Exporting out of Agriculture: The Impact of WTO Accession on Structural Transformation in China*

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Abstract

This paper analyzes the effect of China's accession to the World Trade Organization in 2001 on structural transformation at the local level, exploiting cross-sectional variation in tariff uncertainty faced by local economies pre-2001. Using a new panel of approximately 2,000 Chinese counties observed from 1996 to 2013, we find that counties more exposed to the reduction in tariff uncertainty post-accession are characterized by increased exports and foreign direct investment, shrinking agricultural sectors, expanding secondary sectors, and higher total and per capita GDP. These findings are robust to a range of alternate specifications, and to controlling for other contemporaneous reforms.

JEL Classification: F14, F16, O14, O19

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1 Introduction

Over the past two and a half decades, China has experienced a process of remarkable structural transformation accompanied by rapid economic growth. The share of total employment in the agricultural sector fell from 60% in 1990 to 28% in 2015, and this sectoral shift was matched by unprecedented growth in non-agricultural output, as evident in Figure 1. At the same time, China also experienced a rapid rise in manufacturing exports, increasing from 2% to 19% of global manufacturing exports. This transformation broadly coincided with China's accession to the World Trade Organization in 2001.

China's record of growth has generated a robust debate about its causes. While some analysts argue that trade liberalization stimulated economic growth (Sun and Heshmati, 2010; McMillan and Rodrik, 2011), there is relatively little direct evidence of this relationship.[1] In addition, a robust literature argues that in fact internal policy reforms, including the reform of state-owned enterprises and the creation of Special Economic Zones, were more critical in enabling China to increase productivity and realize its comparative advantage in manufacturing (Autor et al., 2016; Song et al., 2011). Other analysts argue that the reduction of domestic tariffs had a large positive effect on the manufacturing sector (Brandt et al., 2015; Manova and Zhang, 2012), but there is almost no empirical evidence about the effects of trade liberalization on other economic sectors or on the process of structural transformation writ large.

At the same time, a growing literature has analyzed the determinants of structural change, primarily focusing on "push factors", or positive shocks to agricultural productivity.[2] Trade liberalization is arguably among the most important "pull factors" that can stimulate the substitution of productive factors out of agriculture, and given the growing evidence that productivity is much lower in the agricultural sectors of developing economies compared to the non-agricultural sectors of the same economies, this substitution can have important macro-level implications (Gollin et al., 2014; Lagakos and Waugh, 2013; McMillan et al., 2014). Analyzing trade liberalization in China — the focus of this study — represents a valuable opportunity to analyze the effects of an exogenous "pull" shock on structural transformation.

More specifically, in this paper we seek to provide new evidence around the effects of

[1] In a comprehensive review of the recent literature, Goldberg and Pavcnik (2016) conclude that there is only limited empirical evidence of the relationship between trade policy and growth, and further work is required to flesh out this relationship.

[2] More specifically, Foster and Rosenzweig (2004) estimate the impact of shocks to the returns to agriculture in India induced by Green Revolution technology, and find that industrial growth is fastest in areas where agricultural growth is lagging. Hornbeck and Keskin (2015) find no evidence that positive agricultural growth generated by the construction of an aquifer in the U.S. generates non-agricultural growth, while Bustos et al. (2015) present evidence that technological innovations in the soybean sector in Brazil generate industrial growth only when they are labor-saving.

China's WTO accession on structural change and economic growth, analyzing a newly assembled panel of approximately 2,000 counties observed between 1996 and 2013. China's WTO membership did not lead to any significant changes in the tariff levels its products faced in developed country markets, but uncertainty about U.S. trade policy vis-a-vis China was significantly reduced, boosting U.S.-China bilateral trade (Handley and Limão, 2017; Pierce and Schott, 2016b). We utilize an identification strategy that allows us to examine the effects of cross-sectionally varying shocks generated by the reduction in uncertainty post-2001, and present evidence that this shock led to significant growth in exports and foreign direct investment in more exposed regions. This in turn stimulates a reallocation of productive factors from agriculture into manufacturing and services, and a significant increase in county-level output.

Prior to 2002, China's Most Favored Nation (MFN) status in the U.S. required annual renewal by Congress, a risky process; if the renewal had failed, Chinese exports would have been subject to the much higher rates reserved for non-market economies.[3] The U.S. permanently granted Normal Trade Relations (NTR) status—a U.S. term for MFN status—to China in October 2000, tied to its WTO membership and effective as of January 1, 2002 (Handley and Limão, 2017). By contrast, the status of Chinese exports in other major markets did not change. Our empirical design utilizes variation across industries in the gap between the NTR tariffs permanently granted by the U.S. post–2001 and the non-NTR rates, in conjunction with variation across counties in the composition of employment by industry reported in the 1990 census.[4] The interaction of these two sources of variation generates a county-level variable capturing the exposure of local industries to tariff uncertainty pre-2001. If this uncertainty is a significant barrier to exporting, these more exposed counties should experience more rapid export expansion and substitution into the secondary sector post–2001.

While previous studies have analyzed the impact of trade liberalization on the manufacturing sector using firm-level or customs data, we preferentially use county-level data in order to analyze patterns of factor substitution across sectors. The county is an important unit of analysis in the literature on the Chinese economy, corresponding to a local labor market with defined fiscal policies (Chen and Kung, 2016; Zhang, 2006), and analyzing data at the county level enables us to identify the effects of China's WTO accession on the extensive, growth margin, in addition to the intensive margin. In addition, we are able to exploit this novel dataset to trace the effects not only in the short term,

[3]For example, in 2000, the average U.S. MFN tariff was 4%, but China would have faced an average non-MFN tariff of 31% had its MFN status been revoked.

[4]Pierce and Schott (2016b) and Handley and Limão (2017) use this empirical strategy to examine the effects of permanent NTR status on U.S. manufacturing employment and consumer prices using industry-level data.

but for approximately 15 years post-accession. Relatively few studies have been able to trace long-term effects of trade liberalization, and identify if these effects persist.

The main results indicate that counties more exposed to tariff uncertainty prior to 2001 experienced significantly faster growth in exports, greater expansion in the secondary sector, and more rapid increases in total and per capita GDP following WTO accession, conditional on county and province-year fixed effects. Comparing a county at the median level of uncertainty ex ante to a county characterized by the minimum level of uncertainty, the more exposed county shows evidence of an increase in exports of around .2 log points, and increases in secondary, total and per capita county GDP of around .05 log points. This export-driven expansion also has ancillary effects on other sectors: productive factors shift out of agriculture, agricultural production declines, tertiary output expands, and there is some evidence of in-migration. These effects are concentrated in counties with a higher initial concentration of capital-intensive industries and industries that initially export a higher proportion of their output to the U.S. Using firm-level data, we also document that more exposed regions experience an increase in value added per worker and a corresponding rise in the average wage.

Moreover, the magnitude of the implied effects is significant; our findings suggest that reduced trade uncertainty accounted for approximately 10% of the total output growth during this period, and that substitution of productive factors from agricultural to non-agricultural production generated an increase of around 25% in aggregate productivity.[5] Our paper is the first to estimate the causal effects of enhanced access to U.S. export markets on structural transformation and growth in China, analyzing whether an exogenous decline in trade policy uncertainty induced by WTO accession affects employment and output in the primary, secondary, and tertiary sectors.[6] This paper is also one of the first to provide evidence on the employment and GDP effects of enhanced access to advanced country markets in a developing country context.

We also provide extensive evidence of the robustness of our results. The empirical specifications all control for variation in U.S. tariff levels during this period, as well as a range of other trade reforms implemented by both China and the U.S., including the elimination of export licensing requirements, the reduction in barriers to foreign investment, and the expiration of the Multi-Fiber Arrangement. In general, variation in the level of tariffs imposed by the U.S. and other trading partners is small in magnitude relative to the potential increase in tariffs risked if China's NTR status had been revoked

[5]As we document in Section 5.3, the productivity differences across sectors are substantial: value added per worker in the secondary sector is approximately 6.5 times value added per worker in the primary sector.

[6]In this context, the primary sector includes agriculture and agricultural extensions, the secondary sector includes manufacturing and mining, and the tertiary sector includes services.

prior to WTO accession. While we show that this variation in levels has some effect on economic outcomes, the effects of tariff uncertainty proves to be significantly larger.

In addition, we demonstrate that there is no evidence of any significantly different trends when comparing counties characterized by different NTR gaps prior to China's WTO accession. When we estimate a more complex specification evaluating the differences between high and low NTR gap counties over time, we observe that these counties do not show any significant difference in observable characteristics prior to 2001. The gap in their economic trajectories emerges only post–2001, consistent with the hypothesis that the key channel is more secure access to the U.S. market.

We also verify that the key results are consistent when differential trends for counties characterized by different initial economic conditions are included, including differential trends for counties that are initially more concentrated in non-agricultural production, and conduct a placebo test that demonstrates that the cross-sectional variation in the NTR gap is associated only with increased exports to the U.S., and does not predict any increase in exports to other major export markets. Finally, further analysis explores whether the results are robust to controlling for differences in the initial importance of state-owned enterprises, and utilizes the average night lights index within county borders as a proxy for the intensity of local economic activity.

This paper contributes to several related literatures. First, a number of studies have sought to identify the impact of trade liberalization on the Chinese manufacturing sector, focusing on industries or firms as the unit of analysis, and primarily analyzing variation in tariff levels. Although our findings complement these studies, our paper differs significantly in its focus on structural transformation and county-level growth, as well as the channels through which the reduction of trade policy uncertainty may affect these outcomes. In the existing literature, Brandt et al. (2015) demonstrate that the reduced Chinese import tariffs following WTO accession led to significant gains in manufacturing productivity, and Brandt and Morrow (2014) and Manova and Zhang (2012) show that reduced tariffs have also resulted in increased access to imported inputs. Bai et al. (2017) and Khandelwal et al. (2013a) analyze the impact of the removal of export restrictions and MFA quotas on export growth and manufacturing productivity at the firm level, respectively. Recent work has also found that the diminished trade policy uncertainty following China's WTO accession has boosted patent applications (Liu and Ma, 2016) and stimulated entry into export-oriented production (Feng et al., 2016).[7]

[7]A smaller literature has analyzed structural transformation in China in a broader context. Brandt et al. (2013) analyze shifts in factor market distortions in the non-agricultural economy. Marden (2015) provides evidence that agricultural growth in the early reform period is associated with significantly faster growth in non-agricultural output. Leight (2016) analyzes the effect of Bartik-style labor demand shocks on local industrialization in China.

Second, an extensive literature analyzes the effects of increased manufacturing exports from China on manufacturing in developed countries, as summarized in the overview provided by Autor et al. (2016); our paper contributes to this literature by documenting the effects of this reduction in trade uncertainty in China. Autor et al. (2013) and Acemoglu et al. (2016) exploit variation across metropolitan statistical areas in their exposure to Chinese competition. The identification strategy employed in this paper is closely related to Pierce and Schott (2016b), who use industry data to analyze the effects of diminished trade policy uncertainty on U.S. manufacturing employment.[8] Similarly, Handley and Limão (2017) estimate the impact of reduced trade policy uncertainty on U.S. consumer prices.

Finally, our study relates to the literature on trade liberalization in developing country contexts, and contributes to this literature by presenting evidence on the employment and GDP effects of the elimination of trade policy uncertainty in China. A number of papers have analyzed the effects of domestic tariff cuts on regional labor market outcomes in Brazil (Chiquiar, 2008; Kovak, 2013; Dix-Carneiro and Kovak, 2015), but existing studies evaluating the effects of expanded access to developed country export markets primarily focus on Vietnam. Exploiting shocks generated by a bilateral trade agreement, McCaig (2011) finds that the U.S. tariff cuts reduced poverty in Vietnam, and McCaig and Pavcnik (2014b) and McCaig and Pavcnik (2014a) analyze reallocation of labor between household businesses and the formal sector. Another recent paper analyzes trade shocks linked to China's WTO accession on internal migration, but it utilizes only prefecture-level data (Facchini et al., 2016).

The remainder of the paper proceeds as follows. Section 2 provides more background on China's accession to the WTO and a simple conceptual framework. Section 3 describes the data. Section 4 presents the identification strategy and the empirical results. Section 5 presents robustness checks, and Section 6 concludes.

2 Background and conceptual framework

2.1 China's WTO accession

China's accession to the WTO in 2001 was the outcome of a lengthy and extensive negotiation process initiated in 1986. As a member, China both received new trade access

[8] The same authors have also presented evidence regarding the effects of Chinese import competition on voting patterns (Pierce and Schott, 2016a) and mortality (Pierce and Schott, 2016c). Additional research has analyzed the effect of Chinese import competition on manufacturing employment in Norway, Spain, Germany and Brazil (Balsvik et al., 2015; Costa et al., 2016; Dauth et al., 2014, 2017; Donoso et al., 2015).

benefits and committed to additional, liberalizing domestic reforms. However, both the benefits and the reforms inherent in WTO accession were largely phased in gradually and did not result in any discontinuous jumps in 2001. It is useful to highlight the most important policy changes implemented by China as part of this process, including reduced import tariffs, the relaxation of export licensing rules, and fewer barriers to foreign investment.

First, Chinese import tariffs had already been sharply cut prior to 2001 (from a weighted average of over 45% in 1992 to approximately 13% in 2000). WTO accession entailed further cuts (to approximately 7%), but these shifts were relatively small compared to the pre-accession reforms (Bhattasali et al., 2004). Figure 2a shows the evolution of the average weighted domestic tariff rate over time, calculated using industry-level tariffs and the share of each industry in total Chinese imports as reported in 1996 (the first sample year). Agricultural tariffs remained relatively high (22%) as of 2001 and required further cuts to 17.5% by 2004, with deeper cuts for agricultural products prioritized by the U.S. (e.g., corn). In addition, sanitary and other non-tariff barriers to U.S. exports of citrus, meat and grains were eliminated when China accepted U.S. inspection standards, and American companies were also allowed to freely trade agricultural products within China (Cheong and Yee, 2003).

Second, restrictions on direct exporting were substantial prior to WTO accession, though variable by industry, while firms that were not granted licenses to export directly were required to export via partners. In 2000, slightly more than half of the large firms observed in annual surveys of large industrial enterprises were not permitted to export directly, but all firms were allowed to export freely by 2004 (Bai et al., 2017). Third, prior to WTO accession, China had generally implemented relatively attractive policies to draw in foreign investment. However, foreign firms were subject to performance requirements, including criteria related to local content, technology transfers, and investments in research and development. These requirements were eliminated following China's accession to the WTO, facilitating a more rapid inflow of foreign investment (Long, 2005).

What about changes in the tariffs imposed by trading partners? Figure 2b shows fluctuations in tariffs over time for China's most important trading partners: the NTR tariffs imposed by the U.S. and the average tariff rates imposed on Chinese exports by the European Union, Japan, Korea, and Taiwan. On average during this period, the U.S. is the destination for approximately 20% of Chinese exports, followed by the European Union at 17%, Japan at 12%, Korea at 5% and Taiwan at 2%. We again construct these rates as weighted averages of industry-level tariffs, utilizing the shares of total exports constituted by each industry's output in 1996 as weights. The estimated tariffs imposed by Korea are highest (averaging between 8% and 10%), but show no significant trend.

Tariffs imposed by the U.S. and Taiwan decline gradually, and the tariffs imposed by Japan and the EU are roughly constant. In all cases, there is no evidence of any dramatic shifts in tariff rates at the point of China's WTO accession.[9] Despite their gradual nature, however, all of the preceding shifts in trade policy are relevant in understanding the evolution of local economies during this period, and we will control for these shifts in our empirical specifications.

