Productivity Growth and Capital Flows: The Dynamics of Reforms

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Abstract

Why doesn't capital flow into fast-growing countries? We provide a model incorporating heterogeneous producers and underdeveloped domestic financial markets to explain the joint dynamics of total factor productivity (TFP) and capital flows. When a large-scale economic reform eliminates pre-existing idiosyncratic distortions in a small open economy, its TFP rises, driven by efficient reallocation of economic resources. At the same time, because of the financial frictions, saving rates surge, but investment rates respond only with a lag, resulting in capital outflows. These patterns are consistent with real-world growth acceleration episodes, many of which are triggered by large-scale economic reforms.

Keywords: Productivity growth, capital flows, financial frictions

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Standard economic theory predicts that capital should flow into countries experiencing a sustained increase in total factor productivity (TFP). The evidence from developing countries over the last three decades contradicts this prediction. If anything, capital tends to flow out of countries with fast-growing productivity (Prasad et al., 2007; Gourinchas and Jeanne, 2007). To better understand this finding, we focus on the most salient episodes of growth accelerations: The fact that capital flows out even during such episodes is the most puzzling and hence the most revealing about the economic forces not captured by standard models. Upon closer inspection, we observe that the most pronounced accelerations in TFP tend to follow large-scale economic reforms, with TFP growth being accompanied by capital outflows that reflect a surge in aggregate saving and a more muted response of aggregate investment.

The goal of our paper is a successful explanation of this phenomenon. To this end, we develop and analyze a quantitative framework where large-scale growth-enhancing reforms generate an endogenous joint dynamics of TFP and capital flows. The nature of this joint dynamics is shown to depend primarily on the degree of frictions in the domestic financial markets.

Our model has three key ingredients. First, individuals choose whether to operate an individual-specific technology or to supply labor for a wage. This occupational choice allows for endogenous entry and exit of heterogeneous producers, which are important channels of resource reallocation. Second, we incorporate financial frictions in the form of endogenous collateral constraints on capital rental. Financial frictions are not only a source of misallocation themselves, but they also slow down the process of resource reallocation among heterogeneous producers. Third, based on the growth acceleration experiences of several developing countries, we model large-scale growth-enhancing reforms as the elimination of pre-existing idiosyncratic distortions.[1] Such reforms lead to a process of efficient reallocation of production factors, which is intermediated through the underdeveloped domestic financial markets.

We use our model to study the transitional dynamics of a small open economy after such a reform. The initial condition for the transition is the stationary equilibrium of an open economy that (1) has idiosyncratic distortions—e.g. sector-specific and/or size-dependent taxes and subsidies, and (2) has poorly-functioning domestic financial markets. This initial condition is characterized by gross misallocation of resources.

Once the reform is implemented and all idiosyncratic distortions are removed, aggregate TFP rises fast, mirroring the more efficient reallocation of economic resources in the absence

[1]The importance of idiosyncratic distortions in understanding the low TFP of developing countries is discussed by Hsieh and Klenow (2009) and Bartelsman et al. (2009). Earlier theoretical contributions include Hopenhayn and Rogerson (1993), Guner et al. (2008), and Restuccia and Rogerson (2008).

of idiosyncratic distortions. More important, capital flows out of this small open economy, driven by disparate dynamics of aggregate investment and saving.

After the reform, investment rates initially fall, and then rise sluggishly. This results from the downsizing and exit of entrepreneurs who lose their subsidy, and from the domestic capital market frictions constraining and slowing down the entry and expansion of productive entrepreneurs.

On the other hand, saving rates increase strongly following the reform, and then slowly decline. The initial increase is driven by permanent-income consumption/saving behavior of entrepreneurs and, to a lesser degree, by their self-financing motive for saving. First, while low-productivity individuals (i.e., workers) face an income profile that rises over time as wages rise after the reform, as for productive and wealthy entrepreneurs, their income is particularly and temporarily high right after the reform, precisely because factor prices (i.e., wages) are temporarily low before they reach the new steady-state level. Thus, productive and wealthy entrepreneurs take advantage of the opportunity (i.e., temporarily low wages) presented by the reform, and save a higher fraction of profits in a manner consistent with the permanent-income theory. Second, individuals who have high entrepreneurial productivity but relatively little wealth choose high saving rates, so that they can overcome the collateral constraints over time and self-finance their profitable business. However, self-financing alone cannot explain why saving grows faster than investment, because entrepreneurs do have access to external finance: That is, they can invest more than they save, with the collateral constraints limiting the magnitude of this leverage. Self-financing, nevertheless, restricts the excess investment over saving at the individual entrepreneur level. Overall, these saving behaviors of entrepreneurs explain the steep rise of aggregate saving rates in the early stages of the post-reform transition.

In summary, our model generates a strong positive correlation between TFP and saving, and a much weaker one between TFP and investment, consistent with the empirical patterns from the growth acceleration episodes. We find that, in order to explain why capital may flow out of countries with fast TFP growth, it is important to use a framework that allows for rich joint dynamics of TFP, investment, and saving. The development of such a framework is the main contribution of our paper.

We also consider in our framework an alternative sequencing of large-scale economic reforms. In our main exercise of the paper described above, the reform consists of a single component: the elimination of idiosyncratic distortions. Note in particular that the local financial market frictions remain intact. One can think of a farther-reaching reform package that not only removes idiosyncratic distortions but also substantially improves the local financial institutions. With this broader reform, TFP will now increase not only because of

the removal of idiosyncratic distortions but also because of the improved financial markets. At the same time, unlike in the exercise above, capital now flows into this economy. This is primarily because local financial markets now function better than in the main exercise, expediting the entry and expansion of productive entrepreneurs. As a result, aggregate investment now increases strongly even in the early stages of the post-reform transition. On the other hand, saving rates do not increase as much as in the main exercise. The transition to the new steady state is much faster, and hence the permanent-income consumption/saving effect is less strong. In addition, entrepreneurs can now obtain more external financing, and accordingly have weaker self-financing motives for saving. Overall, investment outstrips saving as TFP rises, and capital flows in from overseas to meet this excess demand for capital.

Given the different results we obtain in the two exercises, it is natural to ask which is the more accurate description of developing economies' reform episodes. In addition to the inferred evidence in the form of the correlation between TFP and capital flows, a perusal of the reform episodes that motivate our study suggests the prevalence of the sequencing in our first exercise: The reduction of sector-specific or size-dependent taxes and subsidies preceded domestic financial market reforms in the countries that are the most relevant for our analysis. In fact, the first is often referred to as "first-generation" reforms, while domestic financial institutions belong to the domain of so-called "second-generation" reforms (Camdessus, 1999). More broadly, the reform of domestic financial institutions in emerging economies surfaced onto the center stage of international policy debates only after the East Asian and Russian financial crises of the late 1990s, with the realization that the gains from economic liberalization remain elusive without a developed local financial sector (Mishkin, 2003; Stulz, 2005; Kaminsky and Schmukler, 2008; Obstfeld, 2008).

One additional advantage of our model is that it lends itself well to quantitative welfare analyses. Of particular interest is the welfare consequence of capital account liberalization. While in our benchmark analysis we assume that the economy is already open to capital flows before the reform, many real-world reforms involved efforts at more open capital accounts. We find that this additional reform element further reinforces the tendency for capital to flow out of fast-growing economies with underdeveloped local financial markets. Furthermore, capital account liberalization has implications on factor prices along the transition, resulting in heterogeneous welfare impacts. Since economists readily agree on the desirability of eliminating idiosyncratic distortions, we ask whether it is better to open up to international capital flows at the same time or not.

To address this question using our framework, we now consider an economy that (1) is closed to capital flows, (2) has idiosyncratic distortions, and (3) has poorly-functioning

domestic financial markets. Starting from this initial condition, we compare the results of removing idiosyncratic distortions while opening up with those of removing idiosyncratic distortions while remaining closed. In essence, we are studying the marginal welfare impact of capital account liberalization that accompanies the elimination of idiosyncratic distortions.

One key difference is that the equilibrium interest rate is lower in a closed economy with financial frictions than the world interest rate determined by large countries with well-functioning financial markets. This is because the collateral constraint restricts demand for capital, and also because more capital is supplied to the rental market, other things being equal, driven by entrepreneurs' strong self-financing motives and correspondingly high saving rates: As a result, a lower interest rate is necessary to clear the capital market with financial frictions than without. To the contrary, the equilibrium wage is higher in the closed economy than in the open economy. This is because the interest rate differential implies that capital will flow out of countries with domestic financial market frictions once capital accounts are opened up: Other things being equal, there is less capital per worker for domestic production in the open economy transition, and the wage is lower than in the closed-economy transition.

The wealthy directly benefit from concurrent capital account liberalization, which instantaneously gives them higher returns (i.e., the world interest rate) on their financial assets. Likewise, high-productivity individuals, who will choose to be entrepreneurs and soon become wealthy, are better off with the open-economy reform.[2] On the other hand, low-ability individuals, who will choose to be workers, are better off with the closed-economy transition because of the higher wage, unless they start out very wealthy.

We draw the following conclusion from this exercise. To assess the full effects of the liberalization of international capital flows, it is necessary to first understand its interactions with local distortions that interfere with efficient resource allocation, and to also consider the scope and sequencing of reforms that will be undertaken in conjunction with the capital account liberalization.

Contribution Relative to the Literature The earlier literature on international capital flows focused on the Lucas puzzle—the small volume of capital flows from rich to poor countries. This fact can be explained by the overall lower productivity in poor countries (Lucas, 1990) or their higher relative cost of investment (Caselli and Feyrer, 2007). Gertler and Rogoff (1990) and Boyd and Smith (1997) developed theories demonstrating how frictions in local capital markets can interact with international capital markets and cause capital to flow from poor to rich countries.[3] Caballero et al. (2008) and Mendoza et al. (2009) emphasize

[2]As for entrepreneurial profits, capital rental prices are higher in the open economy together with the interest rate, but they are counterbalanced by lower wages.

