 (4): 582–606.

Landes, William M., and Richard A. Posner. 2003. "Indefinitely Renewable Copyright." *University of Chicago Law Review* 70 (2): 417–518.

Lemley, Mark A. 2005. "Property, Intellectual Property, and Free Riding." *Texas Law Review* 83 (4): 1031–76.

Levi, Margaret. 2010. "An Interview with Elinor Ostrom." Annual Reviews Conversations. https://www.annualreviews.org/userimages/ContentEditor/1326999553977/ElinorOstromTranscript.pdf.

Litman, Jessica D. 1990. "The Public Domain." *Emory Law Journal* 39 (4): 965–1023.

Lobel, Orly. 2013. *Talent Wants to Be Free: Why We Should Learn to Love Leaks, Raids, and Free Riding*. New Haven, CT: Yale University Press.

Madison, Michael J., Brett M. Frischmann, and Katherine J. Strandburg. 2010. "Constructing Commons in the Cultural Environment." *Cornell Law Review* 95 (4): 657–710.

Marchese, Carla, Simone Marsiglio, Fabio Privileggi, and Giovanni B. Ramello. 2019. "Endogenous Recombinant Growth and Intellectual Property Rights." *Macroeconomic Dynamics* 23 (5): 2035–67.

Marciano, Alain, and Steven G. Medema. 2015. "Market Failure in Context: Introduction." *History of Political Economy* 47 (Suppl. 1): 1–19.

Merton, Robert K. 1988. The Matthew Effect in Science, II: Cumulative Advantage and the Symbolism of Intellectual Property." *Isis* 79 (4): 606–23.

Normandin, Sebastian, and Sean A. Valles. 2015. "How a Network of Conservationists and Population Control Activists Created the Contemporary US Anti-immigration Movement." *Endeavour* 39 (2): 95–105.

Nuvolari, Alessandro. 2004. "Collective Invention during the British Industrial Revolution: The Case of the Cornish Pumping Engine." *Cambridge Journal of Economics* 28 (3): 347–63.

Oakes, Jason. 2016. "Garrett Hardin's Tragic Sense of Life." *Endeavour* 40 (4): 238–47.

Ostrom, Elinor. 1986. "An Agenda for the Study of Institutions." *Public Choice* 48 (1): 3–25.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Ostrom, Elinor. 1998. "A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association, 1997." *American Political Science Review* 92 (1): 1–22.

Ostrom, Elinor. 2000. "Collective Action and the Evolution of Social Norms." *Journal of Economic Perspectives* 13 (4): 137–58.

Ostrom, Elinor. 2005. *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.

Ostrom, Elinor. 2007. "A Diagnostic Approach for Going beyond Panaceas." *PNAS* 104 (39): 15181–87.

Ostrom, Elinor. 2010. "Beyond Markets and States: Polycentric Governance of Complex Economic Systems."