Importantly, there was a discontinuous jump in one important dimension of China's market access in 2001: the tariff uncertainty faced in the U.S. market. Prior to WTO accession, the United States granted China NTR tariff rates on a discretionary basis subject to annual congressional renewal. Failure of that renewal would have triggered the imposition of much higher tariffs, originally set by the Smoot-Hawley Act, and designated for non-market economies. Hence, although the tariff applied to Chinese imports remained low because China's NTR status was never withdrawn, the required annual approval generated considerable uncertainty. Using media and government reports, Pierce and Schott (2016b) document that firms perceived the annual renewal of MFN status as far from guaranteed, particularly in periods of political tension in the early 1990s.[10] The CEOs of 340 firms stated in a letter to President Clinton that the "persistent threat of MFN withdrawal does little more than create an unstable and excessively risky environment for U.S. companies considering trade and investment in China, and leaves China's booming economy to our competitors" (Rowley, 1993).

In October 2000, Congress passed a bill that granted permanent NTR status to China, effective as of January 1, 2002. The EU had granted China permanent NTR status much earlier (effective in 1980); thus, China did not face any tariff uncertainty in this market either before or after its WTO accession (Pierce and Schott, 2016b). The permanency of China's NTR status in other markets is ambiguous, but the descriptive evidence generally

[9] In Figure A1 in the Appendix, we provide an alternate representation of the evolution of both domestic tariffs and trading partner tariffs over time, utilizing county-level employment weights provided by the 1990 census to calculate a county-level weighted average tariff and then reporting the mean weighted county-level tariff by year over time. (These average county-level tariffs will subsequently be employed as control variables in the regressions of interest.) The graphs are largely similar, except that the tariffs imposed by Korea on Chinese imports appear much higher, reflecting Korea's extremely high tariffs on agricultural exports from China.

[10] Anecdotal evidence from the Chinese media has emphasized that China's WTO accession "will help build confidence among investors at home and abroad, especially among United States investors, because China currently faces the issue of maintaining its Most Favored Nation trading status every year" (Shanghai Securities News, 1999). Chinese companies have also expressed that "[they] can enjoy multilateral Permanent Most Favored Nation status among the Member States of the WTO, so as to actively explore and enter the international market and participate in international economic competition" (Jiangxi Paper Industry Co. Ltd., 2000). Chinese newsletters described the U.S.'s decision to sever the ties between China's MFN status and human rights record as having "removed a major issue of uncertainty"; in addition, the renewal of China's MFN status would encourage investment and re-exports by "removing the threat of potential losses that would have arisen as a result of revocation" (South China Morning Post, 1994).

suggests there were no dramatic changes in the status of China's exports to other markets during this period, and analysts have noted that WTO members other than the U.S. had already provided China with permanent MFN status prior to its accession to the WTO (Rumbaugh and Blancher, 2004).

Again, a number of policy shifts during this period shaped economic outcomes. However, we will preferentially focus on reduced trade uncertainty given that the previous literature has highlighted this shift had a major impact on the U.S. market, and given the discontinuous nature of the reduction in uncertainty. We will also present evidence that while the other reforms implemented during this period had a meaningful impact on local economic outcomes in China, the effect of reduced tariff uncertainty generally proves to be largest in magnitude. Our analysis allows us to separately identify the impact of tariff uncertainty vis-a-vis levels by exploiting the fact that tariff uncertainty varies only comparing the pre and post period, and is proxied by the difference between low tariff rates and the counterfactual high rates specified by the U.S. tariff schedule. By contrast, realized tariff levels imposed by both the U.S. and other trading partners vary continuously over time. Further details are provided in section 3.2.

2.2 Conceptual framework

The reduction of tariff uncertainty can affect county-level economic outcomes through several channels. First, a reduction in tariff uncertainty creates incentives for Chinese firms to increase their exports to the U.S. market. A large literature has established that price uncertainty (in this case generated by tariff uncertainty in the destination market) generates an option value of waiting, decreasing investment (Bernanke, 1983; Dixit, 1989; Bloom et al., 2007). When tariff uncertainty is reduced, firms facing positive demand in the destination market, primarily manufacturing firms, have a greater incentive to make irreversible investments required to enter foreign markets (Handley and Limao, 2015; Handley and Limão, 2017). Given that industries differ in their exposure to tariff uncertainty, firms in industries with greater exposure ex ante will face a greater decline in the option value of waiting post-WTO accession. Exports from these industries, and counties with a greater concentration in these exposed industries, will differentially increase.

Second, a reduction in tariff uncertainty induces U.S. firms to increase foreign direct investment (FDI) into China, as again the option value of delaying investment declines. In addition, export-oriented industries in China are generally characterized by high FDI, as foreign investors producing for export have benefited from a variety of preferential policies, including the exemption of imported components from import duties (Zhang and Song, 2000) and the establishment of preferential zones that offer reduced taxes on profits and other benefits (Cheng and Kwan, 2000). Accordingly, a growing export sector

can be expected to attract increased FDI, and these effects would be particularly large in industries and counties more exposed to tariff uncertainty ex ante and those industries facing non-trivial foreign demand, primarily in manufacturing.

Third, another channel through which a reduction in tariff uncertainty may affect county-level economic outcomes is the reallocation of productive factors across sectors. Increased demand for exports and increased FDI in the secondary sector will increase the returns to capital and labor, leading factors to flow into this sector (Acemoglu et al., 2016). We denote this the local reallocation effect. On the other hand, an increase in exports and FDI at the county level generates a positive local income effect and an increase in local demand, benefiting producers of non-tradables, as well as any producers of tradables that sell partly to the local market. We describe this as the local demand effect. If there is some input in the tradable sector that is not mobile across sectors, the local demand effect will dominate the reallocation effect for the non-tradable (tertiary) sector, leading to its expansion (Kovak, 2013).[11] In addition, if preferences are non-homothetic, a positive local income effect will shift consumption away from agricultural and agricultural-derived goods, reinforcing the reallocation of productive factors toward the secondary sector (Gollin et al., 2014).

By examining economic outcomes at the level of counties, or local labor markets, we are able to capture both the direct effect of reduced uncertainty on the expansion of sectors that benefit from increased exports and increased FDI, as well as the indirect effects generated by the reallocation of productive factors and the expansion of local demand. Moreover, the reduction in tariff uncertainty may have disproportionate effects on counties with certain baseline characteristics. Since capital investments are generally irreversible, counties with an initially higher concentration of capital-intensive industries are likely to respond more robustly to the reduction in tariff uncertainty. Similarly, the effect of reduced tariff uncertainty is likely to be larger for counties that specialize in industries exporting a higher proportion of their output to the U.S. ex ante. We will also test these hypotheses in the empirical analysis.

3 Data

The empirical analysis incorporates three sources of data: county-level economic outcomes, the county-level NTR gap, and other policy shifts. We will discuss each data source in turn.

[11] The existing literature analyzing the response of U.S. local labor markets to Chinese trade shocks also finds that the local demand effect dominates local reallocation effects (Autor et al., 2013; Acemoglu et al., 2016).

3.1 County-level data

The main outcomes of interest are economic indicators at the county level reported by provincial economic yearbooks. Each year, every province in China publishes a statistical yearbook, primarily reporting economic indicators for the full province or for larger aggregate units such as prefectures. However, most provincial yearbooks also include some economic indicators reported at the county level. These data were compiled and digitized for every year available between 1996 and 2014. (Each yearbook reports data from the previous year; thus, 2013 is the final year observed in the data.) To the best of our knowledge, this study is the first to construct a comprehensive county-level panel of economic outcomes for this time period.

Only one limitation is imposed on the sample. We exclude provincial-level autonomous regions: Tibet, Xinjiang, Ningxia, Inner Mongolia, and Guangxi, as well as the island of Hainan, for which data is generally unavailable. Otherwise, all counties that can be matched between the 1990 county census and the provincial yearbooks are included. Aggregated to the county level, the 1990 census reports data on 2104 units that are (approximately) at the county level in the provinces of interest; of these units, 86%, or 1805 counties, can be matched to the yearbooks.[12]

The county-level panel includes information on exports; GDP and employment by sector; and detailed information about investment in agriculture. GDP and employment are reported for the primary, secondary, and tertiary sectors. Again, the primary sector includes agriculture, fishing, and forestry; the secondary sector includes manufacturing and mining; and the tertiary sector includes services. (Agricultural employment is also reported as a supplement to primary employment, as it is available for a larger sample.)

Exports and GDP are reported in millions of yuan, and per capita GDP is reported in yuan. The nominal figures for GDP and exports reported in the provincial yearbooks are deflated using World Bank deflators. Additional variables capturing investment in agriculture include cultivated area (reported in thousands of hectares), agricultural machinery used (reported in 10,000 kilowatts), grain and partial cash crop output (reported in thousands of tons), and grain yield (reported in tons per hectare).[13]

Summary statistics are reported in Table 1; for each outcome variable, the mean in logs is reported, followed by the mean, minimum and maximum in levels. While the

[12]The 1990 census has one unusual characteristic that differentiates it from subsequent census rounds (2000 and 2010) and from the provincial yearbooks: data for prefecture-level cities are reported only at the prefecture level, not for the constituent county-level units. In some cases, provincial yearbooks report data for these county-level units of prefecture cities. Accordingly, a single census observation can in these cases be linked to multiple county-level observations in subsequent waves of yearbook data.

[13]The production of cash crops is calculated as the sum of the production of meat and edible oils, the most commonly reported cash crops. This is clearly an incomplete measure of cash crop production, but allows us to generate some evidence about evolution of non-staple cultivation.

log variables are used for analysis, the summary statistics in levels are also included for descriptive purpose. The average population in the sampled counties and years is approximately 500,000. Per capita income is approximately 10,000 yuan or $1300.

Missing data Data is missing from the county-level panel for two reasons: counties cannot be matched between the census and the provincial yearbooks, and counties are matched to the yearbooks but specific indicators are not available. Here, we will briefly discuss each case; a detailed discussion can be found in Section A1.1 in the Appendix.

First, some counties that are observed in the census do not appear in provincial yearbooks. These are disproportionately counties that are part of larger, prefecture-level cities, as some provinces omit data for these areas. Accordingly, any bias due to missing counties will orient the sample toward rural areas that are not already fully industrialized. The differences between counties observed and not observed in provincial yearbook data are summarized in Table A1 in the Appendix, in which we estimate a series of specifications regressing county covariates as observed in the 1990 census on a dummy for missing, conditional on province fixed effects. The results suggest that counties missing from the sample are characterized by larger populations, higher levels of education, and a greater concentration of labor outside of agriculture.

Second, for those counties that are observed in provincial yearbooks, different provinces in different years opt to report different indicators at the county level in their yearbooks. As a result, the number of observations varies significantly for different variables, as evident from the summary statistics. The indicators that are reported most infrequently include employment at the sector level and exports, while indicators reported near-universally include gross domestic product, total employment, population, and measures of agricultural inputs and production.[14] (For each variable presented in Table 1, we also note the number of counties reporting any data for that variable. This figure ranges between 1000 and 1700.

We also present further evidence in Table A2 in the Appendix that the number of observations for the key variables of interest is in general lower for more populous counties, and higher for those that are more agricultural and have a lower proportion of employment outside the primary sector. This is again consistent with the underrepresentation of more urban and industrialized counties in the sample. We will subsequently demonstrate that the primary results are all robust to controlling for patterns of selection into the sample. In addition, we will present evidence around the evolution of exports and secondary employment — key outcomes of interest that are infrequently reported in the county-

[14]In particular, a strong positive correlation exists between the probability of reporting any data on export sales value and county-level GDP, and six relatively poor provinces (Shanxi, Sichuan, Guizhou, Shaanxi, Gansu, and Qinghai) report almost no data on exports

level data — drawing on additional data sources.

3.2 County-level NTR gap measure

Our empirical analysis seeks to identify the effect of the substantial reduction in tariff uncertainty in the U.S. market that China experienced following its accession to the WTO. To estimate the impact of China's permanent NTR status, we define the NTR gap at the industry level for each of the 39 subsectors of tradable production represented in the census data.

$$NTR\,Gap_i = Non\,NTR\,Rate_i - NTR\,Rate_i \tag{1}$$

The $Non\,NTR\,Rate_i$ is the higher tariff rate that would have applied if the U.S. Congress had revoked China's annual NTR status for industry i, and the $NTR\,Rate_i$ is the lower tariff rate guaranteed by permanent NTR status.

The industry-level NTR gap data were constructed by Pierce and Schott (2016b) using ad valorem equivalent NTR and non-NTR rates. The NTR gap for industry i is the average NTR gap across the four-digit ISIC Revision 3 tariff lines belonging to that industry. Throughout the empirical analysis, we use the NTR gaps for 1999, two years before the U.S. granted China permanent NTR status.[15] We manually match the industry categories in ISIC Revision 3 to the industry categories reported in the Chinese employment data, and Table A1 in the Appendix provides the details associated with this matching.

We then construct a county-level NTR gap measure equal to the weighted average of industry gaps, where the baseline composition of employment by industry prior to WTO accession is used to construct the weights. More specifically, we utilize the employment data reported in the 1990 census to calculate the share of tradable employment by industry in each county, interacting the NTR gap faced by industry i with each industry's county-specific employment share.

$$NTR\,Gap_c = \sum_i empshare_{ic}^{1990} \times NTR\,Gap_i \tag{2}$$

Given that each county's sectoral composition prior to WTO accession is used to construct the employment shares, the NTR gap does not reflect endogenous changes in employment composition that are driven by reduced trade policy uncertainty. Counties characterized by a larger NTR gap experience a greater reduction in trade policy

[15] We follow Pierce and Schott (2016b) in utilizing the 1999 NTR gaps. These NTR gaps are almost identical to those in 2000 or 2001; accordingly, the results are robust to the use of data from other years.

uncertainty post–2001, and thus ceteris paribus should show greater expansion in export-oriented industries. Permanent NTR rates were effective for China as of January 1, 2002, and thus our analysis characterizes all years from 2002 onward as the post-reform period.

In addition, we preferentially employ the employment shares observed in the 1990 census rather than the 2000 census to minimize potential endogeneity in employment composition. We hypothesize that by 2000, counties with more informed leaders or enterprises with more foresight may have already shifted toward subsectors that were less exposed to trade policy uncertainty. This would generate some correlation between county-level unobserved characteristics and the size of the county NTR gap. We will subsequently demonstrate that the results are robust to the use of 2000 employment weights, and are also consistent when the employment shares are recalculated with respect to total employment (including non-tradable employment).[16]

Table A5 in the Appendix summarizes the NTR gap observed for each industry. The highest NTR gaps are observed for textiles, garments, other manufacturing, medical and pharmaceutical products, and furniture manufacturing; the lowest NTR gaps are observed for mining products and agricultural output. At the county level, the average NTR gap is .123 with a standard deviation of .043. Approximately 5% of counties face NTR gaps of more than 20%.

Figure 3 shows a histogram of the NTR gap at the county level. While there is some evidence of outliers, we will demonstrate that the primary results estimated in Section 4.1 are robust to winsorizing the NTR gap. Figure A2 in the Appendix shows a map of cross-country variation in the NTR gap, utilizing the residuals after the NTR gap is regressed on province fixed effects. Overall, there is substantial variation in exposure to reduction in tariff uncertainty across Chinese counties.

3.3 Other policy changes

In the main empirical analysis, we also consider a number of other policy changes in China and the U.S. to isolate the impact of China's accession to the WTO. In particular, we examine whether other policy shocks could be the cause of the structural change that China has experienced over the past decade. Other policy shocks may constitute plausible alternative explanations if their timing coincides with China's WTO accession

[16]Data on GDP, revenue, and export value per subsector are not available in any year; accordingly, weights can only be constructed using employment data. Constructing measures of exposure to trade shocks using employment weights is common in the literature, and has been theoretically derived by Kovak (2013) as the correct measure of trade exposure. Employment weights are also employed by Topalova (2007, 2010), McCaig (2011), Kovak (2013), and Autor et al. (2013) in analyzing the effects of trade exposure on poverty and local labor market outcomes in regional labor markets in India, Vietnam, Brazil, and the United States, respectively.

and if these shocks would disproportionately affect counties that are more exposed to reduced tariff uncertainty post–2001. As previously noted, major domestic reforms in this period included lower import tariffs, the elimination of import licensing requirements, and reduced restrictions on FDI.