[3]Matsuyama (2005) is a more recent contribution in this context.

this interaction between local and international financial markets to explain "global imbalances," using models where the primary role of financial markets is to facilitate consumption smoothing. Castro et al. (2004) also analyze how domestic financial market imperfections can determine the direction of international capital flows between rich and poor countries.

The goal of our paper is to explain why capital does not flow into countries with fast-growing TFP (Prasad et al., 2007; Gourinchas and Jeanne, 2007). While the models in the aforementioned literature can explain the negative correlation between capital outflows and income *levels* across countries, they cannot generate capital outflows during a spell of exogenous accelerations in TFP. In comparison, we provide a framework that allows for richer joint dynamics of endogenous TFP, investment, and saving. Furthermore, our mechanism is starkly different from those in the literature that rely on interest rate differentials between financially-developed and financially-underdeveloped economies to generate poor-to-rich capital flows: In our main exercises, we start with an already-open economy that takes the constant world interest rate as given both before and after the transition, and hence the capital flows in our model are independent of such interest rate differentials.

More recently, a number of researchers have formulated and addressed a closely-related puzzle: Capital tends to flow out of countries that are fast growing in terms of *income per capita*. Carroll et al. (2000) use habit formation in preferences to explain this in an endowment-economy setup. Sandri (2009) and Song et al. (2011) use production-economy models to explain the best-known example of a country that has grown fast and amassed a huge amount of foreign assets during the past decade and a half: China. Sandri focuses on the market incompleteness in sharing entrepreneurial risk, and in this sense is closely related to the underlying mechanism of Caballero et al. (2008) and Mendoza et al. (2009). Song et al. capture the interaction between the private sector and the state-owned firms with privileged access to financing, an important feature of the Chinese economy.

Our paper complements this literature by addressing the experiences of a broader set of developing countries, where the impact of large-scale economic reforms was intermediated through underdeveloped local financial markets. Our model is uniquely capable of illuminating the disparate forces driving the post-reform transition dynamics of endogenous TFP, investment, and saving.

Our work, in particular the welfare comparison of the closed vs. open transitions in Section 3.4, also relates to the recent papers by Aoki et al. (2007, 2009), who study theoretically how the adjustment to the liberalization of international financial transactions depends upon the degree of domestic financial development.[4] In our model, the liberalization of capital

[4]Compared to their papers, our model has richer heterogeneity across entrepreneurs, an extensive margin allowing unproductive entrepreneurs to become workers, and decreasing-returns-to-scale technologies at the

flows unaccompanied by other reforms only generates an inconsequential TFP dynamics. In order to account for the joint dynamics of capital flows and TFP growth, one needs to consider a broader set of reforms implemented in many developing economies.

1 Motivating Facts

In this section, we document the joint dynamics of saving, investment, and TFP for countries undergoing significant accelerations in output per capita. We show that growth accelerations are driven by a surge in TFP, and are associated with a rise in aggregate saving and a delayed reaction of aggregate investment. We first present evidence for a set of growth accelerations that are identified through a purely statistical procedure, and then for another set of countries whose onset of output and TFP accelerations can be traced to large-scale economic reforms.

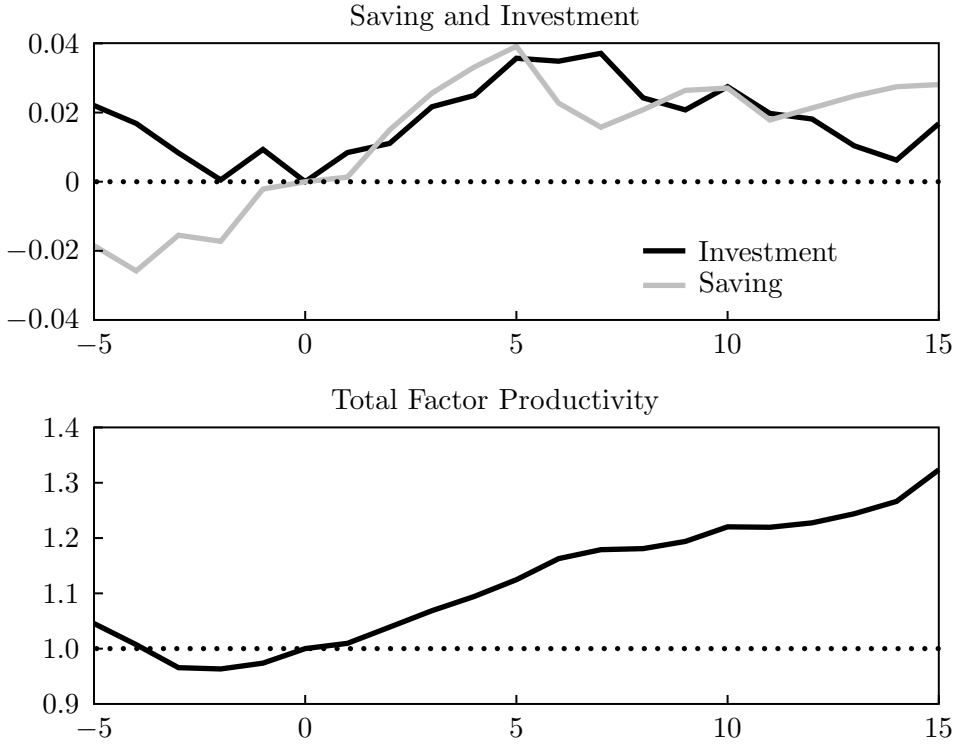

Fig. 1: Saving, Investment, and TFP in Growth Accelerations

In Figure 1 we show the average behavior of saving, investment, and TFP for the 11 sustained growth accelerations identified by Hausmann et al. (2005) in the post-1975 period.[5]

level of production units.

[5]In Hausmann et al. (2005), a growth acceleration starts in year t only if the following three conditions are met: (1) the average growth rate in the seven ensuing years (years t through $t+6$) is above 3.5 percent; (2) the average growth rate in the seven ensuing years is at least two percentage points higher than in the preceding seven years (years $t-7$ to $t-1$); and (3) the output per capita in the ensuing seven years is above the previous peak. If more than one contiguous years satisfy all three conditions, the start of the growth

On the horizontal axis, we have time in years, with year 0 corresponding to the statistically-identified beginning of each country's growth acceleration.

In the top panel, we show the dynamics of saving and investment rates averaged across these 11 episodes, as point deviations from their respective values at the beginning of the growth acceleration (year 0). The average saving rate rises strongly in the early stages of the acceleration episodes (years 2 through 5) and by more than the gradual increment in investment. Investment rates eventually catch up with saving rates (years 6 to 8) but again fall behind (years 12 to 15). This regularity has received limited attention in the literature, with the notable exception being Prasad et al. (2007). Indeed, this panel replicates their Figure 9.

The evolution of TFP, averaged over the 11 sustained acceleration episodes, is shown in the bottom panel of Figure 1. The average TFP is relative to its level at the beginning of the growth accelerations. TFP grows by more than 30 percent on average, through 15 years of sustained growth accelerations.

One important finding of Hausmann et al. is that the beginning of many sustained growth accelerations coincides with large-scale economic reforms. Building on these empirical findings, we take a closer look at the acceleration episodes between 1980 and 1995. For six of them, we can identify and date large-scale economic reforms to which the start of the accelerations can be explicitly traced. They are Chile, India, Israel, Korea, Mauritius, and Taiwan.[6]

Figure 2 shows the evolution of saving rates, investment rates, and TFP before and after major economic reforms. The year of the reform is set to zero, and the three variables are plotted for the surrounding 20 years. Saving and investment rates are shown as point deviations from their respective values in year 0, and TFP is relative to the year-0 level. We show the data for each individual country in the background (dotted line) and for the average over the six countries (solid line). Figure 8 in the appendix plots, country by country, saving rates, investment rates, and TFP. The dates of the reforms are 1981 for Mauritius, 1982 for

acceleration is chosen to be the one for which a trend regression with a break in that year provides the best fit among all eligible years, in terms of the F-statistic. A *sustained* growth acceleration is one for which the average growth rate in the decade following a growth acceleration (years $t + 7$ through $t + 16$) is above 2 percent.

[6]We focus on the 1980–1995 period for three reasons. Firstly, the 1980s witnessed the first wave of capital account liberalization in emerging economies. Secondly, during the 1990s, innovations in international financial markets (e.g. derivatives and off-balance sheet transactions) made it harder to closely keep track of cross-border capital flows, substantially amplifying measurement problems (Lane and Milesi-Ferretti, 2007). Lastly, we abstract from the developments in the aftermath of the East Asian and Russian financial crises of the late 1990s, when many emerging economies espoused an explicit policy of improving their net foreign asset positions as a precautionary measure, e.g. the Guidotti-Greenspan rule and the proposals by Feldstein (1999). Note that our sample period precedes the massive acquisition of foreign assets by China, which is the subject of Sandri (2009) and Song et al. (2011).