American Economic Review 100 (3): 641–72.
Ostrom, Vincent. 1973. "Can Federalism Make a Difference?" *Publius* 3 (2): 197–237.
Ostrom, Vincent, and Elinor Ostrom. 1971. "Public Choice: A Different Approach to the Study of Public Administration." *Public Administration Review* 31 (2): 203–16.
Parisi, Francesco, Norbert Schulz, and Ben Depoorter. 2005. "Duality in Property: Commons and Anticommons." *International Review of Law and Economics* 25 (4): 578–91.
Pigou, Arthur C. 1920. *The Economics of Welfare.* London: Macmillan.
Posner, Richard, A. 2005. "Intellectual Property: The Law and Economics Approach." *Journal of Economic Perspectives* 19 (2): 57–73.
Ramello, Giovanni B. 2011. "Property Rights and Externalities. The Uneasy Case of Knowledge." *European Journal of Law and Economics* 31 (1): 123–41.
Reichman, Jerome H., Paul F. Uhlir, and Tom Dedeurwaerdere. 2016. *Governing Digitally Integrated Genetic Resources, Data, and Literature: Globally Intellectual Property Strategies for a Redesigned Microbial Research Commons.* Cambridge: Cambridge University Press.
Rose, Carol M. 1986. "The Comedy of the Commons: Commerce, Custom, and Inherently Public Property." *University of Chicago Law Review* 53 (3): 711–81.
Safner, Ryan. 2016. "Institutional Entrepreneurship, Wikipedia, and the Opportunity of the Commons." *Journal of Institutional Economics* 12 (4): 743–71.
Samuelson, Paul A. 1954. "The Pure Theory of Public Expenditure." *Review of Economics and Statistics* 36 (4): 387–89.
Sanfilippo, Madelyn R., Brett M. Frischmann, and Katherine J. Strandburg. Forthcoming. *Governing Privacy in Knowledge Commons.* Cambridge: Cambridge University Press.
Schultz, Mark F. 2006. "Fear and Norms and Rock & Roll: What Jambands Can Teach Us about Persuading People to Obey Copyright Law." *Berkeley Technology Law Journal* 21 (2): 651–728.
Schumpeter, Joseph A. 1934. *The Theory of Economic Development.* Cambridge, MA: Harvard University Press.
Schweik, Charles M., and Robert C. English. 2012. *Internet Success: A Study of Open-Source Software Commons.* Cambridge, MA: MIT Press.
Strandburg, Katherine J., Brett M. Frischmann, and Michael J. Madison, eds. 2017. *Governing Medical Knowledge Commons.* Cambridge: Cambridge University Press.
Swaney, James A. 1981. "Externality and Community." *Journal of Economic Issues* 15 (3): 615–27.
Tarko, Vlad. 2017. *Elinor Ostrom: An Intellectual Biography.* London: Rowman and Littlefield.
Thiesenhusen, William C. 1991. "Implications of the Rural Land Tenure System for the Environmental Debate: Three Scenarios." *Journal of Developing Areas* 26 (1): 1–24.
Tullock, Gordon. 1960. "Letters: Competitive Exclusion." *Science* 132 (3419): 95.
Vickrey, William S. 1969. "Congestion Theory and Transport Investment." *American Economic Review* 59 (2): 251–60.
Weitzman, Martin L. 1998. "Recombinant Growth." *Quarterly Journal of Economics* 113 (2): 331–60.
Wilson, Edward O. 1975. *Sociobiology: The New Synthesis.* Cambridge, MA: Harvard University Press.

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Recommendations for Further Reading

Timothy Taylor

This section will list readings that may be especially useful to teachers of undergraduate economics, as well as other articles that are of broader cultural interest. In general, with occasional exceptions, the articles chosen will be expository or integrative and not focus on original research. If you write or read an appropriate article, please send a copy of the article (and possibly a few sentences describing it) to Timothy Taylor, preferably by email at taylort@macalester.edu, or c/o *Journal of Economic Perspectives*, Macalester College, 1600 Grand Ave., St. Paul, MN 55105.

Hors d'Oeuvres

India's Ministry of Finance has published *Economic Survey 2018–19* in two volumes (July 2019; https://www.indiabudget.gov.in/economicsurvey/). The wide-ranging report is impossible to summarize, but here are a few tastes. On demography: "India is set to witness a sharp slowdown in population growth in the next two decades. . . . It will surprise many readers to learn that population in the 0–19 age bracket has already peaked due to sharp declines in total fertility rates (TFR) across the country. . . . Contrary to popular perception, many states need to pay greater attention to consolidating/merging schools to make them viable rather than building new ones. At the other end of the age scale, policy makers need to prepare for ageing." On resolving contractual disputes: "Arguably the single biggest

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constraint to ease of doing business in India is now the ability to enforce contracts and resolve disputes. This is not surprising given the 3.5 crore [that is, ten million] cases pending in the judicial system. . . . Contrary to conventional belief, however, the problem is not insurmountable. A case clearance rate of 100 per cent (i.e. zero accumulation) can be achieved with the addition of merely 2,279 judges in the lower courts and 93 in High Courts even without efficiency gains. . . . Given the potential economic and social multipliers of a well-functioning legal system, this may well be the best investment India can make. . . . As a concerted effort made in the enactment and implementation of the [Insolvency and Bankruptcy Code], India improved its 'Resolving Insolvency' ranking from 134 in 2014 to 108 in 2019. . . . India won the Global Restructuring Review (GRR) award for the most improved jurisdiction in 2018. Financial Sector Assessment Program of IMF-World Bank in January 2018 observed: 'India is moving towards a new state of the art bankruptcy regime.'" On India's minimum wage: "[T]he present minimum wage system in India is extremely complex with 1,915 minimum wages defined for various scheduled job categories for unskilled workers across various states. Despite its complex structure and proliferation of scheduled employments over time, the Minimum Wages Act, 1948 does not cover all wage workers. One in every three wage workers in India has fallen through the crack and is not protected by the minimum wage law."