In our regressions, we use data on China's import tariffs from the WITS–TRAINS database, data on export licensing requirements from Bai et al. (2017), and data on the nature of contracting from Nunn (2007) to control for these policy changes. The data on the nature of contracting provide a measure of the proportion of intermediate inputs employed by a firm that require relationship-specific investments by the supplier; counties with high concentrations of industries characterized by different contracting methods may be differentially affected by reductions in barriers to foreign investment. For each of these variables, we construct a county-level weighted average from the industry-level source data using employment weights from the 1990 census.[17]

We also control for policy changes in the U.S., including the time-varying NTR rate itself, for which we construct an industry-weighted county average. An additional important policy shift during this period was the elimination of textile and clothing import quotas in 2002 and 2005 as part of the global MFA. We employ data on MFA quotas from Khandelwal et al. (2013b), and follow their methodology to construct a measure of the degree to which industries' quotas were binding under the MFA by calculating the import-weighted average fill rate. The fill rates represent the ratio of actual imports to allowable imports under the quota; thus, a higher value indicates greater exposure to MFA quota reductions. Using these industry-level data, we construct a county-level MFA variable, where greater values represent greater exposure to quota reductions and thus greater benefits from the policy shift.

4 Empirical results

In this section, we first analyze the baseline specification focusing on pre-post differences, and demonstrate that the results are robust to a number of additional specifications. Next, we present evidence that counties with high and low NTR gaps are characterized by parallel trends prior to 2001, but diverging economic trajectories post-accession, and also examine heterogeneous effects. Finally, we draw on additional data from a survey of large-scale firms.

[17]Since the industry categories for the export licensing and contract intensity variables are available for SIC categories, these categories are manually matched to the census employment categories. The industry classification for the import tariff data is available in ISIC Revision 3, the same source utilized to construct the NTR gap variable. Table A1 in the Appendix provides the details associated with the matching.

4.1 Baseline specification

First, we use a difference-in-difference specification to analyze the effect of reduced trade policy uncertainty on county-level economic outcomes. More specifically, we examine whether the trajectory of economic outcomes in counties characterized by relatively large gaps between NTR tariff rates and non-NTR rates is different following China's accession to the WTO in 2001. The sample includes annual county-level data from 1996 to 2013; all dependent variables are calculated as the log of the variable of interest.

We employ ordinary least squares (OLS) to estimate the following specification:

$$\begin{aligned}\ln(Y_{cfpt}) = \beta_1 Post_t \times NTR\,Gap_{cfp} + \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} \\ + Urb_{cfp} \times \gamma_{pt} + \delta_c + \epsilon_{cfpt}\end{aligned} \tag{3}$$

The dependent variable is observed in county c in prefecture f in province p in year t. The independent variable is the interaction of the county-level NTR gap, standardized to have a mean of zero and a standard deviation of one, with a post–WTO dummy, equal to one for 2002 and subsequent years.[18]

The specification also includes a number of additional controls denoted $\boldsymbol{X}'_{cfpt}$. This includes the interaction of the post dummy and a time-invariant dummy capturing whether the county is characterized by industries with high contract intensity.[19] We also control for time-varying shocks: the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted domestic import tariff rate, the industry-weighted percentage of local firms licensed to export, and the industry-weighted NTR tariff rates. (All variables capturing other changes in trade policy during this period are also included in the specifications estimated in Pierce and Schott (2016b); we will demonstrate in Section 5 that the results are consistent when estimated without these additional controls.[20]) The specification also includes province-year fixed effects, province-year fixed effects interacted with an urban dummy to allow for differential trends in urban areas, and county fixed effects.[21] Standard errors are clustered at the county level, and all specifications are weighted with respect to total county-level employment in 1990.

[18]The county-level NTR gap is omitted, given the inclusion of county fixed effects; similarly, the post dummy is collinear with province-year fixed effects.

[19]Specifically, this dummy is equal to one if the weighted average of industry contract intensity is above the mean.

[20]There are some differences between our specification and that employed in Pierce and Schott (2016b). They include the contract intensity variable in linear form and use the import tariff and export licensing variables to construct differences over time that interact with the post–WTO dummy. They also include other control variables for baseline capital and skill intensity and the use of high-technology products that are unavailable in our data.

[21]This dummy variable is equal to one if the county name includes the "shi" (i.e., city) suffix in 1990. Approximately 19% of the counties are designated as urban.

The results of estimating equation (3) are reported in Table 2; for concision, only the coefficient β_1 is reported. (The full set of coefficients is reported in Tables A6 through A8 in the Appendix, and will be discussed subsequently.) To analyze the magnitude of the effects, we will compare a county at the median level of uncertainty ex ante to a county characterized by the minimum level of uncertainty observed, a difference equal to one standard deviation in this sample; accordingly, the coefficients reported in the panel can be interpreted directly as the effect in log points. In Panel A, we observe that this increase would lead to an increase in exports of approximately .18 log points in the post–2001 period. There is also evidence of an increase in secondary, tertiary, total and per capita GDP of around .04 log points. No significant effects are observed for primary output.[22]

Panel B reports the employment results; again, employment data are available for a more limited sample, and the results are thus more noisily estimated. There is weak evidence of a decline in primary employment, but the decline in agricultural employment (reported for a larger sample) is significant, and indicates an decrease of .07 log points. We observe an increase in secondary employment of .17 log points, but no shift in tertiary or total employment. The absence of any significant effect for total employment may be somewhat surprising, but the sample for total employment is much larger; accordingly, this result suggests the decrease in primary employment and the increase in secondary employment may be of roughly equal magnitude in the full sample of counties. In addition, we observe a relative increase in population of about .01 log points in counties ex ante more exposed to tariff uncertainty, suggestive of some, albeit limited, in-migration to counties where export-driven manufacturing is growing. Panel C reports the results for agricultural variables. We observe declines in sown area, agricultural machinery used, grain and cash crop production, and grain yield of between .04 and .12 log points.

Taken together, these results suggest a clear pattern. Counties with high concentrations of industries exposed to large gaps between NTR and non-NTR tariffs show evidence of significantly more expansion in the secondary sector following China's WTO accession—a pattern evident in increased employment and GDP—and this growth generates an increase in local GDP and GDP per capita. There is also greater contraction in the agricultural sector as productive factors substitute into secondary production. If we assume that uncertainty is reduced to zero for a county at the median level of uncertainty ex ante, the implied effect at the median is an increase of .12 log points in county-level GDP, and .1 log points in per capita GDP. As will be explored further in Section 5.3,

[22]Unfortunately, the county-level data do not report any information on imports. Data on imports are provided at the provincial level; analyzing the effect of the post-NTR gap interaction in a parallel specification estimated with data at the province-year level reveals only weak evidence of an increase in imports.

these effects are of non-trivial magnitude relative to overall growth in this period.

The coefficients for the full set of control variables are reported in Tables A6 through A8 in the Appendix. In general, there is evidence of more rapid substitution away from agriculture in counties that benefit more from MFA quota reductions, and slower growth in secondary production in counties more exposed to a decline in domestic tariff rates and an increase in competition from imports. The coefficients on the post-contract interaction and the time-varying NTR rate are generally insignificant, and varying in sign. These patterns are consistent with the hypothesis that, while other trade reforms in this period were relevant for the evolution of county-level outcomes, no other policy shift had a positive effect on county-level expansion of exports and secondary production as large as that produced by reduced uncertainty in the U.S. market. In some specifications, the coefficients on the domestic tariff rate are large in magnitude; however, as previously noted the majority of the reduction in domestic tariffs was observed prior to WTO accession, and the sign of the coefficient suggests a negative shock from domestic tariff reduction, rather than a positive shock.[23]

In Table 3, we re-calculate the NTR gap using a number of alternate strategies to evaluate the robustness of these results; for brevity, we focus only on exports and GDP. (In each case, the control variables calculated as county-level weighted averages are also re-calculated.) In Panel A, we construct the NTR gap utilizing the employment data reported in the 2000 census to construct employment weights rather than utilizing the 1990 weights. The results are generally comparable, although the estimated coefficients for exports, GDP and per capita GDP are considerably larger. The use of 2000 employment weights introduces two potential sources of bias: areas already industrialized by 2000 will generally have larger NTR gaps, while industrialized areas that are more strategic in investing in industries characterized by less tariff uncertainty may have lower NTR gaps. The former phenomenon will lead to upward bias in the estimates of the NTR gap if already-industrialized counties continue to expand more rapidly, and this upward bias does seem to be evident in these specifications.[24]

In Panel C, we construct the NTR gap by weighting each subsector with respect to total employment, assigning a zero weight to the tertiary (non-tradable) sectors. In our

[23]A seeming anomaly can be observed here in that the proportion of firms licensed to export is negatively correlated with GDP. In the cross-section, we observe the expected positive correlation between the proportion of firms exporting and county-level GDP prior to 2004 (when export licensing requirements were eliminated). However, when county fixed effects are included, counties that show larger increases over time in export licensing are, mechanically, those with initially lower levels of export licensing, given that the maximum value for this variable is one. These counties with low initial export license levels are also characterized by slower GDP growth.

[24]The number of observations increases slightly, as some county codes can be matched to the 2000 census but cannot be matched to the 1990 census. These results are also consistent if we employ the mean of sector weights as observed in the 1990 and 2000 censuses.

main specification, we estimate the NTR gap without considering the relative size of the services sector, weighting employment with respect to total employment in tradable sectors; this methodology is recommended by Kovak (2013), though earlier papers in the trade literature assign the non-tradable sector a weight of zero.[25] Using this alternate strategy to re-calculate the NTR gaps and re-estimate equation (3) yields consistent results.

As previously noted, in general the gap between NTR tariffs and non-NTR tariffs is relatively low for agricultural products compared with that for industrial products; this raises the potential challenge that the observed growth in high NTR gap counties post–2001 may primarily reflect more rapid growth for already more heavily industrialized counties. Another related source of bias may stem from the fact some of the highest NTR gaps are observed for textiles and garment manufacturing, sectors that also benefited considerably from the relaxation of the MFA quotas. While the main specification includes controls for county-level variation in quotas, bias could be introduced by any shocks to textile production that are not captured by this variable.

We will address both points by implementing a similar strategy: including additional control variables for employment shares in different sectors interacted with year fixed effects. First, we calculate the share of employment in the secondary and tertiary sector as observed in the 1990 census, construct separate quartile dummy variables for each employment share, and include interactions between the quartile dummy variables and year fixed effects in the primary specification. Second, we use the employment shares in the five sectors characterized by the largest NTR gaps (textiles, garments, other manufacturing, medical and pharmaceutical products, and furniture manufacturing), again construct five sets of quartile dummy variables, and interact these variables with year fixed effects. (We use quartile dummy variables rather than the continuous variables to flexibly allow for non-linear effects of variation in employment shares; the results are also consistent if we simply employ the linear variable.) The results are reported in Panels C and D of Table 3, and are consistent with the primary specification.

There is also substantial expansion in China's agricultural imports from the U.S. during this period, particularly in cotton and soybeans.[26] We can utilize data from the 2000 World Census of Agriculture (FAO/IIASA) to analyze the cross-sectional correlation between the NTR gap and the proportion of area sown in soybeans and cotton. In general, this correlation is negative, suggesting that areas experiencing more export-driven growth are less subject to competition from imports. If we re-estimate the main specification including an interaction term between high cotton and soybean production (a dummy for

[25]This strategy has been widely used; see, for example, Autor et al. (2013), McCaig (2011), Topalova (2007), and Topalova (2010).

[26]Figure A3 in the Appendix shows the evolution of China's agricultural imports over time.

the fraction of sown area devoted to cotton and soybeans being above the median) and the NTR gap, the interaction terms are generally insignificant, as reported in Panel E of Table 3.[27] Accordingly, competition from imports is not a channel that seems to be of first-order importance in generating the observed substitution away from agriculture.

Variation in sample size Again, the number of observations fluctuates in the main specifications because many provincial yearbooks do not report specific indicators of interest (particularly employment at the sectoral level and exports). We report in each panel the number of unique counties observed in the sample for each variable; the number of counties ranges between 1000 and 1700. We will subsequently present results derived from additional data sources — a survey of large firms and data reported at the provincial level — that will enable us to corroborate the observed patterns for secondary employment and exports.

In addition, we present in Section A1.1 in the Appendix a number of additional specifications exploring whether the results are robust to selection into the sample, including imposing a sample restriction to only county-years that report export data. We observe consistent results across a number of different specifications controlling for selection into the sample, suggesting that missing data is not a significant source of bias.

4.2 Evidence about timing

Given that we attribute the observed patterns to the reduction in tariff uncertainty following China's accession to the WTO in 2001, a more demanding test of the assumptions of the difference-in-difference specification can be conducted by evaluating the correlation between the variables of interest and the NTR gap prior to 2001. To implement this test, we estimate a more complex specification, in which we interact the NTR gap with a series of dummy variables for two-year intervals. (A single dummy variable captures the three-year pre-treatment interval for the period 1999-2001.) Dummy variables for the years prior to 1997 are omitted, rendering 1996 and the small sample of pre-1996 observations the reference period. The specification of interest can thus be written as follows, including the same control variables employed in equation (3).[28] Again, standard errors are clustered at the county level and the regressions are weighted with respect to initial county-level employment.

[27]The specification also includes interactions between dummies for each quartile of the cotton and soybean fraction variable, measured at the prefecture level, and year fixed effects.

[28]In this specification, to increase precision we convert the MFA variable into ten dummy variables for each decile.

$$\ln(Y_{cfpt}) = \sum_{y=1997}^{2013} \beta_y 1\{y = t, t+1\} \times NTR_{cfp} \tag{4}$$
$$+ \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + Urb_{cfp} \times \gamma_{pt} + \delta_c + \epsilon_{cfpt}$$

The coefficients are presented graphically for county-level GDP in Figures 4a and 4b; we focus on GDP given that it is the variable reported for the largest sample. Figure 4a shows the specification including the full set of control variables, and 4b shows the simpler specification estimated without control variables. We observe that the coefficients for the NTR gap prior to 2002 are uniformly insignificant and generally small in magnitude. In particular, the absence of any significant effect in 1999–2001 is consistent with the evidence presented in Handley and Limão (2017) that China's new tariff status was not implemented until 2002.

However, following China's accession to the WTO, the magnitudes of the coefficients for the NTR gap are increasing over the subsequent decade, and generally statistically significant. This evidence is consistent with the hypothesis that the NTR gap is uncorrelated with any variation in county outcomes pre–2001, but highly predictive of the economic trajectories observed in the same counties post–2001. The pattern of an effect that is consistently positive after 2001, but growing slowly in magnitude, is also consistent with the parallel evidence presented by Pierce and Schott (2016b), showing a gradual decline in manufacturing employment in the U.S. over the same period.[29]

The regression analogues to these results are presented in Columns (1) and (2) of Table 4. We can also test whether the estimated coefficients β are equal when compared across the pre-treatment period (the dummy variables for 1997–1998 and 1999–2001) and the post–2001 period. All of the pairwise tests except two allow us to reject the hypothesis that the pre and post coefficients are significantly different at the one percent level.[30]

To sum up, these results suggest that the observed divergence in economic trajectories of counties subject to different gaps between NTR and non-NTR tariffs following China's WTO accession is primarily due to increased access to the U.S. market, leading to an increase in exports. These patterns first emerge in the early part of the post–2001 period, but they become steadily more pronounced over the subsequent decade.