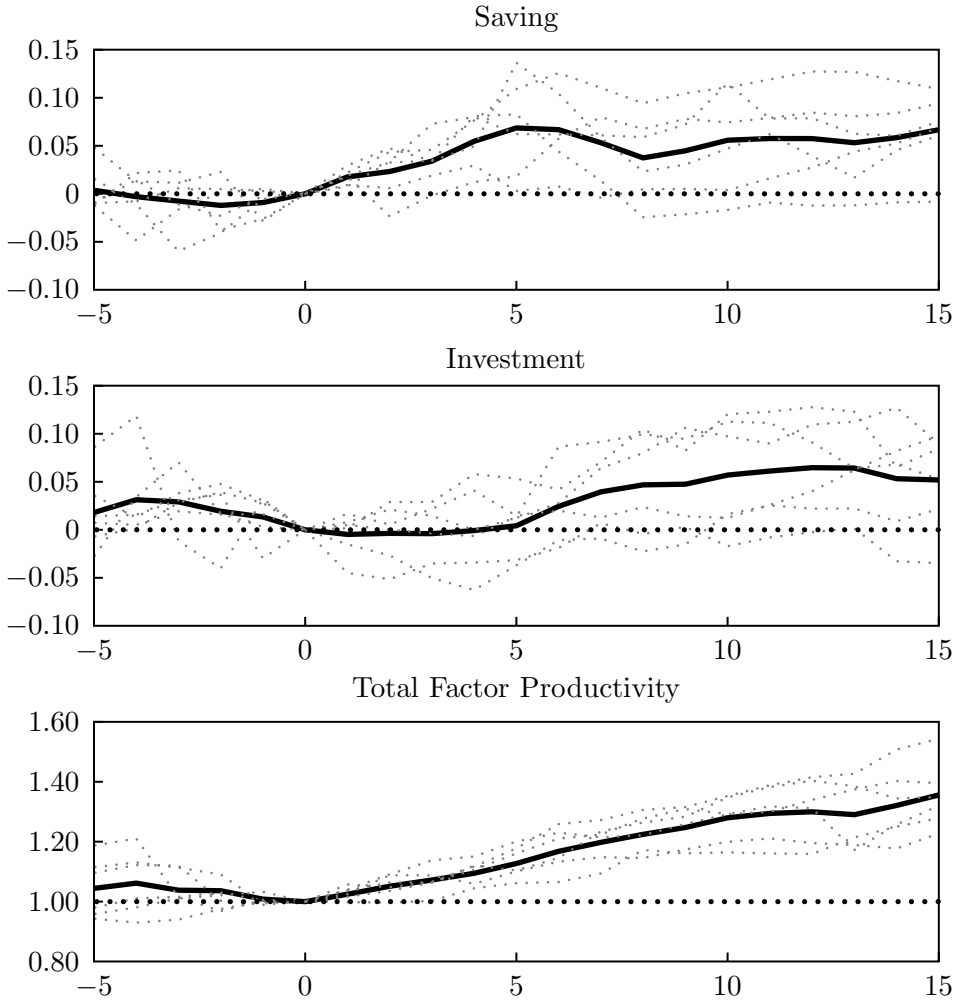

Fig. 2: Saving, Investment, and TFP in Large-Scale Reforms

Korea and Taiwan, 1985 for Chile and Israel, and 1991 for India.

Common elements of their reforms include the abolishment of government directives championing specific industries, more permanent retrenchment of trade barriers, and a broad reduction in the government's intervention in the economy. Substantial reallocation of resources across sectors and productive units ensued. The reforms had a much more muted effect on local financial markets, as suggested by both de jure and de facto measures. See the appendix for a detailed description of all six reform episodes.

In all six cases, the large-scale reforms ushered in a period of sustained productivity growth (bottom panel, Figure 2), which was accompanied by a surge in capital *outflows*. Indeed, these economies show a sharp increase in aggregate saving that contrasts with the delayed increments in investment. In Figure 2, saving rates peak in year 5, while investment rates stagnate until that point.

This evidence on saving, investment, and TFP during the sustained growth accelerations is related to a recently documented regularity about the behavior of capital flows and growth,

often referred to as the allocation puzzle: the positive correlation between capital outflows and economic growth for developing economies. Prasad et al. (2007) show that the countries whose output per worker grew the fastest between 1970 and 2004 tended to run current account surplus over the same period. Gourinchas and Jeanne (2007) establish a similar pattern between capital outflows and TFP growth. Both studies further show that the capital flows and the resulting accumulation of net foreign assets are accounted for by a strong positive correlation between growth and aggregate saving, together with a relatively weaker one between growth and aggregate investment.[7] In our empirical work, by documenting the joint dynamics of capital flows and TFP during the most salient growth acceleration episodes, we complement their discovery of the time-averaged patterns for the average developing country.

To summarize, three robust conclusions can be drawn from the data. First, capital tends to flow out of countries experiencing fast growth in output and TFP, contrary to the predictions of the standard models. Second, this pattern of capital flows is particularly prominent in the early stages of growth acceleration episodes, which are often triggered by large-scale economic reforms. Finally, the pattern of capital flows reflects a surge in aggregate saving that precedes the delayed reaction of aggregate investment to the reforms. In the rest of the paper, we provide a quantitative framework to explain this puzzling phenomenon.

2 Model

The above empirical observations call for a model of TFP dynamics and capital flows. We propose a model with individual-specific technologies and imperfect credit markets.

In each period, individuals choose either to operate an individual-specific technology—i.e. to become an entrepreneur—or to work for a wage. This occupation choice allows for endogenous entry and exit in and out of the production sector, which is an important channel of resource allocation. Individuals are heterogeneous in their entrepreneurial ability and wealth. Our model generates endogenous dynamics for the joint distribution of ability and wealth, which turns out to be crucial for understanding macroeconomic transitions.

Access to capital is limited by entrepreneurs' wealth through an endogenous collateral constraint, based on imperfect enforceability of capital rental contracts.

One entrepreneur can operate only one production unit (establishment) in a given period. Entrepreneurial ideas are inalienable, and there is no market for managers or entrepreneurial talent.

[7] Gourinchas and Jeanne (2007) provide a more systematic interpretation of this evidence by showing that one needs to introduce saving wedges into the neoclassical growth model to explain the correlation between TFP and capital flows in the data.

We consider both an economy that is closed to capital flows and a small open economy facing a constant world interest rate, but our main exercises are for small open economies.

Heterogeneity and Demographics Individuals live indefinitely, and are heterogeneous in their wealth a and their entrepreneurial ability $z \in \mathcal{Z}$, with the former being chosen endogenously by forward-looking saving decisions. Individuals' ability follows a stochastic process. In particular, an individual retains his ability from one period to the next with probability ψ. With probability $1-\psi$, he loses the current ability and has to draw a new entrepreneurial ability. The new draw is from a time-invariant ability distribution, whose cumulative density is $\Omega(z)$, and is independent of his previous ability level. One can think of the ability shock as an arrival of a new technology making existing production processes obsolete or less profitable.

The population size of the economy is normalized to one, and there is no population growth.

Preferences Individual preferences are described by the following expected utility function over sequences of consumption, c_t:

$$U(c) = \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u(c_t)\right], \quad u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}, \tag{1}$$

where β is the discount factor, and σ is the coefficient of relative risk aversion. The expectation is over the realizations of entrepreneurial ideas z.

Technologies At the beginning of each period, an individual chooses whether to work for the market wage w or to operate his own business. An entrepreneur with talent z produces using capital k and labor l according to:

$$zf(k,l) = zk^{\alpha}l^{\theta}, \tag{2}$$

where α and θ are the elasticities of output with respect to capital and labor, and $\alpha+\theta<1$, implying diminishing returns to scale in variable factors at the establishment level.

Taxes and Subsidies The government may set individual-specific subsidies, partly financed by uniform taxes. Individual-specific subsidies are denoted by $\varsigma_i \geq 0$, where the subscript indexes individuals in the economy. The uniform tax rate is denoted by $\tau \geq 0$. Following Restuccia and Rogerson (2008), we assume that these taxes and subsidies are levied on the revenue of an entrepreneur. For entrepreneur i, his revenue after taxes and subsidies is $(1-\tau)(1+\varsigma_i)z_i k^{\alpha}l^{\theta}$.

In addition, the government may use uniform lump-sum taxes or transfers to balance its budget. We denote the lump-sum tax with χ. A negative χ implies lump-sum transfer from the government to individuals.

Taxes, τ and χ, apply equally to everyone in the economy, and is assumed to be constant over time. We further assume that individual-specific subsidies are also constant over time.[8] The latter assumption captures the fact that it is hard to change policies that favor particular groups once they are entrenched (Sowell, 1990; Krueger, 1993; Bridgman et al., 2009).[9]

We assume that the government balances its budget each period.

Credit (Capital Rental) Markets Individuals have access to competitive financial intermediaries, who receive deposits and rent out capital at rate R to entrepreneurs. We restrict the analysis to the case where credit transactions are within a period—that is, individuals' financial wealth is restricted to be non-negative ($a \geq 0$). The zero-profit condition of the intermediaries implies $R = r + \delta$, where r is the deposit rate and δ is the depreciation rate.

Capital rental by entrepreneurs is limited by imperfect enforceability of contracts. In particular, we assume that, after production has taken place, entrepreneurs may renege on the contracts. In such cases, a defaulting entrepreneur can keep a fraction $1 - \phi$ of the undepreciated capital and the after-tax revenue net of labor payments: $(1-\phi)\left[(1-\tau)(1+\varsigma)zf\left(k,l\right) - wl + (1-\delta)\,k\right]$, $0 \leq \phi \leq 1$. The punishment is the loss of their financial assets (a) deposited with the financial intermediary. In the following period, the entrepreneur in default regains access to financial markets, and is not treated any differently, despite his history of default.

Note that ϕ indexes the strength of an economy's legal institutions that enforce contractual obligations. This one-dimensional parameter captures the extent of frictions in the financial market owing to imperfect enforcement of credit contracts. This parsimonious specification allows for a flexible modeling of limited commitment that spans economies with no credit ($\phi = 0$) and those with perfect credit markets ($\phi = 1$).

We consider equilibria where the capital rental contracts are incentive-compatible and are hence fulfilled. In particular, we study equilibria where the rental of capital is quantity-restricted by an upper bound $\bar{k}\left(a, z, \varsigma; \phi\right)$, which is a function of the individual state (a, z, ς). We choose the rental limits $\bar{k}$ to be the largest limits that are consistent with entrepreneurs choosing to abide by their credit contracts. Without loss of generality,

[8] In our main exercise, a completely unexpected reform will be implemented at one point, setting all taxes and subsidies to zero. This is a one-off event, and the changes are permanent. As far as the individuals in the economy are concerned, taxes and subsidies are constant before the unexpected reform, and they are again constant after the reform.