The Congressional Budget Office evaluates "The Effects on Employment and Family Income of Increasing the Federal Minimum Wage" (July 2019; https://www.cbo.gov/system/files/2019-07/CBO-55410-MinimumWage2019.pdf). "As of 2019, 29 states and the District of Columbia have a minimum wage higher than the federal minimum. . . . The minimum wage is indexed to inflation in 17 of those states, and future increases have been mandated in 6 more. . . . About 60 percent of all workers currently live in states where the applicable minimum wage is more than $7.25 per hour. And in 2025, about 30 percent of workers will live in states with a minimum wage of $15 or higher. . . ." The median CBO estimate for a phased-in rise in the minimum wage to $15 per hour includes: "[A]bout 1.3 million workers who would otherwise be employed would be jobless in an average week in 2025. . . . Wages would rise, however, for 17 million directly affected workers who remained employed and for many of the 10 million potentially affected workers whose wages would otherwise fall slightly above $15 per hour. . . . Almost 50 percent of the newly jobless workers in a given week—600,000 of 1.3 million—would be teenagers (some of whom would live in families with income well above the poverty threshold). Employment would also fall disproportionately among part-time workers and adults without a high school diploma. . . . That net effect is due to the combination of factors described above:

- Real earnings for workers while they remained employed would increase by $64 billion,
- Real earnings for workers while they were jobless would decrease by $20 billion,

- Real income for business owners would decrease by $14 billion, and
- Real income for consumers would decrease by $39 billion."

Mark A. R. Kleiman lays out some trade-offs in "The Public-Health Case for Legalizing Marijuana" (*National Affairs*, Spring 2019; https://www.nationalaffairs.com/publications/detail/the-public-health-case-for-legalizing-marijuana). "John Kenneth Galbraith once said that politics consists in choosing between the disastrous and the unpalatable. The case of cannabis, an illicit market with sales of almost $50 billion per year, and half a million annual arrests, is fairly disastrous and unlikely to get better. . . . The choice we now face is not whether to make cannabis available, but whether its production and use should be legal and overt or illegal and at least somewhat covert. . . . Cannabis, even as an illegal drug, is a remarkably cost-effective intoxicant, far cheaper than alcohol. For example, in New York City, where cannabis is still illegal, a gram of fairly high-potency material (say, 15% THC by weight) goes for about $10. A user can therefore obtain 150 milligrams of THC for $10, paying about 7 cents per milligram. Getting stoned generally requires around 10 milligrams of THC to reach the user's bloodstream, but the smoking process isn't very efficient; about half the THC in the plant gets burned up in the smoking process or is exhaled before it has been absorbed by the lungs. So a user would need about 20 milligrams of THC in plant material to get stoned, or a little less than $1.50 worth. For a user without an established tolerance, intoxication typically lasts about three hours. That works out to about 50 cents per stoned hour. . . . So it costs a typical man drinking beer about $4 to get drunk—typically for a couple of hours—and staying drunk costs an additional $1 per hour. . . . Over the past quarter-century, the population of "current" (past-month) users has more than doubled (to 22 million) and the fraction of those users who report daily or near-daily use has more than tripled (to about 35%). . . . Between a third and a half of them report the symptoms of Cannabis Use Disorder: They're using more, or more frequently, than they intend to; they've tried to cut back or quit and failed; cannabis use is interfering with their other interests and responsibilities; and it's causing conflict with people they care about."

Danit Kanal and Joseph Ted Kornegay describe "Accounting for Household Production in the National Accounts: An Update, 1965–2017" (*Survey of Current Business*, June 2019; https://apps.bea.gov/scb/2019/06-june/0619-household-production.htm). "To compute household production, we first aggregated household production hours across seven categories: housework, cooking, odd jobs, gardening, shopping, child care, and domestic travel. The value of nonmarket services is the product of the wage rate of general-purpose domestic workers and the number of hours worked. . . . Household production has declined in significance over time as more women engage in market work. This sector accounted for 37 percent of the satellite account's output in 1965, but that declined to 23 percent in 2017."