[29]The corresponding figure in their paper is Figure 4.

[30]The exceptions are the tests comparing the estimated coefficients for 1997–1998 and 2002–2003, in both specifications (with and without additional controls).

4.3 Heterogeneous effects

We can also usefully extend this analysis to present some evidence regarding heterogeneous effects, identifying counties concentrated in industries that should show a more robust response to the reduction of tariff uncertainty. In particular, we focus on counties that are more capital-intensive, and counties concentrated in industries that export a higher proportion of their output to the U.S.

The tariff uncertainty faced by exporting firms in China prior to WTO accession presumably had a more significant effect on capital utilization vis-a-vis labor utilization, given that capital investments are generally irreversible. While the county-level panel does not include any detailed information about capital investment that would allow for a direct test of this hypothesis, we can examine heterogeneous effects with respect to capital intensity of the industries observed in the county at baseline.

Using a capital intensity variable constructed from a firm-level survey of large firms (described in more detail in Section 4.4), we calculate average capital intensity at the industry level in 1998, the first year reported, and construct a county-level proxy for capital intensity in the secondary sector using the 1990 employment weights.[31] We then re-estimate equation (4) for counties below and above the baseline median level of capital intensity; to increase power, we use the simple specification without additional controls.

Similarly, the export data available at the county level do not report the destination of these exports. However, we can use the available UNCOMTRADE data on Chinese exports at the product-destination level to calculate the proportion of exports destined for the U.S. by industry in 1996, the first sample year. We then generate a county-specific weighted average, and again re-estimate equation (4) for counties below and above the baseline median level of U.S. export share.

The graphical results are presented in Figures 4c through 4f. For counties below the median level of capital intensity at baseline, there is little evidence of any significant effects of the elimination of tariff uncertainty; by contrast, the effects are large and significant post–2001 for counties above the median level of capital intensity. A similar pattern is observed for counties below and above the median U.S. export share.

The regression analogues to these results are reported in Columns (3) through (6) of Table 4. In Columns (3) and (5), we observe no significant coefficients for low-capital intensity and low-U.S. share counties. Columns (4) and (6) report the results for high-capital intensity and high-U.S. share counties, and show coefficients that are insignificant in the pre-period, followed by positive and significant coefficients post–2001. If we again test the equality of coefficients pre- and post-WTO, the hypothesis that the pre and post

[31] Information about capital intensity in the primary sector is not available, and thus it is excluded from this analysis.

coefficients are equal can uniformly be rejected for both specifications. This suggests that as expected, the effects are concentrated in counties for which uncertainty was more likely to be a binding constraint on capital investment, and counties in which uncertainty was highly salient due to the presence of exporters focusing on the U.S. market.

4.4 Firm-level outcomes

The county-level data previously used do not include data on some key outcomes of interest: particularly, capital investment, foreign investment and wages. In addition, the data on secondary employment are very limited. As an additional source of evidence, we utilize the large-scale industrial survey collected from 1998 to 2008, a data source described in detail in Brandt et al. (2012). The data are collected in annual surveys conducted by the National Bureau of Statistics, and they include all state-owned industrial firms (in mining, manufacturing, and public utilities) and all non-state firms in the same sectors with sales above 5 million yuan. For this analysis, we restrict the sample to manufacturing firms.

A variety of firm-level outcomes are observed. Employment and the total wage bill are directly reported, enabling us to estimate the average wage per worker. The perpetual inventory method is used to estimate the capital stock, as the firm's founding year is also reported; the average growth rate observed at the province-sector level over the sample years is used to estimate average annual investment rates. We also use a similar method to calculate the stock of foreign-owned capital, and use the estimate of the capital stock to calculate firm-level capital intensity (the ratio of the capital stock to total employment). For sales, profits and value added, we use the deflators constructed by Brandt et al. (2012) to construct constant-price estimates, and we again calculate value added per worker.

The firms can be geographically linked only to the prefecture, as county indicators are unavailable. Accordingly, we perform this analysis at the prefecture level; the dependent variables are calculated as the sum of the relevant firm-level variables within the prefecture and year, to capture the total size of the large-scale manufacturing sector. (For capital intensity, wage per worker, and value added per worker, the mean is employed.) All dependent variables are then employed in log form.

The NTR gap is constructed as the mean of the NTR gap across all constituent counties in the prefecture and is denoted Y_{fpt} for the NTR gap in prefecture f and province p. The same control variables are also included and are calculated as the prefecture-level mean, and province-year fixed effects and prefecture-level trends are included, in addition

to a level control for the prefecture-level NTR gap.

$$\ln(Y_{fpt}) = \beta_1 Post_t \times NTR\,Gap_{fp} + \beta_2 NTR\,Gap_{fp} + \boldsymbol{X}'_{fpt}\theta + \gamma_{pt} + \nu_f t + \epsilon_{cfpt} \qquad (5)$$

The results are reported in Table 5; again, the coefficients correspond to prefecture-level aggregates of the firm data. The first three columns in Panel A show that a one standard deviation increase in the prefecture-level NTR gap is associated with increases in employment, capital and foreign capital of between .05 and .15 log points. Given that the expansions of capital and labor are of equal magnitude, there is no significant shift in capital intensity, as reported in Column (4). Finally, in Columns (5) and (6), we observe that the total wage bill and the average wage per worker both increase.

In Panel B, we report results for additional outcomes: sales, value added, profits and value added per worker. Again, the coefficients are positive, and significant with the exception of profits, for which the coefficient is noisily estimated. The magnitude suggests a one standard deviation increase in tariff uncertainty is associated with increases of around .1 log points post–2002. These results are generally somewhat larger than those employing county-level data, suggesting that the effects of reduced tariff uncertainty may be larger for above-scale firms.[32]

Additional province-level data Given that exports is reported for only a small sample of counties, and foreign direct investment is reported only in the firm-level data, we also present additional results using data at the province level on exports and foreign direct investment for the full sample of provinces from 1996 to 2013. We then re-estimate the primary specification in parallel including the same control variables, all calculated as provincial-level means; the dependent variables include exports, total foreign capital used, foreign loans, and direct foreign investment. All are calculated as the log of real values in millions of yuan.

The results are reported in Table A9 in the Appendix, and show coefficients that are consistently positive and significant. The magnitude suggest a one standard deviation increase in tariff uncertainty ex-ante is associated with increases of around .2 log points in exports and .5 log points in foreign direct investment. These results corroborate the previous evidence around an increase in exports and foreign direct investment in counties previously more exposed to tariff uncertainty.

[32]In addition, 20% of the firms in this sample are state-owned or collective firms; on average, the level of exports observed in these firms is approximately one-sixth the level of exports observed for non-state firms. In general, the observed effects are smaller in magnitude and often insignificant in the subsample of state-owned firms, though the differences comparing state-owned and non state-owned firms are not statistically significant.

4.5 Mechanisms

Returning to the conceptual framework, it is useful to highlight the mechanisms that generate the observed patterns of accelerated structural transformation post-WTO accession in counties more exposed to tariff uncertainty ex ante. First, we observe both a substantial increase in exports and an increase in foreign direct investment. Both effects are evident in data from a range of complementary sources. Second, as previously noted, there is fairly robust evidence of substitution of productive factors out of agriculture in counties characterized by higher ex ante NTR gaps following WTO accession. In addition, we observe increased investment and output in both the secondary and tertiary sectors, although the effects are larger in the secondary sector.

The growth of the secondary sector as the primary sector shrinks is consistent with both the reallocation and the local demand channels. However, the fact that non-tradable (tertiary) production is expanding suggests that the local demand effect dominates the reallocation effect for the tradable sector. In addition, we can document that the reduction in tariff uncertainty seems to generate an increase in returns to factors in the medium-term, as evident in the persistent increase in wages and value added per worker observed in the firm data. This is consistent with the hypothesis that there are barriers to full mobility of capital and labor that slow the equalization of factor returns across counties. Alternatively, there may be positive agglomeration effects in export production that lead to persistently more rapid growth in counties that benefit from the reduction in tariff uncertainty post-WTO.

5 Additional robustness checks

In this section, we present additional robustness checks, including placebo tests that corroborate the hypothesis that the main effects are driven by reduced uncertainty in the U.S. market, and further exploration of the primary results, including specifications that evaluate potential bias due to reform of state-owned enterprises and utilize night-lights data. We also summarize the overall economic significance of the observed effects.

5.1 Placebo analysis

Throughout this analysis, we have assumed that the discontinuous shock experienced by China at the point of its WTO accession is a decrease in tariff uncertainty in the U.S. market. Here, we implement two placebo analyses to evaluate this assumption. As previously noted, the EU endowed China with permanent NTR status in 1980, long before the latter's accession to the WTO, and other trading partners (excluding the U.S.)

followed suit. Accordingly, China faced no tariff uncertainty in non-U.S. markets during the period of interest here.

We conduct two placebo tests. The first uses data from the UNCOMTRADE database reporting China's exports to all destinations at the 2-digit product level from 1995 to 2013. We then estimate a simple regression in which the dependent variable is the log of total export value of product p to destination country d in year t. The independent variables include a post dummy interacted with the U.S. NTR gap at the product level and a dummy for the U.S., and the post-NTR interaction interacted with a dummy for the other four top export destinations (the EU, Japan, Korea, and Taiwan). The specification also includes controls for the product-specific tariff imposed by each of the five major destinations on each product, summarized $\boldsymbol{X}_{pdt}$, and product-year fixed effects.

$$\begin{aligned}\ln(Exp_{pdt}) = \beta_1 NTR_{pt} \times US_d \times Post_t + \beta_2 NTR_{pt} \times Other_d \times Post_t \\ + \boldsymbol{X}_{pdt} + \omega_{dt} + \epsilon_{dpt}\end{aligned} \tag{6}$$

We hypothesize that β_1 will be positive and significant, and β_2 will not be significantly different from zero: products characterized by a larger NTR gap exhibit a disproportionate increase in exports to the U.S. post-WTO accession, but there should be no significant increase in exports to other major destinations. The results are reported in Panel A of Table 6; in Columns (3) and (4), quadratic controls for tariffs are also included. Columns (1) and (3) include standard errors clustered at the partner level, and Columns (2) and (4) include standard errors clustered at the product level.

We can observe that β_1 is positive and β_2 is negative and insignificant. This evidence is consistent with the hypothesis that the key immediate shock experienced with WTO accession was a reduction in trade uncertainty in the U.S. market, not a shock in other major export destinations.

Second, we construct an artificial "other trading partners gap", comparing the highest tariff rates imposed by other major trading partners — the EU, Japan, Taiwan and Korea — to the tariff rates imposed by the same trading partners on Chinese goods. For each other trading partner (e.g., the EU), we identify for each industry a "maximum tariff" imposed by the EU on imports of that good.[33] We then calculate a placebo "other trading partner gap" equal to the difference between this high tariff and the tariff imposed on Chinese goods, and calculate the weighted average across the four major non-U.S. trading partners using as weights the share of total Chinese exports shipped to that destination.

The same procedure used to construct the NTR gap is then used to construct a county-level "other trading partners gap". The intuition is as follows: if Chinese exporters

[33]More specifically, we use the mean of the five highest tariffs observed.

did in fact perceive any tariff uncertainty in other non-U.S. markets, the gap between the realized tariff on Chinese goods and the highest observed tariff may be a proxy for the magnitude of this uncertainty, and the constructed "other tariff partner" gap thus captures uncertainty in other markets. If the WTO served to reduce this uncertainty, we should expect parallel results when the primary specification is re-estimated with the placebo gap.

To test this hypothesis, we estimate the primary specification using the other trading partner county-level gap, including the same control variables and fixed effects included in the main specification. We also control flexibly for the other trading partner high tariff rate $Other_{cfpt}$.[34]

$$\ln(Y_{cfpt}) = \beta_1 Other\,Gap_{cfpt} + Other_{cfpt} + \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + Urb_{cfp} \times \gamma_{pt} + \delta_c + \epsilon_{cfpt} \quad (7)$$

The results are reported in Table 6, and the estimated coefficients are small in magnitude, insignificant and varying in sign. This suggests that there is no evidence that tariff variation presumed to be orthogonal to China's export expansion predicts cross-county variation in economic outcomes.

5.2 Alternate specifications

To further explore the robustness of the primary results, we report a number of alternate specifications in Tables A10 and A11 in the Appendix. Again, we focus on exports and GDP as outcome variables. In Panel A of Table A10, we estimate the baseline specification including only province-year and county fixed effects. In Panel B, we include the full set of controls and weight each county observation by its 1990 population, rather than utilizing employment weights.[35] In Panel C, we winsorize the NTR gap above the 99th percentile and below the first percentile. In all three cases, the results are observed to be consistent.

In Panel A of Table A11, a full set of interactions between year fixed effects and a dummy variable for each quartile of initial GDP are added. In Panel B, we characterize counties based on the proportion of the population in 1990 reported to have post-primary education (on average, only a third), generate dummy variables for counties in each quartile of initial education, and include the interactions between these education quartile dummy variables and year fixed effects. In Panel C, we calculate a Herfindahl

[34]Specifically, we generate a set of dummy variables for each two-percent range in the distribution of the high tariff rate (50 dummy variables in all) and include these variables, as well as their interaction with the post dummy.

[35]A small number of observations are missing population data. The results are also consistent if the regressions are weighted with respect to initial total GDP.

index capturing initial concentration in the tradable (primary and secondary) sectors and include interactions between dummy variables for each quartile of the Herfindahl index and year fixed effects. The results are again uniformly consistent.

Evidence around state-owned enterprises An additional robustness check explores whether the reform of state-owned enterprises (SOEs) could be an alternate channel for the observed pattern. In addition to the market liberalization implemented in this period linked to WTO accession, a major restructuring of SOEs was implemented starting in the mid-1990s and accelerating in the latter part of the decade (Naughton, 2007).

Unfortunately, no county-level data are available on SOE employment. However, we can construct a county-level proxy using data on SOE employment in broad sectors (agriculture, mining and manufacturing) in each province as a percentage of total sector employment in that province in 1996 (the first year in the sample). We then use the 1990 employment weights by sector to construct a county-level average.[36] Cross-county variation in the imputed baseline share of SOE employment is thus generated by variation across counties in the salience of agriculture, mining and manufacturing, and variation across provinces in the relative importance of SOE employment in these three sectors.

Finally, we construct dummy variables for counties in each quartile of the initial imputed SOE fraction, and interact these dummies with year fixed effects in the main specification. The results are reported in Panel D of Table A11, and they are entirely consistent with the main specifications, suggesting that initial cross-county variation in the salience of SOE employment is not a significant source of bias.

Night-lights data To address the potential challenge introduced by measurement error or selective misreporting in county yearbook data, we re-estimate the results employing as the dependent variable the average night lights index within county borders as a proxy for the intensity of local economic activity. We observe a correlation of .65 between the night lights index and reported county-level GDP.

In addition, when the primary specification is re-estimated using the night lights index as a dependent variable, the estimated relationship is significant and positive at the one percent level, and suggests that a county at the median level of tariff uncertainty ex ante shows evidence of a 17% relative increase in night brightness post-2001 compared to a county at the minimum level of tariff uncertainty. This suggests that bias due to misreporting is of limited salience in the primary results.

[36]These employment data are drawn from the national statistical yearbooks; data on SOE employment in the highly disaggregated subsectors reported in the census are unavailable until much later, in the post–WTO period. Unsurprisingly, SOE employment is close to zero in agriculture (averaging 2%) and near universal in mining (averaging 91%). The SOE share in manufacturing employment is variable, with a mean of 38% and a standard deviation of 13%.