[9] See Fernandez and Rodrik (1991) and Coate and Morris (1999) for models of the persistence of policies.

we assume $\bar{k}(a, z, \varsigma; \phi) \leq k^u(z, \varsigma)$, where k^u is the profit-maximizing capital inputs in the unconstrained static problem.

The following proposition, proved in Buera et al. (2011a), provides a simple characterization of the set of enforceable contracts and the rental limit $\bar{k}(a, z, \varsigma; \phi)$.

Proposition 1 *Capital rental k by an entrepreneur with wealth a, talent z, and individual-specific subsidy ς is enforceable if and only if*

$$\max_l \{(1-\tau)(1+\varsigma)zf(k,l) - wl\} - Rk + (1+r)a \geq (1-\phi)\left[\max_l \{(1-\tau)(1+\varsigma)zf(k,l) - wl\} + (1-\delta)k\right]. \quad (3)$$

The upper bound on capital rental that is consistent with entrepreneurs choosing to abide by their contracts can be represented by a function $\bar{k}(a, z, \varsigma; \phi)$, which is increasing in a, z, ς, and ϕ.

Condition (3) states that an entrepreneur must end up with (weakly) more economic resources when he fulfills his credit obligations (left-hand side) than when he defaults (right-hand side). This static condition is sufficient to characterize enforceable allocations because we assume that defaulting entrepreneurs regain full access to financial markets in the following period.

This proposition also provides a convenient way to operationalize the enforceability constraint into a simple rental limit $\bar{k}(a, z, \varsigma; \phi)$. Rental limits increase with the wealth of entrepreneurs, because the punishment for defaulting (loss of collateral) is larger. Similarly, rental limits increase with the talent of an entrepreneur and the individual-specific subsidy rate, because defaulting entrepreneurs keep only a fraction $1-\phi$ of the subsidy-adjusted revenue.[10]

Individuals' Problem The problem of an individual in period t can be written as:

$$\max_{\{c_s, a_{s+1}\}_{s=t}^{\infty}} \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} u(c_s) \quad (4)$$
$$s.t.\ c_s + a_{s+1} \leq \max\{w_s, \pi(a_s, z_s, \varsigma_s)\} + (1+r_s)a_s - \chi,\ \forall s \geq t$$

where z_t, a_t, and the sequence of wages and interest rates $\{w_s, r_s\}_{s=t}^{\infty}$ are given, and $\pi(a, z, \varsigma)$ is the maximized profit from operating an individual-specific technology. This indirect profit

[10] An alternative specification, where entrepreneurs own capital and issue debt subject to a debt limit determined by a similar limited-commitment constraint, would provide an equivalent result, if we assume that productivity shocks are known one period in advance. This assumption would guarantee that the debt contracts and the returns to investment are deterministic. The details of this analysis is available upon request.

function is defined as follows.

$$\pi(a,z,\varsigma) = \max_{l,k} \{(1-\tau)(1+\varsigma)zf(k,l) - wl - (\delta+r)k\}$$
$$s.t. \;\; k \leq \bar{k}(a,z,\varsigma;\phi)$$

Similarly, we denote the input demand functions by $l(a,z,\varsigma)$ and $k(a,z,\varsigma)$.

The max operator in the budget constraint stands for the occupation choice, which can be represented by a simple policy function. Type-z individuals with subsidy ς decide to be entrepreneurs if their current wealth a is higher than the threshold wealth $\underline{a}(z,\varsigma)$, where $\underline{a}(z,\varsigma)$ solves:

$$\pi\left(\underline{a}(z,\varsigma), z, \varsigma\right) = w.$$

Intuitively, individuals of a given ability choose to become entrepreneurs only if they are wealthy enough to overcome the collateral constraint and run their businesses at a profitable scale. Similarly, individuals of a given wealth level choose to become entrepreneurs only if their ability is high enough.

Competitive Equilibrium (Closed Economy) We denote by $\mu_t(z,\varsigma)$ the cumulative density function of the joint distribution of entrepreneurial talent z and individual-specific subsidies ς at time t. We denote by $G_t(a,z,\varsigma)$ the cumulative density function for the joint distribution of wealth, z, and ς, at the beginning of period t. For notational convenience, $G_t(a|z,\varsigma)$ is the associated c.d.f. of wealth for a given (z,ς) pair.

A competitive equilibrium in a closed economy consists of sequences of joint distribution $\{G_t(a,z,\varsigma)\}_{t=0}^{\infty}$, allocations $\{c_t(a,z,\varsigma), a_{t+1}(a,z,\varsigma), l_t(a,z,\varsigma), k_t(a,z,\varsigma)\}_{t=0}^{\infty}$ for all $t \geq 0$, and prices $\{w_t, r_t\}_{t=0}^{\infty}$ such that:

1. Given $\{w_t, r_t\}_{t=0}^{\infty}$, $\{c_t(a,z,\varsigma), a_{t+1}(a,z,\varsigma), l_t(a,z,\varsigma), k_t(a,z,\varsigma)\}_{t=0}^{\infty}$ solve the individual's problem in (4) for all $t \geq 0$;
2. The labor, capital, and goods markets clear at all $t \geq 0$—in particular:

$$\int \left[\int_{\underline{a}_t(z,\varsigma)}^{\infty} l_t(a,z,\varsigma) G_t(da|z,\varsigma) - G_t\left(\underline{a}_t(z,\varsigma)|z,\varsigma\right) \right] \mu_t(dz,d\varsigma) = 0, \qquad \text{(Labor Market)}$$

$$\int \left[\int_{\underline{a}_t(z,\varsigma)}^{\infty} k_t(a,z,\varsigma) G_t(da|z,\varsigma) - \int_0^{\infty} a G_t(da|z,\varsigma) \right] \mu_t(dz,d\varsigma) = 0; \qquad \text{(Capital Market)}$$

3. The government balances its budget each period:

$$\int (\tau + \tau\varsigma - \varsigma) z \left[\int_{\underline{a}_t(z,\varsigma)}^{\infty} k_t^{\alpha}(a,z,\varsigma) l_t^{\theta}(a,z,\varsigma) G_t(da|z,\varsigma) \right] \mu_t(dz,d\varsigma) + \chi = 0$$

4. The joint distribution of ability and wealth $\{G_t(a,z,\varsigma)\}_{t=1}^{\infty}$ evolves according to the equilibrium mapping:

$$G_{t+1}(a,z,\varsigma) = \psi \int_{\{a_{t+1}(\hat{a},\hat{z},\hat{\varsigma})\leq a,\hat{z}\leq z,\hat{\varsigma}<\varsigma\}} G_t(d\hat{a},d\hat{z},d\hat{\varsigma}) + (1-\psi)\Omega(z)\int_{\{a_{t+1}(\hat{a},\hat{z},\hat{\varsigma})\leq a,\hat{\varsigma}<\varsigma\}} G_t(d\hat{a},d\hat{z},d\hat{\varsigma}).$$

Also note that the c.d.f. of the joint distribution of (z,ς) follows

$$\mu_{t+1}(z,\varsigma) = \psi\mu_t(z,\varsigma) + (1-\psi)\Omega(z)\int_{\hat{z}\in\mathcal{Z},\hat{\varsigma}\leq\varsigma}\mu(d\hat{z},d\hat{\varsigma}),$$

because of the invariant $\Omega(z)$ and the fact that individual-specific subsidies remain fixed over time.

Competitive Equilibrium (Small Open Economy) A competitive equilibrium for a small open economy is defined similarly, given a world interest rate r^*, with $r_t = r^*$ for all t. In this case, the domestic capital rental market and goods market do not need to clear, and the net foreign asset (NFA) equals:

$$NFA_t = \int\left[\int_0^{\infty} aG_t(da|z,\varsigma) - \int_{\underline{a}_t(z,\varsigma)}^{\infty} k_t(a,z,\varsigma)\,G_t(da|z,\varsigma)\right]\mu_t(dz,d\varsigma).$$

In addition, for a small open economy, we impose irreversibility on *aggregate* capital used for domestic production:

$$\int\left[\int_{\underline{a}_t(z,\varsigma)}^{\infty} k_t(a,z,\varsigma)\,G_t(da|z,\varsigma)\right]\mu_t(dz,d\varsigma) \geq (1-\delta)\int\left[\int_{\underline{a}_{t-1}(z,\varsigma)}^{\infty} k_{t-1}(a,z,\varsigma)\,G_{t-1}(da|z,\varsigma)\right]\mu_{t-1}(dz,d\varsigma). \quad (5)$$

That is, while there is no irreversibility at the individual level, it is assumed that capital used for domestic production cannot be shipped abroad. Note that this assumption puts a *lower* bound on investment rates, and hence limits capital *outflows*. We will subsequently show that, in our main exercises, capital flows out *in spite of* this irreversibility constraint on aggregate capital.

Obviously, this constraint does not bind in steady states. It may bind along our transitions, in which case, the domestic capital rental rate $r_t + \delta$ falls below the world capital rental rate $r^* + \delta$ until (5) holds with equality. This also requires that the price of capital installed domestically appreciate over time to make individuals indifferent between holding capital domestically and abroad.

3 Quantitative Exploration

The central objective of this paper is to construct a quantitative model of TFP dynamics and capital flows during the growth accelerations that follow large-scale growth-enhancing reforms. To construct a simple and transparent model of resource misallocation in the pre-reform periods and to operationalize the nature of the economic reforms discussed in Section 1, we build upon the recent literature emphasizing the role of idiosyncratic distortions (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Bartelsman et al., 2009). In particular, we model transition dynamics triggered by a reform that removes pre-existing idiosyncratic distortions.