Competition in the Digital Economy

An expert panel formed by the UK government, made up of Jason Furman, Diane Coyle, Amelia Fletcher, Philip Marsden, and Derek McAuley, has written *Unlocking Digital Competition: Report of the Digital Competition Expert Panel* (March 2019; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785547/unlocking_digital_competition_furman_review_web.pdf). "There is nothing inherently wrong about being a large company or a monopoly and, in fact, in many cases this may reflect efficiencies and benefits for consumers or businesses. But dominant companies have a particular responsibility not to abuse their position by unfairly protecting, extending or exploiting it. . . . Acquisitions have included buying businesses that could have become competitors to the acquiring company (for example Facebook's acquisition of Instagram), businesses that have given a platform a strong position in a related market (for example Google's acquisition of DoubleClick, the advertising technology business), and data-driven businesses in related markets which may cement the acquirer's strong position in both markets (Google/YouTube, Facebook/WhatsApp). Over the last 10 years the 5 largest firms have made over 400 acquisitions globally. None has been blocked and very few have had conditions attached to approval, in the UK or elsewhere, or even been scrutinised by competition authorities."

Fiona Scott Morton, Pascal Bouvier, Ariel Ezrachi, Bruno Jullien, Roberta Katz, Gene Kimmelman, A. Douglas Melamed, and Jamie Morgenstern have written *Committee for the Study of Digital Platforms: Market Structure and Antitrust Subcommittee Report*, published by the Stigler Center at the University of Chicago (May 2019; https://research.chicagobooth.edu/-/media/research/stigler/pdfs/market-structure—report-as-of-15-may-2019.pdf). "By looking at the sub-industries associated with each firm—social platforms (Facebook), internet software (Google), and internet retail (Amazon)—a different trend emerges. Since 2009, change in startup investing in these sub-industries has fared poorly compared to the rest of software for Google and Facebook, the rest of retail for Amazon, and the rest of all VC for each of Google, Facebook, and Amazon. This suggests the existence of so-called 'kill-zones,' that is, areas where venture capitalists are reluctant to enter due to small prospects of future profits. In a study of the mobile app market, Wen Wen and Feng Zhu come to a similar conclusion: Big tech platforms do dampen innovation at the margin."

A group of outside advisers for the European Commission, made up of Jacques Crémer, Yves-Alexandre de Montjoye, and Heike Schweitzer, has written *Competition Policy for the Digital Era* (April 2019; https://ec.europa.eu/competition/publications/reports/kd0419345enn.pdf). "Data is acquired through three main channels. First, some data is volunteered, i.e. intentionally contributed by the user of a product. A name, email, image/video, calendar information, review, or a post on social media would qualify as volunteered data. . . . Second, . . . many activities leave a digital trace, and 'observed data' refers to more behavioural data obtained automatically from a user's or a machine's activity. The movement of individuals is traced by their mobile phone; telematic data records the roads taken by

a vehicle and the behaviour of its driver; every click on a page web can be logged by the website and third party software monitors the way in which its visitors are behaving. . . . Finally, some data is inferred, that is obtained by transforming in a non-trivial manner volunteered and/or observed data while still related to a specific individual or machine. This will include . . . categories resulting from clustering algorithms or predictions about a person's propensity to buy a product, or credit ratings. The distinction between volunteered, observed and inferred data is not always clear. . . . [W]e will also consider how data is used. We will define four categories of uses: non-anonymous use of individual-level data, anonymous use of individual level data, aggregated data, and contextual data."

These three reports dovetail and overlap in a number of ways, and also complement the two-paper "Symposium on Issues in Antitrust" in the Summer 2019 issue of this journal.

Symposia

The *Harvard Data Science Review* has published its first issue (June 2019; https://hdsr.mitpress.mit.edu/). Among the essays, Alan M. Garber offers a broad-based essay on "Data Science: What the Educated Citizen Needs to Know." Mark Glickman, Jason Brown, and Ryan Song use a machine learning approach to figure out whether Lennon or McCartney is more likely to have authored certain songs by the Beatles that are officially attributed to both, in "(A) Data in the Life: Authorship Attribution in Lennon-McCartney Songs." Michael I. Jordan contributes "Artificial Intelligence—The Revolution Hasn't Happened Yet," which is followed by eleven comments and a rejoinder from Jordan entitled "Dr. AI or: How I Learned to Stop Worrying and Love Economics." "Am I arguing that we should simply bring in microeconomics in place of computer science? And praise markets as the way forward for AI? No, I am instead arguing that we should bring microeconomics in as a first-class citizen into the blend of computer science and statistics that is currently being called 'AI.' . . . Indeed, classical recommendation systems can and do cause serious problems if they are rolled out in real-world domains where there is scarcity. Consider building an app that recommends routes to the airport. If few people in a city are using the app, then it is benign, and perhaps useful. When many people start to use the app, however, it will likely recommend the same route to large numbers of people and create congestion. The best way to mitigate such congestion is not to simply assign people to routes willy-nilly, but to take into account human preferences—on a given day some people may be in a hurry to get to the airport and others are not in such a hurry. An effective system would respect such preferences, letting those in a hurry opt to pay more for their faster route and allowing others to save for another day. But how can the app know the preferences of its users? It is here that major IT companies stumble, in my humble opinion. They assume that, as in the advertising domain, it is the computer's job to figure out human users' preferences, by gathering as much information as possible about their users, and by using AI. But