5.3 Aggregate productivity and growth

Finally, it may be useful to present some simple back-of-the-envelope calculations that quantify the contribution of the reduction in trade uncertainty generated by WTO accession to shifts in aggregate productivity and growth in China over this period. First, we can quantify the contribution of labor reallocation across sectors (from agricultural production to non-agricultural production) to aggregate productivity, following McCaig and Pavcnik (2014b). A growing literature has documented that value added per worker is significantly higher in non-agricultural compared to agricultural production in developing countries (Gollin et al., 2014), and we can replicate this stylized fact using limited data reported at the county level on value added per worker; value added per worker in the secondary sector is approximately 6.5 times value added per worker in the primary sector.[37] If we re-estimate the employment specification for agricultural employment in levels, it suggests that around 4% of the agricultural labor force shifted into non-agricultural production following WTO accession, implying an increase of around 25% in aggregate productivity driven by this reallocation alone.[38]

We can also explore the importance of WTO accession in overall growth in county-level GDP during this period; more details about how these calibrations are conducted can be found in Appendix A1.2. The average county in this sample shows growth in county-level GDP of 1.2 log points from 2002 to 2013 (i.e., in the post-WTO period). Our results suggest that for a county characterized by an NTR gap at the mean prior to WTO accession, the reduction in tariff uncertainty in the U.S. market to zero results in an increase in GDP of .1 log point. Accordingly, export-driven growth enhanced by WTO membership accounts for approximately 10% of overall GDP growth. A similar calculation for secondary GDP suggests that growth driven by the WTO accession shock accounts for approximately 9% of overall secondary growth from 2002 to 2010, the final year in which secondary GDP is observed for a substantial sample.

Turning to employment, using data on average secondary employment at baseline in 2002, we can conservatively estimate that the number of additional positions created in the secondary sector as a result of export expansion to the U.S. is roughly 10.9 million in the sampled counties. According to the 2000 census, the counties included in the

[37] The sample reported for value added per worker is not sufficient to utilize it as an outcome in the primary results.

[38] This calculation ignores any possible labor reallocation into the tertiary sector, for two reasons. First, there was no significant evidence of an increase in tertiary sector employment in the primary results, although these results may be limited by the small sample. Second, it is not possible to estimate value added per worker in the tertiary sector, as value added in this sector is not generally reported. In addition, to be conservative we use the estimated coefficient for the decline of employment in the agricultural sector, rather than the (larger) estimated increase in employment in the secondary sector; this is the specification reported in Column (2) of Panel B of Table 2.

sample account for 75% of total secondary employment in China in that year; under the assumption that the effects of the NTR shock are identical in the counties not represented in our sample, we estimate that total secondary employment created equals 14.6 million nationwide. This compares to an estimate of 1.5 million manufacturing positions lost in the U.S. as a result of Chinese export expansion, as reported in Autor et al. (2013). Thus we can conclude that while WTO accession is certainly not the only phenomenon generating rapid economic expansion in China during this period, its importance is non-trivial.

6 Conclusion

In this paper, we use a new panel of county-level data to present the first evidence of the effect of China's accession to the WTO in 2001—a policy shift that removed uncertainty over the tariff rates that Chinese exporters would face in the U.S. market—on structural transformation and growth. The identification strategy exploits variation across industries in the size of the gap between the MFN tariffs and the higher tariffs that Chinese producers risked exposure to prior to WTO accession, as well as variation across counties in the baseline composition of employment in the secondary sector. We then evaluate whether counties with a high concentration of industries characterized by large tariff gaps show more rapid growth post–2001.

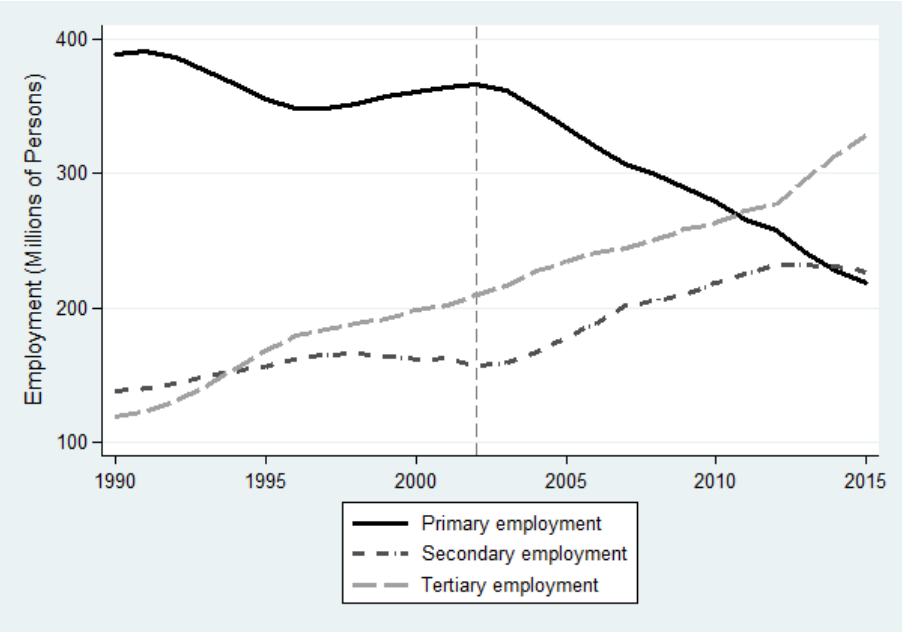
Our results suggest that counties that benefited most from the reduced tariff uncertainty show substantial expansion post–2001. Employment and GDP in the secondary sector all increase, while the agricultural sector contracts. We also observe a substantial increase in GDP per capita. Moreover, these patterns are observed only after WTO accession, suggesting that they do reflect the hypothesized channel of reduced tariff uncertainty, and are not evidence of ex ante differences in observable characteristics comparing across counties with larger and smaller NTR gaps.

This paper is the first to present evidence on the impact of the reduction in tariff uncertainty on structural transformation at the local level in China, and joins a relatively small literature analyzing the effects of enhanced trade access in stimulating growth in developing countries. These results highlight the importance of securing access to developed country markets for developing countries that pursue export-driven growth strategies. Understanding the implications of U.S. trade for Chinese growth may contribute to a more complete understanding of the global impact of rising U.S.–China bilateral trade and China's rise as a global manufacturing powerhouse over the past two decades.

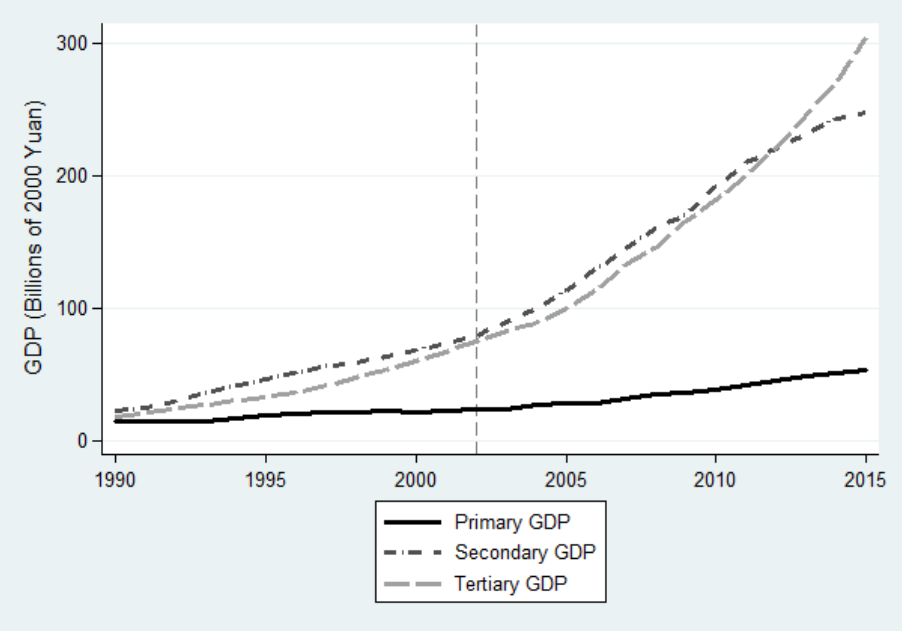
7 Figures and Tables

FIGURE 1: COMPOSITION OF EMPLOYMENT AND GDP IN CHINA

(A) Employment



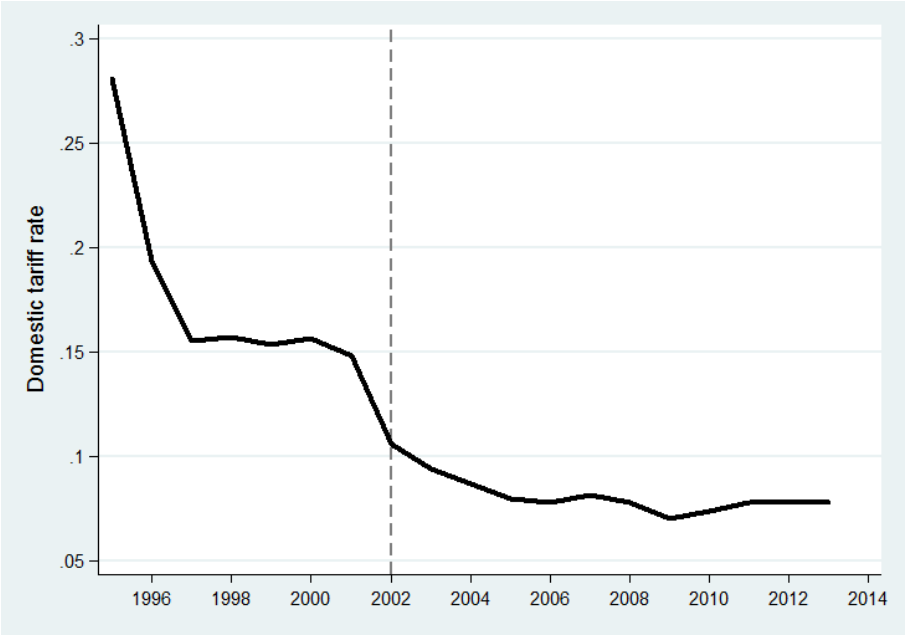
(B) GDP



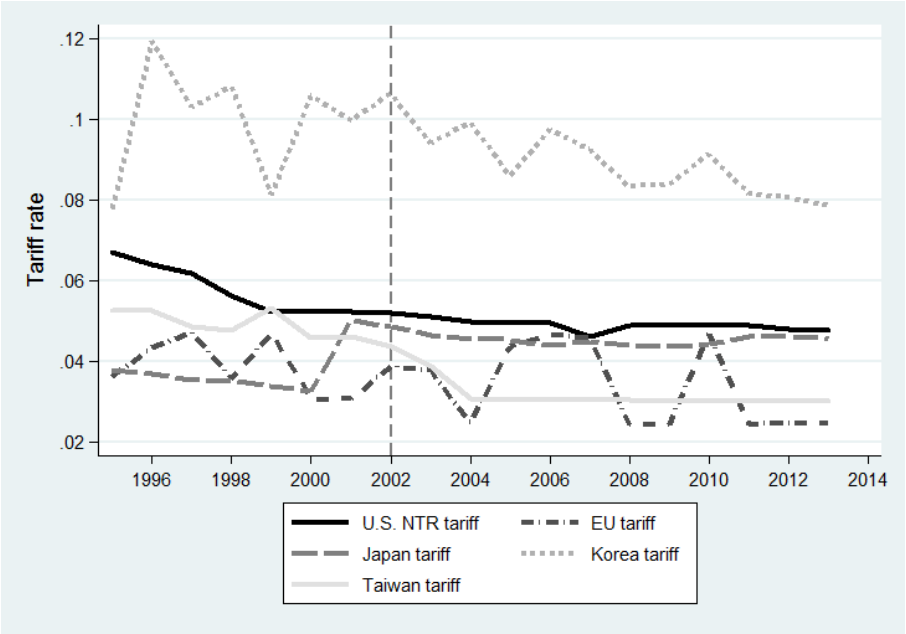
Notes: This graph presents aggregate statistics for China as a whole from 1990 to 2015, employing data from the National Bureau of Statistics. The primary sector includes agriculture, forestry and fishing, the secondary sector includes manufacturing and mining, and the tertiary sector includes services. GDP is reported in billions of constant 2000 yuan. Employment is reported in millions of persons.

Figure 2: Variation in Tariff Policy Over Time

(A) China's Import Tariffs Over Time

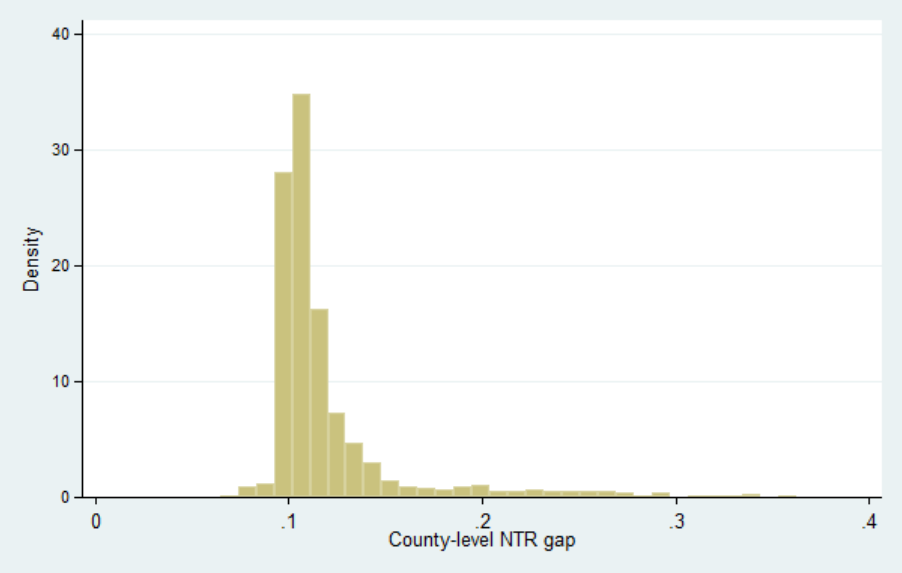


(B) Major Trading Partners' Tariffs Over Time



Notes: The first subfigure shows China's average domestic import tariff, calculated as the weighted average of industry-level tariffs and utilizing as weights the share of total Chinese imports constituted by each industry's imports. The second subfigure shows the mean tariff imposed on Chinese exports by major trading partners from 1996 to 2013. For each trading partner, we again calculate the weighted average of industry-level tariffs, utilizing as weights the share of total Chinese exports constituted by each industry's exports. Tariff data is obtained from the WITS-TRAINS database.

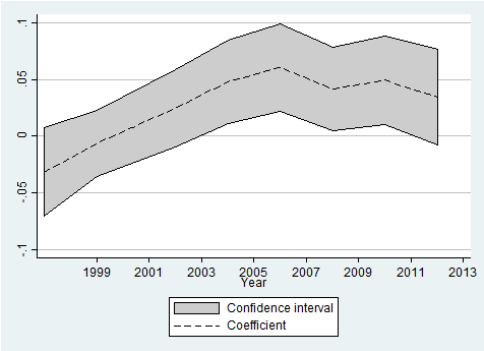
Figure 3: NTR Gap at the County Level



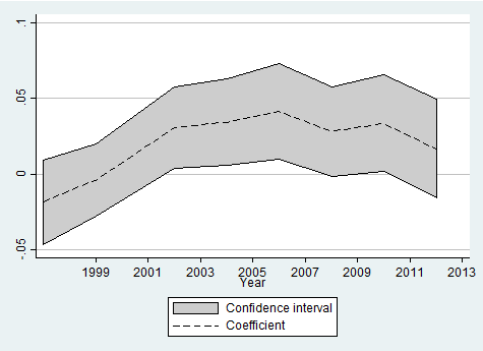
Notes: The figure is a histogram of the gap between normal trade relations (NTR) tariffs and non-NTR tariffs, calculated at the county level utilizing industry employment shares as reported in the 1990 census as weights.