In order to quantify our theory, we first need to choose a set of structural parameters—preferences, technologies, distribution of entrepreneurial ability—that are invariant to the reforms. Then we choose another set of parameters that can be changed by the reforms: parameters governing idiosyncratic distortions and financial frictions. Once all the parameters are chosen, we use our model to construct the initial condition for the transition exercises. This initial condition is a stationary equilibrium of a small open economy that has idiosyncratic distortions and poorly-functioning domestic financial markets.

3.1 Calibration

3.1.1 Parameters Invariant to Reforms

For the sake of clarity, we choose a parsimonious parametrization that follows as much as possible the standard practices in the literature.

The utility function and the span-of-control production function are as in equations (1) and (2).

The entrepreneurial ability z is assumed to follow a Pareto distribution, with the cumulative density given by $\Omega(z) = 1 - z^{-\eta}$ for $z \geq 1$. Each period, an individual may retain his previous entrepreneurial ability with probability ψ. Obviously, ψ controls the persistence of ability, while η determines the dispersion of ability in the population.

We now need to determine seven parameter values: two technological parameters, α and θ, and the depreciation rate δ; two parameters describing the ability process, ψ and η; the coefficient of relative risk aversion, σ, and the subjective discount factor, β.[11]

We let $\sigma = 1.5$ following the standard practice. The one-year depreciation rate is set at $\delta = 0.06$. We choose $\alpha/(\alpha + \theta) = 0.33$ to match the aggregate income share of capital. We are thus left with four parameters: $\alpha + \theta$, η, ψ, and β. We calibrate them using as many

[11] As is common in heterogeneous-agent models with incomplete markets, the discount factor must be jointly calibrated with the parameters governing the stochastic income process.

	US Data	Model	Parameter
Top 10% Employment	0.69	0.69	$\eta = 4.84$
Top 5% Earnings Share	0.30	0.30	$\alpha + \theta = 0.79$
Establishment Exit Rate	0.10	0.10	$\psi = 0.89$
Real Interest Rate	0.04	0.04	$\beta = 0.92$

Table 1: Calibration. The model quantities are from the calibrated version of our perfect-credit benchmark ($\phi = 1$) without idiosyncratic distortions.

relevant moments in the US data: the employment share of the top decile of establishments; the share of earnings generated by the top twentieth of the population; the exit rate of establishments; and the real interest rate. To be more specific, we calibrate the perfect-credit benchmark of our model without idiosyncratic distortions to match these moments in the United States, a relatively undistorted economy.[12] We allow for the possibility that the average entrepreneurial productivity in the US is higher than in less developed economies, reflecting human capital and exogenous TFP differences.[13] As the primary mechanism of our model concerns the allocation of resources among heterogeneous producers, however, our calibration and results are not affected by cross-country differences in the mean.[14]

The first column of Table 1 shows the moments in the US data. The decile with the largest—measured by employment—establishments in the US accounts for 69 percent of the total employment in 2000. We target the earnings share of the top twentieth of the population (0.3 in 1998), and an annual establishment exit rate of ten percent. Finally, as the target interest rate, we pick four percent per year.

The second column of Table 1 shows the moments simulated from the calibrated model. Even though in the model economy all four moments are jointly determined by the four parameters, each moment is primarily affected by one particular parameter. Given the span-of-control parameter $\alpha+\theta$, the tail parameter of the talent distribution η can be inferred from the tail of the employment distribution. We can then infer $\alpha + \theta$ from the earnings share of the top five percent of the population. Top earners are mostly entrepreneurs both in the data and in our model, and $\alpha + \theta$ controls the share of output going to the entrepreneurial input.

[12]The assumption that the US has perfect credit markets is not unreasonable in our framework. The ratio of external finance to GDP in the model economy with perfect credit markets ($\phi = 1$) is 2.3, which is close to the value in the US data of 2.4.

[13]That is, for the US, one can use the production function $Azk^{\alpha}l^{\theta}$ with $A > 1$.

[14]One may consider introducing exogenous differences across countries in the higher-order moments of the entrepreneurial ability distribution. The difficulty here is that the available data do not provide enough guidance or discipline on the direction and magnitude of cross-country variations in these moments. However, even without such exogenous differences in the higher-order moments of the underlying entrepreneurial ability distribution, our model endogenously generates different distributions of productivity among *active* entrepreneurs for economies with different degrees of financial frictions or idiosyncratic distortions.

We obtain $\alpha + \theta = 0.79$ and $\eta = 4.84$. The parameter $\psi = 0.89$ leads to an annual exit rate of ten percent in the model. This is consistent with the exit rate of establishments reported in the US Census Business Dynamics Statistics. Finally, the model requires a discount factor of $\beta = 0.92$ to attain an interest rate of four percent per year.

3.1.2 Parameters for Idiosyncratic Distortions and Financial Frictions

We now discuss the calibration of the parameters governing the taxes and idiosyncratic subsidies, as well as the one for financial development.

In our transition exercises, the initial state of the economy is thought of as a steady state, where individuals are subject to taxes and idiosyncratic subsidies. While the economy is open to international capital flows, the local financial markets are underdeveloped.

The initial distribution of idiosyncratic subsidies are modeled as a legacy of past industrial policies. To be more specific, we assume that, at $t = -\infty$, the government introduces individual-specific subsidies ς_i, for $i \in [0, 1]$. At that point, the government subsidizes the fraction λ of the population with the highest entrepreneurial productivity with a subsidy rate $\bar{\varsigma}$. For the remaining $1 - \lambda$ fraction of the population, their subsidy rate is zero. Once given, these individual-specific subsidy rates remain constant over time. This assumption captures the inertia of policies that favor particular groups, which tend to become entrenched.[15] To pay for the subsidy, the government levies a uniform revenue tax at rate τ and a lump-sum tax of χ. One interpretation is that this policy is adopted by myopic policymakers to boost short-term aggregate output by giving more resources to productive entrepreneurs who are likely to be financially constrained. Although the government initially targets the subsidies to the most productive entrepreneurs, eventually the individual-specific subsidies that remain fixed over time become independent of an individual's entrepreneurial productivity, because of the mean-reversion in the entrepreneurial productivity process. To construct our initial steady state at $t = 0$, we maintain this independence assumption. However, it should be emphasized that the subsidy rates and the entrepreneurial productivity are *negatively* correlated among active entrepreneurs: Among the low-productivity individuals, only those who are subsidized will enter into entrepreneurship and be active producers. This negative correlation between measured idiosyncratic subsidies and plant-level TFP has been documented in the literature on idiosyncratic distortions (Hsieh and Klenow, 2009).[16]

[15] See the references given in Section 2.

[16] We refer readers to Buera, Moll, and Shin (2011b) for more discussions on how one can model the rampant idiosyncratic distortions found in developing countries as a legacy of well-intended industrial policies of the past. Again, the most important assumption is policy inertia, motivated by the observations that subsidies and other favors directed at particular groups more often than not become entrenched and outlive the original rationale—if there was one.

Given our modeling of idiosyncratic subsidies, we have four parameters to be pinned down: the fraction subsidized, λ, the subsidy rate for those who are subsidized, $\bar{\varsigma}$, the tax rate, τ, and the lump-sum tax, χ. To calibrate them, we need four moments. We will adjust χ to balance the government budget in the initial state. We now need three.

In our main exercise, the macroeconomic transitions are triggered by an unexpected reform that eliminates all taxes and idiosyncratic subsidies. We infer the taxes and subsidies in the initial state by comparing aggregate quantities before and after the transition in this main exercise of Section 3.2.1.

For this purpose, we use the available data from those six countries with dated large-scale reforms (Section 1). We use the following three moments. First, in the data, TFP increases by 35 percent over the 15 years following the reform, when averaged across the six countries (bottom panel, Figure 2).[17] Second, over the same time period, capital-to-output ratio increases by 0.1, from 1.67 to 1.77, when averaged across these countries.[18] Finally, from the data on the size distribution of establishments, which is available for five of the six countries, we observe that the average manufacturing establishment size decreased by 18 percent, again when averaged across these countries.[19] These three moments, along with the government budget constraint in the initial state, gives us $\lambda = 0.0298$, $\bar{\varsigma} = 1.3$, $\tau = 0.5$, and $\chi = 0.0134$.

In our main exercise, the parameter for the domestic financial market imperfections, ϕ, is not affected by the reform and held constant. This parameter can be identified primarily by the ratio of external finance to GDP. For the six countries that we consider here, this ratio increases only gradually over the relevant period. Since most of the model transition dynamics following the elimination of taxes and idiosyncratic subsidies occurs within the first eight years or so, it is not unreasonable to assume that ϕ is constant over time. We compute each country's average external finance to GDP ratio over this period, which is in turn averaged across the six countries. This average is 0.4, and we obtain this number in the model by setting $\phi = 0.22$.

[17]The aggregate TFP, both for the data and the model, is computed as $Y/(K^{\frac{1}{3}}L^{\frac{2}{3}})$, where Y is gross domestic product, K is aggregate capital, and L is the number of workers. For the model TFP calculation, L includes both workers and entrepreneurs, which is consistent with the data counterpart.

[18]In our calibration of the model in Section 3.1.1, we do not target capital-output ratios. Nevertheless, the new steady state reached at the conclusion of the post-reform transition in our main exercise (Section 3.2.1) has a capital-output ratio of 1.8, which is remarkably close to its empirical counterpart. In the model transition, we target the change in the ratio so that it increases from 1.69 in the initial state to 1.79 year 15.

[19]The decline in the average establishment size is observed in four of the five countries: India, Israel, Korea, and Taiwan. It is particularly pronounced in Korea and Taiwan, where the most important part of the economic reforms of 1982 was the abandonment of interventionist policies propping up large-scale heavy and chemical industries.

3.2 Post-Reform Transition Dynamics

In this section, we study the joint dynamics of TFP and capital flows following large-scale economic reforms. We first consider two reform exercises (Sections 3.2.1 and 3.2.2), both starting from the same initial condition constructed in Section 3.1.2: the stationary equilibrium of a small open economy that has idiosyncratic distortions and poorly-functioning domestic financial markets. We then consider an extension with a corporate sector (Section 3.3), and then another where a closed economy opens up to international capital flows (Section 3.4).