this is absurd; in most real-world domains—where our preferences and decisions are fine-grained, contextual, and in-the-moment—there is no way that companies can collect enough data to know what we really want. Nor would we want them to collect such data—doing so would require getting uncomfortably close to prying into the private thoughts of individuals. A more appealing approach is to empower individuals by creating a two-way market where (say) street segments bid on drivers, and drivers can make in-the-moment decisions about how much of a hurry they are in, and how much they're willing to spend (in some currency) for a faster route."

The Peter G. Peterson Foundation has commissioned 31 research papers as part of its "US 2050" project, falling into the broad categories of population, early investments in children, employment and adult workers, caregiving, retirement, and politics (March 2019; https://www.pgpf.org/us-2050). In the "caregiving" category, here's Stipica Mudrazija in "Work-Related Opportunity Costs of Providing Unpaid Family Care": "Accounting for future population aging and trends in physical disability and adjusting for compositional changes of the future population, the number of caregivers needed to keep the current prevalence of unpaid caregiving constant would have to almost double. . . . Therefore, future discussions of the role of unpaid family care should recognize that this is a finite and increasingly expensive resource." In another paper, Gal Wettstein and Alice Zulkarnain ask, "Will Fewer Children Boost Demand for Formal Caregiving?" "The authors estimate that, among people over age 50, having one fewer child increases the probability of having spent a night in a nursing home in the last two years by 1.7 percentage points—a magnitude comparable to the effect of having poor self-reported health, or of being ten years older."

The *Russell Sage Foundation Journal of the Social Sciences* has published a double issue with 13 papers illustrating the theme of "Using Administrative Data for Science and Policy"—which is also the title of the introductory essay by Andrew M. Penner and Kenneth A. Dodge (March 2019, 5:2–3; https://www.rsfjournal.org/content/5/2). "Research using administrative data has much in common with history and archeology, insofar as it observes the tracks that individuals leave as they move through society and draws lessons from these glimpses into their lives. . . . Given their origin in a particular institutional context, administrative records are typically fragmented, and these data are often not linked to other data that would be useful for research and policy. Hospitals, for example, collect detailed information about patients' health, schools regularly collect information about student development, and employers often keep records not only about the performance of employees, but also about applicants who were ultimately not offered positions. Although various combinations of these data can provide important insights, they are typically compartmentalized. Likewise, given their origin, administrative records often lack certain kinds of information that are less likely to be collected in these records. For example, information about attitudes, affinities, and motives are not often collected in administrative records. Combining administrative data with records from other sources—either by

linking administrative records across sources or by making administrative records available to be linked to data collected via other means—is thus central to building administrative data infrastructure."

Interviews

Rachel Glennerster was interviewed by Robert Wiblin and Nathan Labenz at the 80,000 Hours website in "A Year's Worth of Education for Under a Dollar and Other 'Best Buys' in Development, from the UK Aid Agency's Chief Economist" (December 20, 2018; https://80000hours.org/podcast/episodes/rachel-glennerster-best-buys-in-international-development/). "I think actually RCTs [randomized controlled trials] should not be seen as looking at testing this specific program, they should be seen as testing big questions that can then influence policy. For example, you might test a specific project on education. A lot of the work on education has suggested that the most effective thing we can do in education is to focus on the learning within the classroom. It's not about more money, it's not about more textbooks, it's not about . . . And that's what governments spend their money on. They spend it on teachers and textbooks, mainly teachers. But more teachers doesn't actually improve learning. More textbooks doesn't improve learning. But that's what the Indian government is spending their money on. . . . If you look at the data, just descriptive data, again, the power of descriptive data . . . within an average Indian classroom in 9th grade, none of the kids are even close to the 9th grade curriculum. They're testing at somewhere between 2nd grade and 6th grade. No wonder they're not learning very much, 'cause the teacher, the only thing that a teacher has to do by law in India is complete the curriculum, even if the kids have no idea what they're talking about. So yes, you have RCTs testing very specific interventions; all of the ones that worked were ones that got the teaching down from the 9th grade curriculum to a level that the kids could actually understand. Now the lesson from that, the big lesson for the Indian government if they were ever to agree to this, is change your curriculum. That's the biggest thing that you could do. Reform the curriculum and make it more appropriate to what children are doing. So yes, you're testing little things, but you're coming out with big answers."