Figure 4: Estimated Dif-in-dif Coefficients and 90% Confidence Intervals

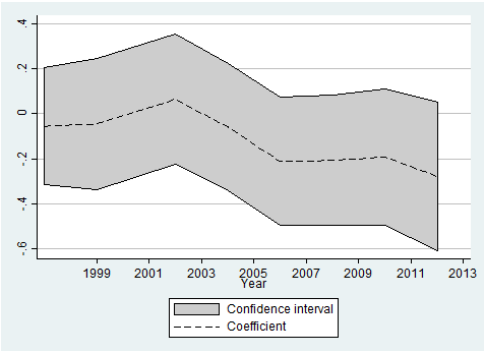
(a) GDP



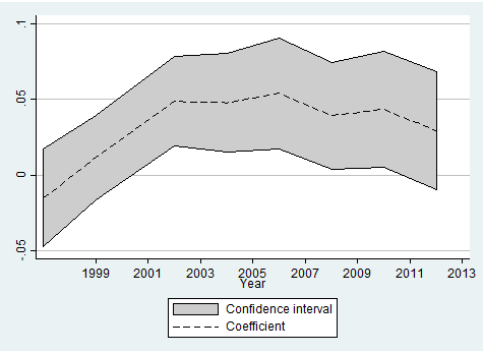
(b) GDP - simple specification



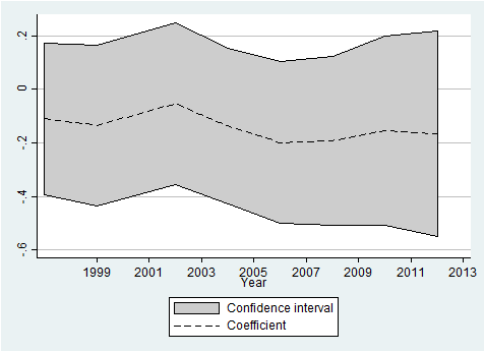
(c) Low capital intensity



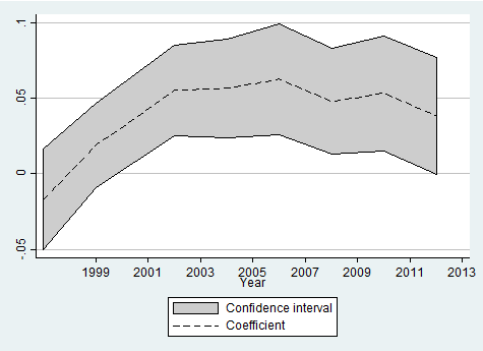
(d) High capital intensity



(e) Low U.S. share of exports



(f) High U.S. share of exports



Notes: These graphs report the coefficients on the interaction of dummy variables for each two-year interval and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specifications estimated to construct Figure 4a also include a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. In Figures 4b - 4f, only the fixed effects of interest are included. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline county-level employment.

In Figures 4c and 4d, the sample is restricted to counties below and above the median of estimated baseline capital intensity, respectively. In Figures 4e and 4f, the sample is restricted to counties below and above the median estimated baseline share of exports directed to the U.S., respectively.

Table 1: Summary Statistics

Variable	Mean (log)	Mean (level)	Min. (level)	Max. (level)	Obs.	Num. counties
Primary emp.	4.77	169.59	.07	779	4577	1533
Ag emp.	4.32	159.94	0	3681	21539	1619
Secondary emp.	3.66	89.72	.04	1708.53	5660	1551
Tertiary emp.	3.87	76.67	0	1169.02	5926	1623
Total pop.	5.94	603.26	.8	421270	28874	1642
Total emp.	5.26	256.92	3.4	1550.4	19972	1440
Exports	4.93	1184.65	0	190204.6	5337	1017
GDP	7.95	9813.69	.1	611638.25	29782	1688
GDP per capita	8.79	9942.79	0	254907.92	26903	1609
Primary	6.4	1119.97	3.39	18743.66	15673	1496
Secondary	6.88	6937.37	.06	6295413.3	15688	1496
Tertiary	6.74	5979.91	.69	4403172.2	15616	1496
Sown area	3.63	64.76	0	1620.79	8328	989
Agri. machine	2.9	37.76	0	1669.41	28246	1637
Grain output	4.99	247.81	0	5600.1	28277	1627
Cash output	2.91	46.74	0	2377.79	26823	1574
Grain	3.51	56924.16	0	2305598	7169	885

Notes: This table reports the mean in logs, meann in levels, minimum, maximum, number of observations and number of counties reporting any observations for key variables. Total population and employment is reported in thousands of persons. Exports and GDP are reported in millions of yuan and GDP per capita in yuan, deflated to 2000 constant prices. Sown area is reported in thousands of hectares; agricultural machinery power used is reported in 10,000 kilowatts. Grain production and cash crop production are reported in thousands of tons, and grain yield is reported in tons per hectare.

Table 2: Primary Results

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Exports and GDP						
	Exports	Primary	Secondary	Tertiary	GDP	Per capita
Post x NTR gap	.185	.004	.034	.024	.040	.036
	(.083)**	(.018)	(.014)**	(.014)*	(.012)***	(.016)**
Obs.	5158	15208	15688	15375	29782	26359
Num. counties	1017	1496	1496	1496	1688	1609
Panel B: Employment						
	Primary	Agri.	Secondary	Tertiary	Total emp.	Total pop.
Post x NTR gap	-.048	-.074	.166	-.010	-.002	.013
	(.057)	(.026)***	(.053)***	(.041)	(.012)	(.007)**
Obs.	4577	21532	5660	5802	19972	28874
Num. counties	1533	1619	1551	1623	1440	1642
Panel C: Agricultural investment						
	Sown area	Agri. machine	Grain	Cash	Grain yield	
Post x NTR gap	-.040	-.080	-.127	-.049	-.044	
	(.022)*	(.023)***	(.039)***	(.025)**	(.024)*	
Obs.	8322	28149	28161	26818	7168	
Num. counties	989	1637	1627	1574	885	

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment.

In Panel A, the dependent variables include exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. Exports and GDP are reported in millions of yuan deflated to 2000 constant prices; per capita GDP is reported in yuan, similarly deflated. In Panel B, the dependent variables include employment in the primary, agricultural, secondary, and tertiary sectors, total employment, and population, all reported in thousands of persons. In Panel C, the dependent variables include sown area reported in thousands of hectares, agricultural machinery reported in 10,000 kilowatts, grain and cash crop production reported in thousands of tons, and grain yield reported in tons per hectare. All dependent variables are logged. Asterisks indicate significance at the ten, five, and one percent level.

Table 3: Robustness Checks

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: NTR gaps estimated using 2000 employment weights						
Post x NTR gap	.118	-.080	.156	.252	.155	.048
	(.054)**	(.059)	(.052)***	(.071)***	(.045)***	(.023)**
Obs.	5158	14722	15688	15375	29782	26340
Panel B: NTR gaps estimated assigning non-tradables zero weights						
Post x NTR gap	.088	-.056	.003	-.009	.024	.019
	(.049)*	(.019)***	(.014)	(.010)	(.009)**	(.009)**
Obs.	5158	14722	15688	15375	29782	26433
Panel C: Main specification controlling for the share of non-primary employment						
Post x NTR gap	.209	.006	.026	.023	.032	.012
	(.085)**	(.020)	(.015)*	(.014)	(.012)***	(.016)
Obs.	5158	14722	15688	15375	29782	26340
Panel D: Main specification controlling for the share of high gap employment						
Post x NTR gap	.212	.010	.032	.024	.041	.018
	(.081)***	(.020)	(.015)**	(.014)*	(.012)***	(.015)
Obs.	5158	14722	15688	15375	29782	26358
Panel E: Heterogeneity with respect to import competition						
Post x NTR gap	.163	.016	.029	.010	.033	.042
	(.086)*	(.020)	(.015)*	(.013)	(.013)***	(.017)**
Import comp int	.031	.020	-.020	-.038	-.014	.028
	(.089)	(.013)	(.017)	(.012)***	(.015)	(.018)
Obs.	5158	14722	15688	15375	29782	26358

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment. The dependent variables are exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. All dependent variables are logged.

In Panel A, the NTR gap at the county level is estimated using employment weights from the 2000 census. In Panel B, the NTR gap is estimated using employment weights from the 1990 census and assigning the services or non-tradable sector a zero weight. In Panel C, the specification includes a full set of interactions between dummies for quartiles of initial secondary and tertiary employment as a fraction of total employment and year fixed effects. In Panel D, the specification includes a full set of interactions between dummies for quartiles of employment in each of five high NTR gap industries as a fraction of total employment and year fixed effects. In Panel E, the post-NTR interaction is interacted with a dummy equal to one for districts who are above the median of soybeans and cotton as a fraction of total sown area, and we also include interactions between quartiles of this fraction and year fixed effects. Asterisks indicate significance at the ten, five, and one percent level.

Table 4: Evidence around timing

	GDP					
	(1)	(2)	(3)	(4)	(5)	(6)
NTR gap x 97-98	-.031	-.018	-.056	-.015	-.110	-.017
	(.024)	(.017)	(.159)	(.020)	(.173)	(.020)
NTR gap x 99-01	-.006	-.004	-.046	.012	-.135	.019
	(.018)	(.014)	(.178)	(.017)	(.183)	(.017)
NTR gap x 02-03	.025	.031	.065	.049	-.054	.055
	(.021)	(.016)*	(.176)	(.018)***	(.185)	(.018)***
NTR gap x 04-05	.048	.034	-.060	.048	-.137	.056
	(.023)**	(.017)**	(.171)	(.020)**	(.178)	(.020)***
NTR gap x 06-07	.060	.041	-.212	.054	-.200	.062
	(.023)***	(.019)**	(.173)	(.022)**	(.184)	(.022)***
NTR gap x 08-09	.042	.028	-.208	.039	-.192	.048
	(.022)*	(.018)	(.176)	(.021)*	(.192)	(.021)**
NTR gap x 10-11	.049	.034	-.193	.043	-.154	.053
	(.024)**	(.020)*	(.185)	(.023)*	(.215)	(.023)**
NTR gap x 12-13	.034	.017	-.279	.029	-.167	.038
	(.026)	(.020)	(.202)	(.024)	(.234)	(.024)
Sample	Full		Low cap. intensity	High cap. intensity	Low U.S. share	High U.S. share
Additional controls	Yes	No	No	No	No	No
Obs.	29782	30390	15892	14498	15902	14488

Notes: The primary independent variable is the interaction of the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one, and a series of dummy variables capturing two-year intervals. The dependent variable is the log of county-level GDP. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment.

In Column (1), the specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Column (2) includes only county and province-year fixed effects, and province-year fixed effects interacted with an urban dummy.

In Columns (3) through (6), again the specifications include only county and province-year fixed effects, and province-year fixed effects interacted with an urban dummy. Column (3) reports the results for counties below the median of baseline capital intensity; Column (4) reports the results for counties above median baseline capital intensity. Column (5) reports the results for counties below the median of baseline U.S. share of total exports; Column (4) reports the results for counties above median U.S. export share. Asterisks indicate significance at the ten, five, and one percent level.

Table 5: Factor utilization and other firm outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Factor utilization						
	Emp.	Capital	Foreign capital	Cap. intensity	Wages	Wages per worker
Post x NTR gap	.062	.124	.156	-.071	.092	.066
	(.035)*	(.047)***	(.047)***	(.047)	(.037)**	(.028)**
Obs.	2492	2515	2504	2052	2515	2492
Panel B: Other firm outcomes						
	Sales	Value added	Profits	Value added per worker		
Post x NTR gap	.089	.154	.125	.122		
	(.035)**	(.057)***	(.100)	(.054)**		
Obs.	2515	2262	2061	2247		

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the prefecture-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification includes the same control variables described in the notes to Table 2, all calculated as the average at the prefecture-year level, as well as the NTR gap at the prefecture level entering linearly, and province-year fixed effects and prefecture-specific trends. Standard errors are estimated employing clustering at the prefecture level.

All dependent variables are logged. The dependent variables in Panel A include total employment in sampled firms, total capital in sampled firms, total foreign capital in sampled firms, the total wage bill in sampled firms, and mean wage per worker. The dependent variables in Panel B include total exports, sales, value added and profits in sampled firms, as well as mean value added per worker. Asterisks indicate significance at the ten, five, and one percent level.

Table 6: Placebo Tests

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Chinese exports to all destinations						
			Exports			
Post x NTR gap x U.S.	.338	.338	.337	.337		
	(.029)***	(.007)***	(.029)***	(.007)***		
Post x NTR gap x Other four	-.113	-.113	-.118	-.118		
	(.478)	(.081)	(.478)	(.082)		
Obs.	330669	330669	330669	330669		
Panel B: Placebo NTR Gap						
	Exports	Primary	Secondary	Tertiary	GDP	Per capita
Other trading partner gap	-.535	.106	.085	.017	.038	.017
	(.573)	(.060)*	(.056)	(.049)	(.027)	(.028)
Obs.	5158	14722	15688	15375	29782	26433

Notes: In Panel A, the independent variables are the U.S. NTR gap at the product level interacted with post interacted with a dummy for the U.S., and the post-NTR interaction interacted with a dummy for the other four top export destinations (the EU, Japan, Korea, and Taiwan). The dependent variable is China's exports to all destinations at the 2-digit product level from 1995 to 2013, as reported in the UNCOMTRADE database. The specification also includes controls for the product-specific tariff imposed by each of the five major destinations on each product, and product-year fixed effects; in Columns (3) and (4), quadratic controls for product-specific tariffs are added. Standard errors are clustered at the partner level in Columns (1) and (3), and at the product level in Columns (2) and (4).

In Panel B, the independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the gap between the highest "other trading partner" tariff observed for a given industry and the tariff imposed on Chinese exports of that industry's output to other trading partners, standardized to have mean zero and standard deviation one. The other trading partners include the EU, Japan, Korea and Taiwan, and the tariffs are calculated as the weighted average using the export shares as weights. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. We also control flexibly for the high "other trading partner" tariff by constructing fifty dummy variables corresponding to different percentiles of the tariff distribution, generating dummy variable fixed effects, and also interacting those fixed effects with the post dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment. The dependent variables are exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. All dependent variables are logged. Asterisks indicate significance at the ten, five, and one percent level.

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A1 Appendix - for online publication

A1.1 Missing data

Data can be missing from the county-level panel for two reasons: counties cannot be matched between the census and the provincial yearbooks, and counties are matched to the yearbooks but specific indicators are not available. First, some counties that are observed in the census do not appear in provincial yearbooks at all; these are disproportionately counties that are part of the urbanized areas of larger, prefecture-level cities, as some provinces omit data for these areas. To provide more systematic evidence about the characteristics of these missing counties, we estimate the following specification at the county level in which county covariates as observed in the 1990 census are regressed on a dummy variable equal to one if the county is missing due to a failure to match between the census and the provincial yearbooks, as well as province fixed effects. Standard errors are clustered at the province level.

$$Y_{ifp}^{1990} = \beta Missing_{ifp} + \omega_p + \epsilon_{ifp} \tag{8}$$

The results are reported in Table A1, employing six covariates: total population, the number of households including children, the percentage of households including elderly, the percentage of individuals who received a post-primary education, the percentage of individuals with an agricultural registration, and the percentage of individuals working in the non-primary (secondary and tertiary) sectors. We can observe that counties missing from the sample are characterized by larger populations, higher levels of education, and a greater concentration of labor outside of agriculture, consistent with the hypothesis that these are more urbanized counties.

Second, for those counties observed in provincial yearbooks, different provinces in different years opt to report different indicators at the county level in their yearbooks. As a result, the number of observations varies significantly for different variables, as evident from the summary statistics. Thus (for example) Guangdong consistently reports employment data by sector for all counties for all years; Shanxi does not report employment data by sector for any county in any year. It is never the case that in the same yearbook (corresponding to a single province-year), a particular indicator is reported for some counties and not for others. The indicators that are reported most infrequently include employment at the sector level and exports, while indicators reported near-universally include gross domestic product, total employment, population, and agricultural inputs and production.