3.2.1 Elimination of Taxes and Idiosyncratic Subsidies

The economic reform occurs at $t = 0$. It is unexpected. Once it happens, everyone understands that it is a permanent change. In this exercise, the reform consists of only one component: the elimination of all taxes (τ, χ) and idiosyncratic subsidies (ς_i). The economy is already open to capital flows before the reform, and remains so afterwards. We assume that domestic financial frictions, controlled by ϕ, remain as before. We are thinking of financial frictions as arising from legal enforcement problems, which are a component of broader institutions and are hence slower-moving. The reform experiences of the six countries we study in Section 1 are consistent with this sequencing of reforms. Measured in both de jure and de facto sense, domestic financial market reforms lagged behind the removal of size-dependent or industry-specific taxes and subsidies, as well as capital account liberalization.[20]

We acknowledge that ours is a very stark exercise, and that it simplifies actual reform episodes, which tended to be more gradual. The advantage of our stark exercise is that the dynamics following the reform is wholly endogenous and intrinsic to the model, providing a theory of the joint dynamics of TFP and capital flows built on resource misallocation and local financial frictions.

The result of this reform exercise is shown in Figure 3. Solid lines represent the model simulations, and the dashed lines reproduce the average across the six countries in Figure 2. From year 0 on, as the reform is implemented, resources are reallocated more efficiently. Reallocation occurs along two margins. Firstly, capital and labor are reallocated among existing entrepreneurs (intensive margin). Those who lose subsidy downsize, and those who are now free from taxes (τ) ramp up their production. Secondly, more individuals with high productivity will enter into business now that taxes are gone, while previously-subsidized incompetent entrepreneurs will exit (extensive margin). The reallocation along these two margins occurs gradually over time (the horizontal axis is in years), slowed down by the

[20] Beim and Calomiris (2001) also document evidence of capital account liberalization preceding domestic financial market reforms in a broader set of developing economies.

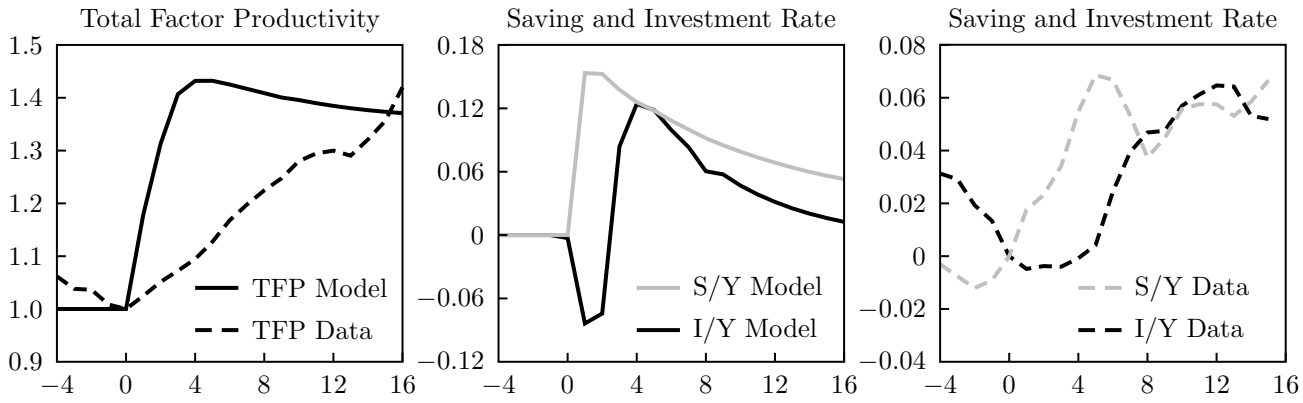

Fig. 3: Transition Dynamics: Removal of Idiosyncratic Distortions

frictions in the domestic financial market: It takes time for a talented-but-poor entrepreneur to save up and self-finance the capital needed for operating at a profit-maximizing scale. The increase in TFP reflects this reallocation (left panel). Over the first four years, TFP increases by about 10 percent per year.[21]

GDP per capita (not shown) also increases following the reform, largely mirroring the increase in TFP early on (first four years) and the accumulation of capital afterwards.

TFP and GDP in the model increase much faster than in the data initially, but slow down significantly after year 5. This should not come as a surprise, because of the way we model the reform: a sudden and drastic one-off event. Its real world counterparts are more gradual. We decided against modeling our reform as a more gradual process, so that we can illuminate and emphasize the endogenous dynamics in our model uncontaminated by any other exogenously-imposed driving force.

The center panel of Figure 3 shows the net investment (black solid line) and saving (gray solid line) rates in our model before and after the reform. Upon impact, investment rates drop, and then rise above the pre-reform level, only to fall gradually as the economy converges to the new steady state. Saving rates rise first and then slowly revert to the new steady state level. As a result, capital keeps flowing out of the country, while its TFP increases fast during the first five years after the reform.

Investment exhibits a rich dynamics. With the reform, the entrepreneurs who lose their subsidy will downsize and begin to exit, reducing the demand in the domestic capital rental market. However, their disinvestment is not immediately offset by productive individuals who were previously taxed out of entrepreneurial activities: They are not rich enough to overcome collateral constraints and to substantially scale up their production right away. They have to save up enough collateral first. This explains the initial drop in investment. In fact,

[21]The solid line from the model and the dashed line from the six-country data cross in year 15, which was one of the target moments in our construction of the initial state (Section 3.1.2).

during the first two years of the post-reform transition, the irreversibility on the aggregate domestic capital, condition (5), binds.[22] Investment would have fallen even further—and more capital would have flown out—without the irreversibility. Over time, productive individuals enter into entrepreneurship and increase their scales of operation, boosting domestic demand for capital and hence investment.

As for saving, two forces should be considered: permanent-income consumption/saving behavior and constrained entrepreneurs' self-financing. First, while low-productivity individuals (i.e., workers) face an income profile that rises over time as wages rise after the reform, as for the most productive and wealthiest entrepreneurs, their income is particularly and temporarily high right after the reform, precisely because factor prices—both wages and domestic rental rates—are temporarily low before they reach the new steady-state levels. Thus, productive and wealthy entrepreneurs take advantage of the opportunity (i.e., temporarily low factor prices) presented by the reform, and save a higher fraction of profits in a manner consistent with the permanent income theory. Second, productive entrepreneurs choose high saving rates, so that they can overcome the collateral constraints over time and self-finance their profitable business. However, self-financing alone cannot explain why saving grows faster than investment, because entrepreneurs do have access to external finance: In other words, they can invest more than they save, with the collateral constraints limiting the magnitude of this leverage. Self-financing, nevertheless, restricts the excess investment over saving for individual entrepreneurs. These saving behaviors of entrepreneurs explain the rise of aggregate saving rates in the early stages of the post-reform transition.

The patterns of aggregate saving and investment rates in the model are consistent with the data. In the right panel of Figure 3, we plot the average of the de-meaned saving (gray dashed line) and investment (black dashed line) rates across the six countries.[23] In these six countries, following the reform, saving rates go up immediately. Investment rates remain flat for the first five years, in spite of the sustained acceleration in TFP in the data (dashed line, left panel). Qualitatively, the model predictions are comparable to the data, although, unsurprisingly, the model transitions are faster because of the drastic nature of the reform in the model.

As discussed above, the aggregate dynamics of saving and investment rates is driven

[22]This implies that the domestic capital rental rate is lower than $r^* + \delta$ during this period. Reflecting this, immediately after the reform, the price of domestically-installed capital goes down by six percent. Subsequently, the price rises, until it reaches parity with capital held abroad in year 3. As a result, after the unexpected drop in the price of domestically-installed capital in year 0, individuals are again indifferent between holding capital domestically and abroad, as the low rental rate of domestically-installed capital is compensated by its appreciation.

[23]We first compute 25-year average saving and investment rates for each of the six countries, and de-mean each series using its own, country-specific mean. Then we average the series across the six countries.

by the capital and wealth accumulation of individuals with heterogeneous productivity and wealth, who are affected differently by the reform. To further illustrate this point, in the four panels of Figure 4, we show the evolution of the income-weighted average saving rates (gray line) and investment rates (black line) for four entrepreneurial productivity groups: bottom ninety percentiles, ninety-first to ninety-fifth percentiles, ninety-sixth to ninety-ninth percentiles, and top one percentile.