Douglas Clement at the Federal Reserve Bank of Minneapolis has published a "William 'Sandy' Darity Jr. Interview: 'If You Think Something's the Right Thing to Do, Then You Pursue It'" (*The Region*, June 3, 2019; https://www.minneapolisfed.org/publications/the-region/interview-with-william-a-darity-jr). The subtitle reads: "His recent focus has been on reparations for African Americans, but his scholarship spans decades and ranges from imperialism to psychology, from 'price-specie flow' to rational expectations." On inequalities of wealth: "I'm absolutely convinced that the primary factor determining household wealth is the transmission of resources across generations. The conventional view of how you accumulate wealth is through fastidious and deliberate acts of personal saving. I would argue that the capacity to engage in some significant amount of personal saving is really contingent on

already having a significant endowment, an endowment that's independent of what you generate through your own labor. . . . I think these effects go beyond inheritances and gifts. I think it includes the sheer economic security that young people can experience being in homes where there is this cushion of wealth. It provides a lack of stress and a greater sense of what your possibilities are in life. . . . And if your family's wealthy enough, you come out of college or university without any educational debt. That can be a springboard to making it easier for you to accumulate your own level of wealth." On stratification economics: "Stratification economics is an approach that emphasizes relative position rather than absolute position. What's relevant to relative position are two considerations: one, a person's perception of how the social group or groups to which they belong have standing vis-à-vis other groups that could be conceived of as being rival groups. . . . This kind of frame as the cornerstone for the analysis comes out of, in part, the old work of Thorstein Veblen and also out of research on happiness. The latter increasingly shows that people have a greater degree of happiness if they think that they're better off than whoever constitutes their comparison group rather than simply being better off; so it's comparative position that comes into play. Conventional economics doesn't start with an analysis that's anchored on relative position, as opposed to absolute position; so I think that's the fundamental shift in stratification economics. But also important to stratification economics is the notion that people have group affiliations or group identifications."

David Price interviews Enrico Moretti in *Econ Focus*, a publication of the Federal Reserve Bank of Richmond (First Quarter 2019, 18–23; https://www.richmondfed.org/publications/research/econ_focus/2019/q1/interview). "The explosion of the internet, email, and cellphones democratizes the access to information. In the 1990s, people thought it would also make the place where the company is located or where workers live much less important. . . . But what we have seen over the past 25 years is that the opposite is true: Location has become more important than ever before, especially for highly educated workers. The types of jobs and careers that are available in some American cities are increasingly different from the ones available in other American cities. . . . It's a paradox because it is true that we can have access to a lot of information and communicate easily from everywhere in the world, but at the same time, location remains crucial for worker productivity and for economic success. In the first three decades after World War II, manufacturing was the most important source of high-paying jobs in the United States. Manufacturing was geographically clustered, but the amount of clustering was limited. Over the past 30 years, manufacturing employment has declined, and the innovation sector has become a key source of good jobs. The innovation sector tends to be much more geographically clustered. Thus, in the past, having access to good jobs was not tied to a specific location as much as it is today. I expect the difference in wages, earnings, and household incomes across cities to continue growing at least for the foreseeable future. . . . Thus, the concentration we observe in tech employment has drawbacks in the sense that it increases inequality across cities, but at the same time, it is good from the point of view of the overall production of innovation in the country. I see this as an equity-efficiency trade-off."

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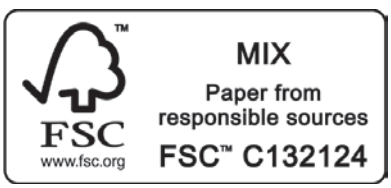

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