Again, to provide more systematic evidence, we estimate the following specification,

in which the dependent variable is the number of observations for a particular variable observed for a particular county, and the independent variables include the same county-level covariates as observed in the 1990 census.

$$Obs_{ifp} = \xi X_{ifp}^{1990} + \omega_p + \epsilon_{ifp} \tag{9}$$

For counties that are missing, the number of observations is set at zero. The results are reported in Table A2, and we again observe that the number of observations is in general lower for more populous counties, and higher for those that are more agricultural and have a lower proportion of employment outside the primary sector. This is consistent with more urban and industrialized counties being generally underrepresented in the sample.

In the bottom of the table, we also report the average number of observations per county for each variable, conditional on reporting any data. The main years represented in the sample are the eighteen years from 1996 to 2013 inclusive, though a very small number of counties report data for 1994 and 1995. The average number of observations per county is considerably lower for all outcomes other than GDP, for which the average is 16-17 years per county. However, conditional on reporting any data, counties generally report at least eight years of data for the key variables of interest, excluding only exports.

Finally, we turn to the question of whether selection into the sample is a source of bias in the primary results. In Panel A of Table A3, we restrict the sample to county-years that report export data. In Panel B, we include for each variable only the subset of counties that reports at least eight observations for that variable, to avoid bias due to the entry and exit of counties from the sample. In Panel C, we characterize each county and each variable as to whether the number of observations is above or below the median number of observations for that variable, and interact the dummy variables for a high number of observations with year fixed effects. In all three cases, the results are generally robust, though in some cases the coefficients of interest are noisily estimated. The consistency across a range of specifications suggests that selection into the sample is not a significant source of bias.

Table A1: Counties missing from the provincial yearbooks

	Pop.	Hh incl. children	Hh incl. elderly	Post primary educ.	Prop. agri.	Prop. non-prim. empl.
	(1)	(2)	(3)	(4)	(5)	(6)
Missing counties	226877.700	-.0006	.010	.119	-.217	.229
	(63938.950)	(.007)	(.005)	(.016)	(.052)	(.057)
Mean dep. var.	516645.34	.25	.21	.34	.83	.28
Obs.	2104	2101	2101	2102	2100	2102

Notes: The dependent variables are variables reported in the 1990 census: county population, the percentage of households including children age 0-7, the percentage of households including elderly members, the proportion of adults with post-primary education, the proportion of the population designated as agricultural, and the proportion of the population working in the secondary and tertiary sectors. The independent variable is equal to one if the county is missing from the provincial yearbooks; all specifications include province fixed effects and standard errors clustered at the province level. Asterisks indicate significance at the ten, five, and one percent level.

Table A2: Number of observations and initial county characteristics

			Number of observations			
	GDP	Primary	Secondary	Tertiary	Export	Emp.
	(1)	(2)	(3)	(4)	(5)	(6)
Pop.	-.002	-.0006	-.0006	-.0006	2.17e-06	-.0002
	(.0003)***	(.0002)***	(.0002)***	(.0002)***	(.0002)	(.0001)**
Prop. children	-3.174	-1.140	-1.144	-1.218	-9.200	4.654
	(5.157)	(3.116)	(3.117)	(3.103)	(2.829)***	(1.854)**
Prop. elderly	12.585	3.280	3.302	3.295	7.534	-2.043
	(7.814)	(4.721)	(4.722)	(4.702)	(4.287)*	(2.809)
Post-primary	-5.211	-2.806	-2.817	-2.780	7.370	-2.592
	(1.950)***	(1.178)**	(1.179)**	(1.173)**	(1.070)***	(.701)***
Prop. agri.	13.183	3.580	3.569	3.543	9.070	1.700
	(2.028)***	(1.225)***	(1.225)***	(1.220)***	(1.112)***	(.729)**
Prop. non-prim.	-4.157	-3.505	-3.503	-3.514	.588	.776
	(1.795)**	(1.084)***	(1.085)***	(1.080)***	(.985)	(.645)
Mean (Obs. $>$ 00	16.92	9.77	9.77	9.73	5.24	8.74
Obs.	2100	2100	2100	2100	2100	2100

Notes: The dependent variable is the number of observations observed at the county level for the specified variable. The independent variables are a series of county characteristics observed at baseline: the fraction of the population engaged in primary employment, the total population, and the fraction of the population with post-primary education (all observed in the 1990 census); GDP in the first year in which the county is observed in a provincial yearbook; and a dummy for an urban county. All specifications include prefecture fixed effects. Asterisks indicate significance at the ten, five, and one percent level.

TABLE A3: MAIN SPECIFICATIONS CONTROLLING FOR SELECTION INTO THE SAMPLE

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Sample reporting export data						
Post x NTR gap	.185	-.034	.035	.052	.067	.059
	(.083)**	(.014)**	(.023)	(.017)***	(.017)***	(.015)***
Obs.	5158	3096	3120	3119	5330	5182
Panel B: Sample excluding prefectures with sparse observations						
Post x NTR gap	.183	.004	.034	.020	.039	.008
	(.083)**	(.018)	(.014)**	(.013)	(.013)***	(.017)
Obs.	5117	13479	14388	14112	22989	21187
Panel C: Including observation number quartile - year fixed effects						
Post x NTR gap	.188	.001	.030	.022	.030	.035
	(.083)**	(.016)	(.015)**	(.014)	(.012)**	(.016)**
Obs.	5158	14722	15688	15375	29782	26340

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment. The dependent variables are exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. All dependent variables are logged.

In Panel A, the sample is restricted to county-year observations reporting export data. In Panel B, the sample for each variable is restricted to the subset of counties that report at least eight observations for this variable. In Panel C, we characterize each county by the number of observations reported for each variable, and generate a dummy variable for whether the number of observations is above the median; the specification then interactions between this dummy variable and year fixed effects. Asterisks indicate significance at the ten, five, and one percent level.

A1.2 Calibrations for aggregate effects

In order to conduct a simple back-of-the-envelope calculation estimating the contribution of the export shock captured by the NTR gap to total growth over this period, we must first make some assumptions about the magnitude of the decrease in uncertainty experienced by the average county between the pre and the post period. First, we assume that uncertainty captured by the NTR gap is reduced to zero in the post-WTO period, a decrease of 2.9 standard deviations. We can then calculate the implied increase in GDP (.12 log points) and secondary GDP (.10 log points) predicted for the mean county in the post-WTO period, and compare these implied increases to the mean overall growth in each measure observed in the sampled counties in this period. We calculate the mean growth rates across all counties that report the indicators of interest; the median county shows growth in total GDP of 1.21 log points, and in secondary GDP of 1.12 log points. The ratio of the first measure to the second is the proportion of total growth generated by the reduction in tariff uncertainty.

For employment, we use the estimated effect magnitude implied by the prefecture-level specification, given that the implied magnitude in the county-level specification is quite high and reflects only a subset of the sample The prefecture data when estimated in levels suggest that the median county experiences an increase in secondary employment of 12.5% relative to a county characterized by the minimum level of uncertainty ex ante. We then convert this estimate of growth into an estimate of the absolute increase in employment, using median secondary employment observed in the 2000 census and focusing on the 1805 counties observed in the sample. Since secondary employment is not universally observed in 2002, we impute median employment in 2002 (the first post-WTO year) using the 2000 census data and the average annual growth rate in secondary employment observed in the sample. The number of new positions created by the reduction in tariff uncertainty post-WTO in the sampled counties is then calculated using 2002 estimated employment and the estimated growth rate of 11%.[39] Given that the sampled counties account for 74.7% of total secondary employment in the 2000 census, with the remaining quarter attributable to counties not observed in the sample, we then adjust this estimate upward accordingly.

It should be noted that these estimates reflect a number of underlying assumptions and should be considered merely illustrative. However, they do suggest that the effects of export expansion driven by the reduction in uncertainty are non-trivial in magnitude.

[39] More specifically, the calculation is $48397 * .125 * 1805$, where 48397 is estimated average secondary employment per county in 2002, .125 is the estimated growth generated by the NTR shock, and 1805 is the number of counties.

A1.3 Night lights data

To generate county-level averages of night lights data, high-resolution data on light density measured by satellites at night was downloaded from `http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html`. ArcMAP was used to process the files. They were converted from raster to GRID files, and averaged across the two sets of data available for each year.[40]

Next, gas flares were removed by using the China gas flares shapefile.[41] The erase function in ArcMap was used to remove the gas flares from the dataset. The average night light intensity observed within each county boundary was then calculated using the zonal statistics function and the shape file corresponding to the 2010 county boundaries. The night lights variable ranges from 0 to 63 across counties for each year, based on the highest and lowest brightness captured on the satellite images.

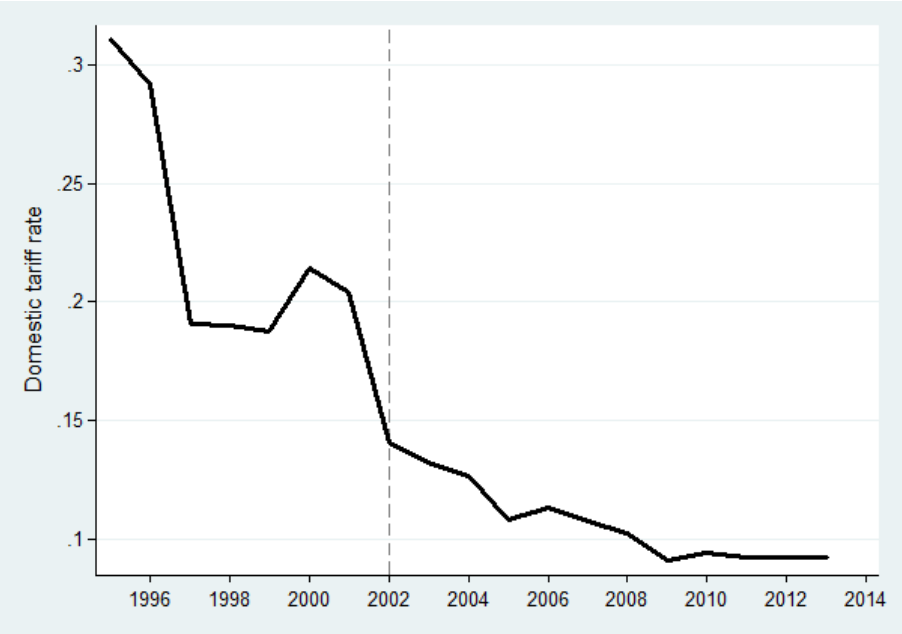
[40] This excludes only 2007, given that only one dataset is available.

[41] The file was downloaded from `https://www.ngdc.noaa.gov/eog/data/web_data/gasflares_v2/country_vectors_20090618/Flares_China_1.tgz`.