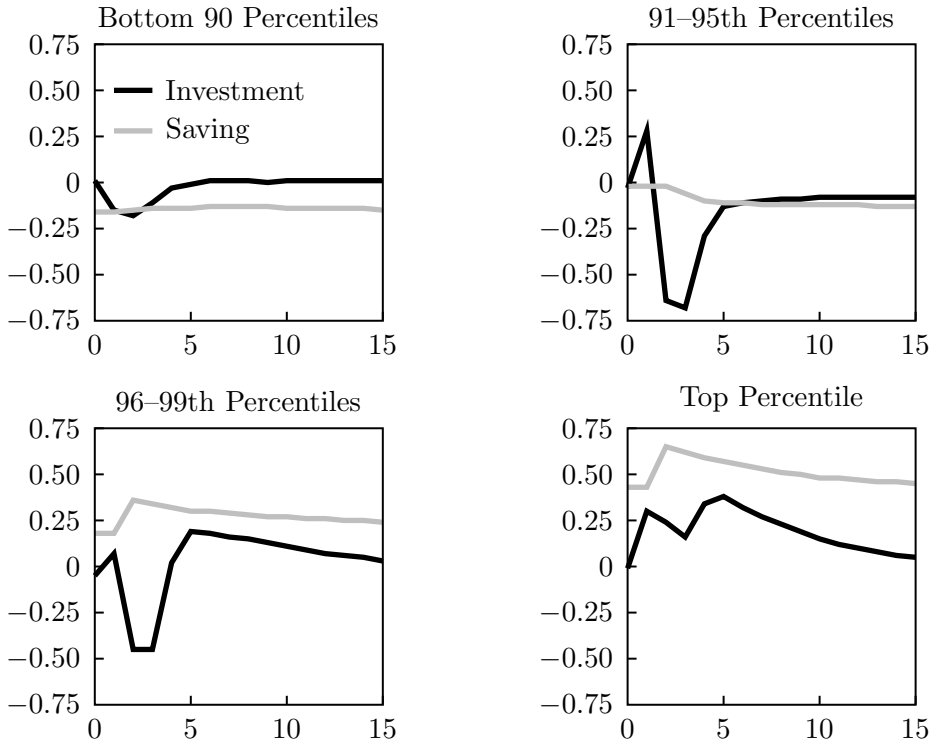

Fig. 4: Saving and Investment Rates by Entrepreneurial Productivity Percentiles

The aggregate dynamics of investment indeed reflects the disinvestment by the previously-subsidized incompetent entrepreneurs (black line, first three panels) and the more gradual investment by talented but poor entrepreneurs (black line, bottom right panel).[24] Since the bottom three ability groups account for a substantial fraction of the aggregate income especially in the first few years of the post-reform transition, and since some of the most productive individuals take time to accumulate collateral and enter into entrepreneurship, the disinvestment of the individuals who lose subsidy shapes aggregate investment rates. Only after the first four years, the income share of the most productive individuals becomes

[24]For all the ability groups, investment rates are non-monotonic over time because of transitional dynamics in factor prices and compositional effects within each group. For the top three groups, investment rates are particularly high in the year following the reform because of the temporary low factor prices. Investment rates then decline as factor prices rise. They then reverse their courses, as the income share of wealthier individuals with lower investment rates in those groups declines, with the advance of the relatively-poor, high-investment entrepreneurs through accumulation of collateral.

large enough that the aggregate investment rates more closely track their investment rates. [25]

The behavior of aggregate saving rates reflects the temporary high saving rates of the top two groups (gray line, bottom panels). In early stages of the post-reform transition, factor prices are lower than their new steady state levels, because financial constraints prevent productive entrepreneurs from immediately absorbing all the capital and labor being released by those who lose subsidy. The reallocation of resources takes time, but factor prices will eventually reach higher levels, reflecting the more efficient allocation of resources in the absence of idiosyncratic distortions. Temporary low factor prices imply temporary high profits for talented and wealthy entrepreneurs. They save a large fraction of their temporary high income, consistent with the permanent income theory. In addition, the talented but poor individuals have very high saving rates early on, because they try to overcome financial frictions through self-financing or accumulation of collateral. As these talented entrepreneurs become wealthier, their self-financing motive for saving weakens over time. Finally, there is also a compositional effect that contributes to the initial rise in saving rates. Once the subsidies and taxes are removed, the income share of the most productive individuals increases, as more of them now become entrepreneurs. Since the saving rates of the most productive individuals are the highest and the aggregate saving rates are an income-weighted average of all ability groups' saving rates, the increase in the income share of the top productivity group leads to a rise in aggregate saving rates.

In summary, our model generates a joint dynamics of TFP, saving, and investment, and explains why capital may flow out of countries with fast-growing TFP.

3.2.2 Tax/Subsidy Elimination and Domestic Financial Reform

The difference here is that the large-scale reform in year 0 has one additional component. On top of the removal of idiosyncratic distortions, we will also reform the domestic financial market, increasing its ϕ from 0.22 to 0.77. The choice of $\phi = 0.77$ corresponds to an external finance to GDP ratio of about 1.5 in the new steady state, a level that few, if any, developing countries attained before 2000.[26] In this sense, $\phi = 0.77$ represents a very well-functioning

[25] With the independence between subsidy and entrepreneurial productivity in the pre-reform steady state, most (99 percent, to be exact) of the subsidy recipients are in the bottom three groups. Initially, the bottom group alone accounts for over half of all active entrepreneurs in the economy. Without subsidy, the entrepreneurs in the bottom group slowly exit over the first ten years after the reform, and are replaced by those in the other three groups, most of whom enter into entrepreneurship within the first five years.

[26] Of the six countries whose post-reform transitions we use for the calibration of the initial state, only Korea reaches a similar level (1.45, after 17 years) when external finance is defined as private credit. If we include stock market capitalization in our measure of external finance, Chile reaches this level in 9 years after the reform, and Korea still in 17 years.

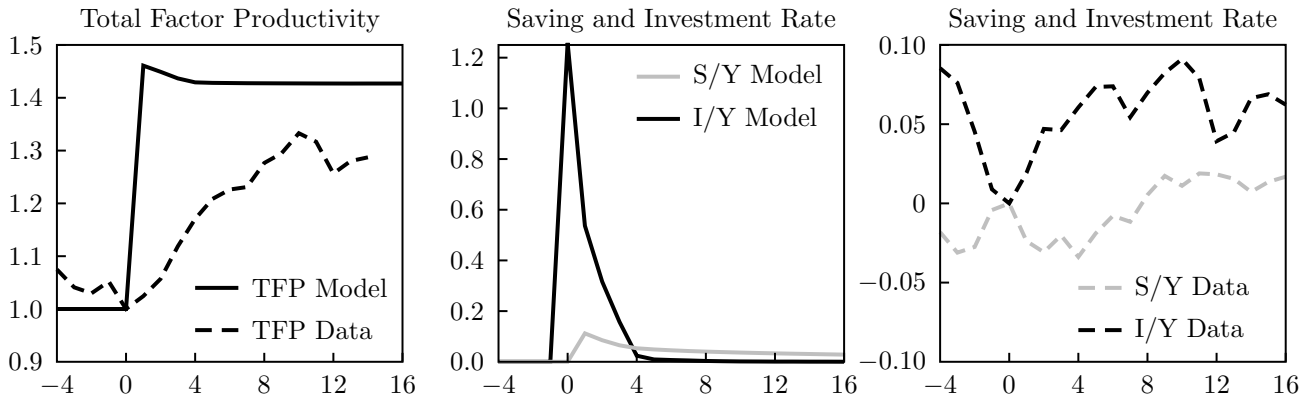

Fig. 5: Transition Dynamics: Distortion Removal and Domestic Financial Reform

financial market by the standard of developing countries.

The results are shown in Figure 5. The reform leads to more efficient reallocation of resources, as is reflected on the TFP series. The TFP increases faster and rises higher than in Section 3.2.1. The exercises in Sections 3.2.1 and 3.2.2 have the same initial condition, and Figures 3 and 5 have the same scale for TFP, facilitating visual comparison. TFP and hence GDP here increase for two reasons: the elimination of the distorting taxes and idiosyncratic subsidies and the improved local financial market. The latter expedites the reallocation of capital among heterogeneous producers, and facilitates the entry of talented but poor entrepreneurs. As a result, the post-reform transition is now much faster. In addition, the domestic financial market reform has its own permanent effect on the long-run level of TFP and GDP.[27]

However, it is the investment rate that is the most starkly different between the two exercises. With the reform, investment rates shoot up to a staggeringly high level, then crash down subsequently to the steady state level. In the first four years of the post-reform transition, investment rates far exceed saving rates, implying a massive *inflow* of capital into this fast-growing economy.

Entrepreneurs who lose their subsidy downsize and exit, just like in Section 3.2.1. However, as the collateral constraints are now a lot less stringent thanks to the local financial market reform (higher ϕ), productive individuals can enter into entrepreneurship and start production immediately at a scale much larger than in Section 3.2.1, even if they do not have much collateral. Their entry and expansion more than offset the disinvestment by incumbent entrepreneurs who lose subsidy, and capital flows in from overseas to meet the excess

[27]Even in the stationary equilibrium, resources need to be reallocated from previously-productive entrepreneurs who are hit by the ability shock and lose their high ability to newly-productive entrepreneurs. Financial frictions slow down this reallocation, and have adverse effects on the long-run output and the measured TFP of the economy.

demand immediately after the reform.

On the saving side, the effect is qualitatively similar to that in Section 3.2.1. The difference is that the transition to the new steady state is much quicker with the domestic financial reform, which implies less of the temporary high profit for talented and wealthy entrepreneurs. In turn, there is less room for the permanent income consumption/saving behavior to produce a temporary hike in saving rates. In addition, with the higher ϕ, entrepreneurs now have weaker self-financing motives given the more generous access to external financing. As a result, saving rates do not increase as much as in Section 3.2.1.

In summary, investment jumps up initially, in contrast to Section 3.2.1, while saving does not increase by as much, with the result that capital flows into the country during the post-reform transition.[28]

Empirically, the experiences of Estonia, Portugal, and Thailand can be interpreted as a version of this exercise. Estonia underwent an economy-wide reform in 1992, scrapping industrial policies and improving the domestic banking sector (Roland, 2000). In particular, major Swedish banks set up subsidiaries in Estonia and since accounted for most of domestic financial intermediation. Castro and Clementi (2009) also document the large-scale reform in Portugal as it joined the European Union in 1986. In addition to reducing idiosyncratic taxes and subsidies, Portugal rewrote its century-old commercial code to enhance investor protection in its financial markets. To some degree, the Thai reform of 1986 also addressed the domestic financial markets (Townsend, 2010). In particular, the fraction of bank loans coercively channeled to the government was sharply reduced.

We take the average of TFP, saving rates, and investment rates for these three countries before and after their respective reforms. The dashed line in the left panel of Figure 5 shows the TFP increase in these countries. The right panel shows the saving and investment rates. Following the reforms in these countries, investment rates rise strongly but saving rates stagnate, resulting in capital inflows. The joint dynamics of TFP and capital flows following the joint reforms that reduce idiosyncratic distortions and improve local financial markets in these three countries looks qualitatively similar to our model predictions.