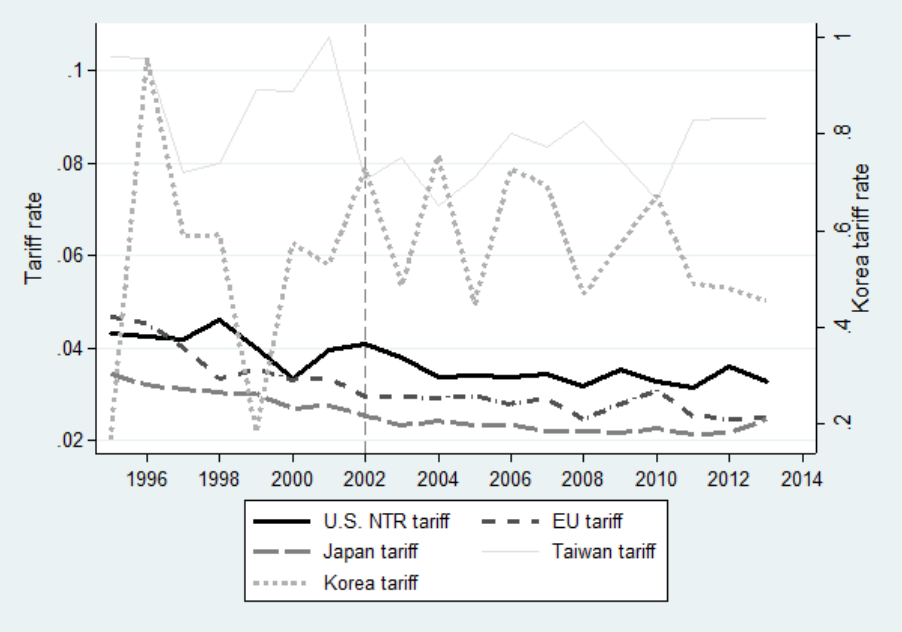
A1.4 Appendix Figures and Tables

FIGURE A1: VARIATION IN TARIFF POLICY ACROSS COUNTIES AND OVER TIME

(A) China's Import Tariffs Over Time

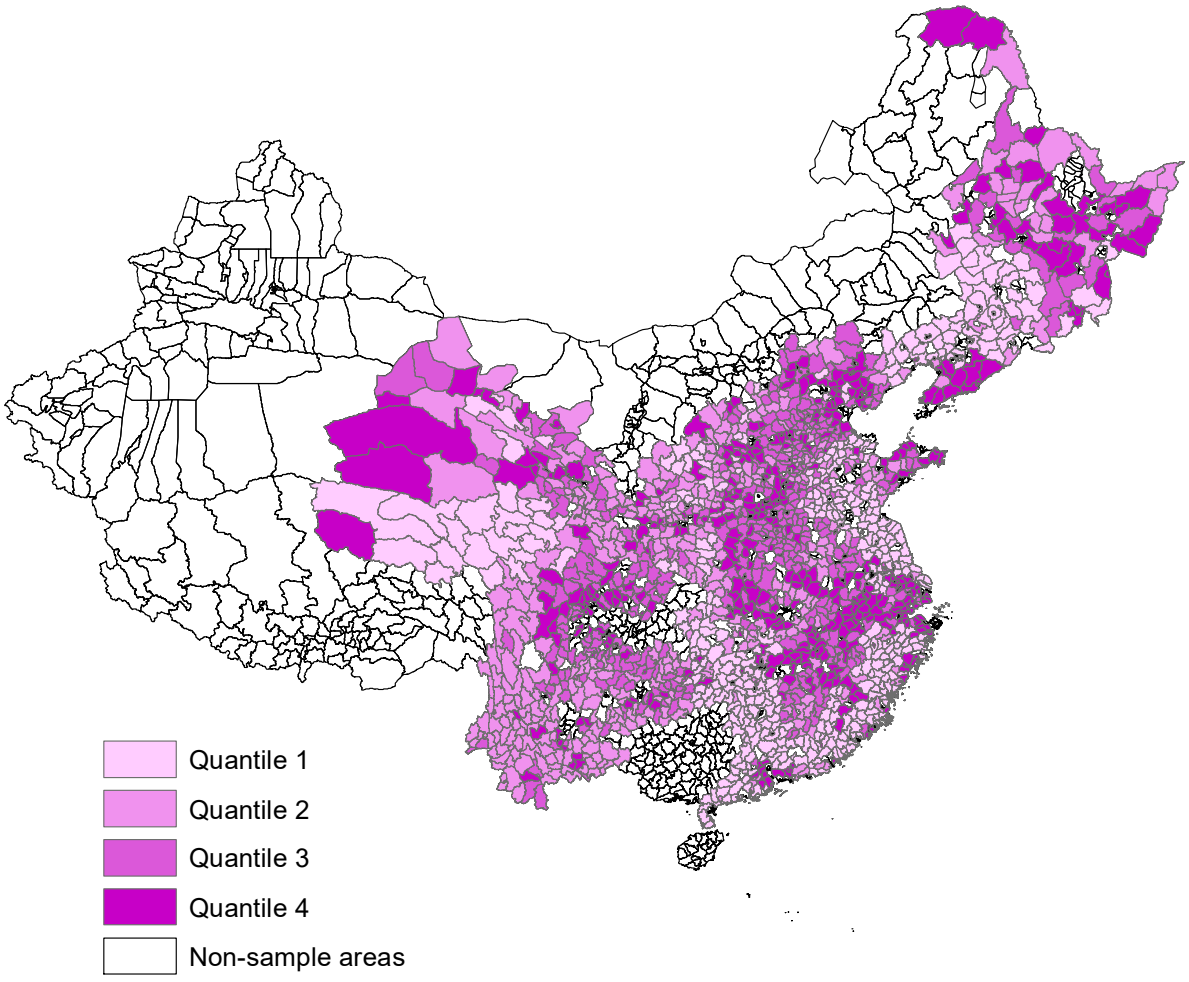


(B) Major Trading Partners' Tariffs Over Time



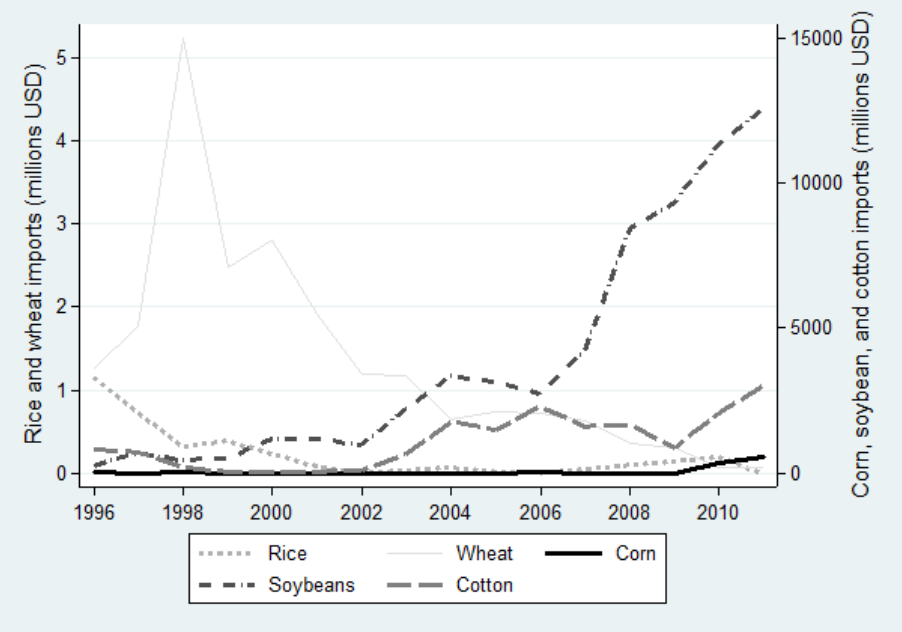
Notes: The first subfigure shows the average domestic import tariff and the second subfigure shows the mean tariffs imposed on Chinese exports by major trading partners from 1996 to 2013. For each variable, we calculate the average county-level weighted average tariff, using tariffs by industry and employing as weights the county-level employment share of each industry as reported in the 1990 census. We then report the mean weighted tariff over all counties in each year. Tariff data is obtained from the WITS-TRAINS database.

Figure A2: NTR Gap by County



Notes: This figure shows the NTR gap at the county level, utilizing the residuals from the gap regressed on provincial fixed effects. Areas not shaded are out of sample. This includes the autonomous regions (Inner Mongolia, Guangxi, Ningxia, Tibet, and Xinjiang) and counties that cannot be matched between the county-level census data and the provincial yearbooks.

Figure A3: China's Agricultural Imports from the U.S.



Notes: This figure shows the evolution of Chinese imports of agricultural products from the U.S. during the period of interest in the primary analysis.

Table A4: Concordance between Chinese Census Industry Categories, ISIC and SIC

Chinese Census Industry:		*ISIC Revision 3:*		*SIC:*	
Codes	Labels	2-Digit	3-Digit	2-Digit	3-Digit
90136	Farming		11	1	
90137	Forestry	2		8	
90138	Animal Husbandry		12	2	
90139	Fishery	5		9	
90140, 90141	Agricultural Services		11	7	
90142	Coal Mining and Dressing	10		12	
90143	Extraction of petroleum and Natural Gas	11		13	
90144	Mining and Dressing of Ferrous Metals	12			101
90145	Mining and Dressing of Nonferrous Metals	13			102, 103, 104, 105, 106, 107, 108, 109
90146	Mining and Dressing of Nonmetal Minerals		141		141
90147	Mining and Dressing of Other Minerals		142		142, 143, 144, 145,
90148					146, 147, 148, 149
90149	Logging and Transport of Wood and Bamboo	2			241
90151	Food Processing		151, 152, 153, 154		201, 202, 203, 204, 205, 206, 207, 209
90152	Beverages		155		208
90153	Tobacco	16		21	
90155	Textiles	17		22	
90156	Garments and Other Fiber Products	18		23	
90157	Leather, Furs, Down and Related Products	19		31	
90158	Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products	20		24	
90159	Furniture Manufacturing		361	25	
90160	Paper-making and Paper Products	21		26	
90161	Printing and Record Medium Reproduction	22		27	
90165, 90166	Petroleum Processing and Coking	23		29	
90167	Raw Chemical Materials and Chemical Products		241, 242		281, 283, 284, 285, 286, 287, 288, 289
90168	Medical and Pharmaceutical Products	33			384
90169	Chemical Fiber		243		282
90170	Rubber Products		251		301, 302, 303, 304, 305, 306
90171	Plastic Products		252		308
90172	Nonmetal Mineral Products	26		32	
90173	Smelting and Pressing of Ferrous Metals		271		331, 332
90174	Smelting and Pressing of Nonferrous Metals		272		333, 334, 335, 336, 337, 338, 339
90175	Metal Products	28			341, 342, 343, 344, 345, 346, 347, 349
90176	Ordinary Machinery		291, 293		351, 352, 353, 354
90177	Transport Equipment	34, 35		37	
90178	Electric Equipment and Machinery	31			361, 362, 363, 364, 365
90179	Electronic and Telecommunications Equipment	32			366, 367, 368, 369
90180	Instruments, Meters, Cultural, and Office Machinery	30		38	
90181	Other Manufacturing		369	39	

Notes: This table reports the industry categories and their labels in the 1990 Chinese Census that can be matched to ISIC Revision 3 codes and SIC codes. Three-digit codes represent more disaggregated industry categories compared to two-digit codes. All industry categories reported in the Chinese Census are matched to two- or three-digit codes in ISIC or SIC codes. The category of cultural, educational, and sporting goods (90162, 90163) does not match to the ISIC or SIC codes, and is therefore excluded.

Table A5: NTR gap by industry

Subsectors	*NTR gap*
Coal Mining and Dressing	.000
Mining and Dressing of Ferrous Metals	.000
Fishery	.012
Extraction of petroleum and Natural Gas	.059
Mining and Dressing of Nonferrous Metals	.061
Animal Husbandry	.076
Petroleum Processing and Coking	.088
Farming	.096
Agricultural Services	.096
Forestry	.123
Logging and Transport of Wood and Bamboo	.123
Mining and Dressing of Other Minerals	.128
Food Processing	.134
Mining and Dressing of Nonmetal Minerals	.175
Smelting and Pressing of Ferrous Metals	.199
Beverages	.201
Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products	.206
Rubber Products	.217
Transport Equipment	.222
Smelting and Pressing of Nonferrous Metals	.231
Printing and Record Medium Reproduction	.242
Raw Chemical Materials and Chemical Products	.269
Leather, Furs, Down and Related Products	.283
Papermaking and Paper Products	.284
Cultural, Educational and Sports Goods	.305
Nonmetal Mineral Products	.309
Tobacco	.317
Instruments, Meters, Cultural and Office Machinery	.321
Electric Equipment and Machinery	.334
Electronic and Telecommunications Equipment	.338
Ordinary Machinery	.363
Metal Products	.3835
Chemical Fiber	.383
Plastic Products	.420
Furniture Manufacturing	.424
Medical and Pharmaceutical Products	.425
Other Manufacturing	.426
Garments and Other Fiber Products	.457
Textiles	.523

Notes: This table reports the NTR gap by industry for each tradable subsector reported in the 1990 Chinese county census.

Table A6: Exports and GDP, Full Results

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Post x NTR gap	.185	.004	.034	.024	.040	.036
	(.083)**	(.018)	(.014)**	(.014)*	(.012)***	(.016)**
Post x Contract	.042	.024	-.104	-.116	-.009	.029
	(.110)	(.037)	(.032)***	(.029)***	(.022)	(.023)
MFA	-.057	-.080	.002	-.009	.009	-.0005
	(.031)*	(.026)***	(.007)	(.008)	(.007)	(.007)
Tariff	.112	-.018	.020	.121	.108	.113
	(.563)	(.098)	(.095)	(.090)	(.055)**	(.064)*
License	-.124	.056	-.120	.029	-.083	-.057
	(.256)	(.044)	(.052)**	(.040)	(.031)***	(.030)*
NTR rate	.385	.013	-.044	-.001	.0003	.004
	(.114)***	(.030)	(.022)**	(.018)	(.016)	(.019)
Obs.	5158	14722	15688	15375	29782	26340

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment.

The dependent variables include exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. Exports and GDP are reported in millions of yuan deflated to 2000 constant prices; per capita GDP is reported in yuan. All dependent variables are logged. Asterisks indicate significance at the ten, five, and one percent level.

Table A7: Employment, Full Results

	Primary (1)	Agri. (2)	Secondary (3)	Tertiary (4)	Total emp. (5)	Total pop. (6)
Post x NTR gap	-.048	-.074	.166	-.010	-.002	.013
	(.057)	(.026)***	(.053)***	(.041)	(.012)	(.007)**
Post x Contract	.053	-.103	.106	-.058	-.035	-.043
	(.063)	(.039)***	(.072)	(.051)	(.013)***	(.013)***
MFA	-.051	.043	.063	.025	.020	.012
	(.016)***	(.024)*	(.030)**	(.018)	(.006)***	(.009)
Tariff	-.147	.025	.354	-.183	-.013	.016
	(.206)	(.057)	(.251)	(.134)	(.033)	(.022)
License	.008	-.061	.153	.120	-.051	-.037
	(.056)	(.040)	(.090)*	(.094)	(.014)***	(.013)***
NTR rate	-.009	-.046	-.074	-.007	.003	-.019
	(.033)	(.032)	(.081)	(.043)	(.010)	(.017)
Obs.	4577	21532	5660	5802	19972	28874

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment.

The dependent variables include employment in the primary, agricultural, secondary, and tertiary sectors, total employment, and population; all variables are reported in thousands of persons, and then logged. Asterisks indicate significance at the ten, five, and one percent level.

Table A8: Agricultural Investment, Full Results

	Sown area (1)	Agri. machine (2)	Grain (3)	Cash (4)	Grain yield (5)
Post x NTR gap	-.040	-.080	-.127	-.049	-.044
	(.022)*	(.023)***	(.039)***	(.025)**	(.024)*
Post x Contract	-.026	-.002	.053	.028	.028
	(.037)	(.027)	(.033)	(.034)	(.041)
MFA	.005	-.069	-.072	-.017	-.022
	(.018)	(.014)***	(.021)***	(.013)	(.022)
Tariff	-.132	-.157	-.198	.012	.204
	(.094)	(.077)**	(.104)*	(.085)	(.162)
License	.078	.034	.033	-.044	-.072
	(.036)**	(.038)	(.035)	(.039)	(.047)
NTR rate	-.047	.003	-.026	-.039	-.028
	(.037)	(.021)	(.039)	(.023)*	(.068)
e(N)	8322	28149	28161	26818	7168

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment. All dependent variables are logged.

The dependent variables include sown area in thousands of hectares, agricultural machinery in 10,000 kilowatts, grain and cash crops in thousands of tons, and grain yield in tons per hectare. Asterisks indicate significance at the ten, five, and one percent level.

Table A9: Additional Province-level Data

	Exports (1)	Foreign capital used (2)	Foreign loans (3)	Direct FDI (4)
Post x NTR gap	.211	.322	.517	.617
	(.111)*	(.085)***	(.266)*	(.117)***
Obs.	384	278	217	382

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the province-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables, all calculated as the mean across counties within the province: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province and year fixed effects are included. Standard errors are estimated employing clustering at the province level.

The dependent variables include exports, foreign capital used, foreign loans, and direct FDI at the province level, are reported as the log of constant-price million yuan. Asterisks indicate significance at the ten, five, and one percent level.

Table A10: Alternate Specifications

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: NTR Gap Winsorized at 1/99 percentile						
Post x NTR gap	.179	.021	.028	.022	.038	.033
	(.080)**	(.024)	(.015)*	(.015)	(.013)***	(.015)**
Obs.	5158	14722	15688	15375	29782	26358
Panel B: Baseline specification without controls						
Post x NTR gap	.114	-.049	.029	.017	.053	.042
	(.051)**	(.025)**	(.014)**	(.011)	(.012)***	(.015)***
Obs.	5187	15261	16248	15934	30401	26599
Panel C: Population-weighted standard errors						
Post x NTR gap	.181	-.002	.036	.027	.042	.039
	(.082)**	(.018)	(.015)**	(.015)*	(.013)***	(.017)**
Obs.	5155	14716	15682	15369	29767	26325

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced good, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects are included, and the province-year fixed effects are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level. The dependent variables are exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. All dependent variables are loggedg.

In Panel A, the NTR gap is winsorized at the 1st and 99th percentiles. In Panel B, the specification is estimated including only county and province year fixed effects. In Panels A and B, the regressions are weighted with respect to baseline employment. In Panel C, the regressions are weighted with respect to the 1990 county population. Asterisks indicate significance at the ten, five, and one percent level.

Table A11: Alternate Specifications

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Baseline GDP quartile - year fixed effects						
Post x NTR gap	.180 (.082)**	.004 (.018)	.034 (.015)**	.023 (.014)	.043 (.012)***	.043 (.017)**
Obs.	5158	14722	15688	15375	29782	26340
Panel B: Baseline education quartile - year fixed effects						
Post x NTR gap	.217 (.081)***	.0009 (.018)	.031 (.015)**	.029 (.014)**	.045 (.012)***	.037 (.017)**
Obs.	5158	14722	15688	15375	29782	26340
Panel C: Baseline Herfindahl - year fixed effects						
Post x NTR gap	.201 (.081)**	.006 (.020)	.029 (.015)*	.023 (.014)*	.038 (.012)***	.025 (.016)
Obs.	5158	14722	15688	15375	29782	26340
Panel D: SOE employment-quartile fixed effects						
Post x NTR gap	.185 (.083)**	.004 (.018)	.034 (.014)**	.024 (.014)*	.040 (.012)***	.036 (.016)**
Obs.	5158	14722	15688	15375	29782	26340

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. In all panel, the control variables and fixed effects included are identical to those reported in the notes to Table 2. Standard errors are estimated employing clustering at the county level, and the regressions are weighted with respect to baseline employment. The dependent variables are exports at the county level; primary, secondary, tertiary, and total GDP; and per capita GDP. All dependent variables are logged.

In Panel A, a full set of interactions between year fixed effects and dummy variables for each quartile of initial GDP are added. In Panel B, a full set of interactions between year fixed effects and dummy variables for each quartiles of initial post-primary education are added. In Panel C, a full set of interactions between year fixed effects and dummy variables for each quartile of the initial Herfindahl index are added. In Panel D, a full set of interactions between year fixed effects and dummies for each quartile of estimated baseline fraction of SOE employment are added. Asterisks indicate significance at the ten, five, and one percent level.