[28]It is informative to compare this exercise with the standard neoclassical growth model. In our setup, an economy with perfect local credit markets ($\phi = 1$) is isomorphic to the standard neoclassical model. If the productivity of the aggregate production function is raised in a neoclassical model, capital will flow into the small open economy and instantaneously equalize the return to capital with the world level. Although our domestic financial market reform does not take our economy all the way to the perfect-credit benchmark, we obtain results that are similar.

3.3 Extension: Corporate Sector

In this section, we consider an extension of our model that incorporates a corporate sector, in addition to the entrepreneurial production sector. This extension addresses the observations, made even on economies with underdeveloped financial markets, that there are entities who have much easier access to uncollateralized external financing, and that a firm's saving decisions may be independent of consumption-smoothing considerations, unlike an entrepreneur's saving decisions.

We adds on a corporate sector into our model of entrepreneurship. The corporate sector is modeled as a competitive representative firm with constant-returns-to-scale production technology using capital (K) and labor (L): $Z_c K^{\alpha_c} L^{1-\alpha_c}$. The firm vies for capital and labor in the factor markets alongside entrepreneurs, taking factor prices as given. However, there is no fixed factor (e.g., entrepreneurial talent) in the corporate production function. More important, this representative firm faces no financial constraint.

We need to pin down Z_c and α_c. We assume that $\alpha_c = \alpha/(\alpha + \theta) = 0.33$. We make the following assumption on Z_c. We note that the production side of our model of entrepreneurship without a corporate sector can be aggregated with perfect credit markets ($\phi = 1$). We compute the TFP term of this aggregated production function, which is a function of the right tail of the entrepreneurial productivity distribution $\Omega(z)$, and use this value for Z_c. This Z_c falls in the ninety-fifth percentile of the z distribution. Although the assigned value of Z_c is derived from $\Omega(z)$, we again note that no entrepreneur is working in our frictionless corporate sector.

Finally, the scale of our corporate sector needs to be somehow pinned down. For this purpose, we use data on the ratio of stock market capitalization to GDP, using stock market capitalization as a measure of the capital stock of the corporate sector. We take the average of these series for the six countries, which starts around 0.1 on the eve of the reforms to 0.7 by the fifteenth year after the reform.

We now repeat the same reform exercise as in Section 3.2.1, with the scale of the corporate sector pinned down by the exogenous time-series of stock market capitalization to GDP, averaged across the six countries. We use the same initial state as before, constructed in Section 3.1.2. In other words, we assume that there is no corporate sector in the pre-reform period, which obviates the discussion on how taxes and subsidies affected the corporate sector relative to the entrepreneurial sector. This is not quantitatively important, as the corporate sector used a very small fraction of the total capital stock by our measure: 0.1 divided by the capital-to-output ratio of 1.67.

The macroeconomic transition following the elimination of taxes and idiosyncratic subsidies, with the scale of the corporate sector taken into account for the post-reform periods,

is shown in Figure 6. As in Section 3.2.1, the frictions in local financial markets for entrepreneurs, measured by ϕ, are held constant through the transition. Again, the corporate sector faces no such constraint.

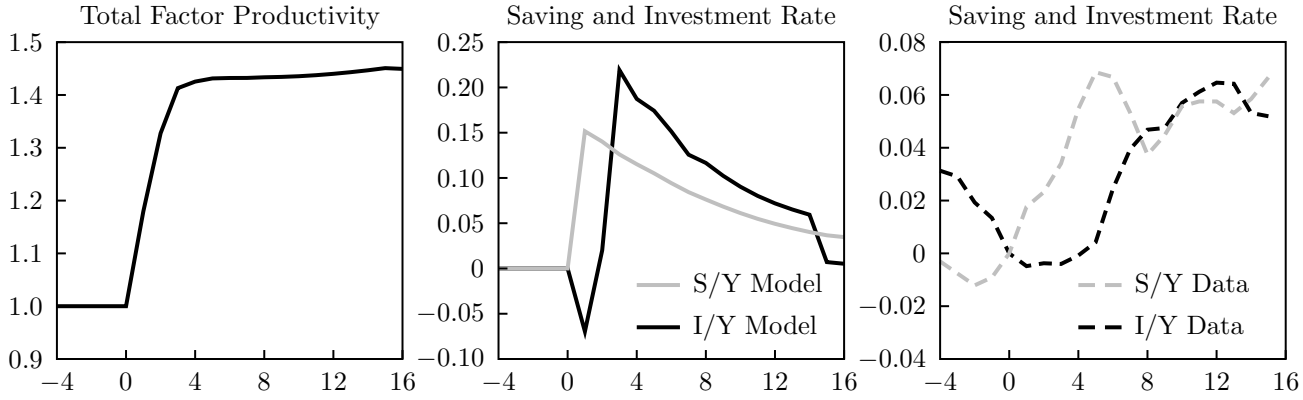

Fig. 6: Transition Dynamics with Corporate Sector: Removal of Idiosyncratic Distortions

In essence, this exercise falls somewhere between the exercises of Sections 3.2.1 and 3.2.2. While the collateral constraint for entrepreneurs does not change with the reform, the economy as a whole now has more external financing with the rise of the financially-unconstrained corporate sector. The corporate sector grows at an exogenously-given gradual pace, in contrast to the sudden and drastic improvement in local financial markets of Section 3.2.2. It is thus not surprising that the model transition is a convex combination of the transitions shown in Figures 3 and 5.

TFP (left panel) increases faster than in Figure 3, but more slowly than in Figure 5. Investment rates (center panel) are higher than in Figure 3, but far lower than in Figure 5.

One qualitative difference in this exercise is that, after the reform, resources are not only reallocated among entrepreneurs, but also from the entrepreneurial production sector to the corporate sector, whose scale is chosen to match the average pattern of stock market capitalization relative to GDP in the data. The productivity of the corporate sector, Z_c, is higher than the marginal entrepreneurs' productivity, but lower than the most talent ones', as it corresponds to the ninety-fifth percentile of the entrepreneurial productivity distribution.

Nevertheless, the driving forces behind TFP, investment, and saving are qualitatively the same as those explained in Section 3.2.1. As can be seen in Figure 6, the direction of capital flows immediately after the reform is as in Section 3.2.1. Following the reform, as TFP goes up fast, capital flows out of the country, as investment falls initially and rebounds with a lag, while saving increases from the beginning. Although the corporate sector is financially unconstrained, its scale is small early in the post-reform transitions, consistent with the data. This is why the disinvestment of the entrepreneurs who lose subsidy is still the dominant force behind the aggregate investment rates. However, we observe that investment eventually

overtakes saving, which did not happen in Section 3.2.1. In the right panel, we reproduce the average saving and investment rates of the six countries from Figure 3. We again find the model prediction consistent with the data on the joint dynamics of TFP, saving, investment, and hence capital flows, even when a frictionless corporate sector is incorporated.

3.4 Capital Account Liberalization

In all our exercises above, we start out with an already open economy and consider the impact of economic reforms that remove distortions within the economy. We finalize our quantitative analysis by exploring an alternative sequencing of reforms: an economic reform that eliminates idiosyncratic distortions and liberalizes capital flows in an initially closed economy. This exercise captures the fact that, in many of the reform episodes motivating our study, the liberalization of capital accounts is an important part of the reform package, as discussed in the appendix.

This exercise also allows us to address an important welfare question in international economics. While economists readily agree on the merits of removing idiosyncratic distortions and reforming domestic financial institutions, there seems to be less certainty regarding the benefits of opening up to international capital flows. Our framework can be used to assess the welfare gains from capital account liberalization.[29]

In our main analysis of Sections 3.2 and 3.3, the initial state of the economy is constructed, in Section 3.1.2, as the stationary equilibrium of a small *open* economy that has idiosyncratic distortions and poorly-functioning domestic financial markets. To consider capital account liberalization, we now need to construct a different initial state, which is a stationary equilibrium of a *closed* economy that has idiosyncratic distortions and financial frictions. This equilibrium is defined in Section 2. We recalibrate the tax/subsidy parameters to match the same four moment conditions as in Section 3.1.2. We obtain $\lambda = 0.055$, $\bar{\varsigma} = 1.0$, $\tau = 0.575$, and $\chi = 0.0825$.

Here we focus on the interaction of capital account liberalization with other reforms. This is a very relevant question, since capital account liberalization of developing countries is typically accompanied by other reforms that remove distortions within these economies. We compute the marginal welfare gains from capital account liberalization by comparing the economic outcomes of removing idiosyncratic distortions while opening up with those of

[29] In most studies in the literature, capital account liberalization is found to improve welfare, but the welfare gains are rather small. See Gourinchas and Jeanne (2006) and the references therein. Unlike most work in the literature that assumes a small economy populated by a representative agent, our model has heterogeneous individuals within an economy and can address differential effects of capital flows on them. Aoki et al. (2007, 2009) and Mendoza et al. (2009) also provide welfare analyses with heterogeneous-agent models.

removing idiosyncratic distortions while remaining closed to capital flows. In either case, we assume that domestic financial markets are not affected by the reforms.

If the country opens up to capital flows, we assume that it becomes a small open economy, taking the world interest rate $r^* = 0.04$ as given. As is the case with many models of financial frictions, in our closed economy with collateral constraints, the equilibrium interest rate is lower than the world interest rate determined by countries with advanced financial markets. This is because the collateral constraint restricts demand for capital, and also because more capital is supplied to the rental market, other things being equal, driven by entrepreneurs' strong self-financing motives and correspondingly high saving rates: As a result, a lower interest rate is necessary to clear the capital market with financial frictions than without. Hence, opening up implies not only the movement of goods and capital in and out of the economy, but also an instantaneous upward convergence of the interest rate. To the contrary, the equilibrium wage is higher in the closed economy than in the open economy. This is because the interest rate differential implies that capital will flow out of countries with domestic financial market frictions once capital accounts are opened up: Other things being equal, there is less capital per worker for domestic production in the open economy transition, and the wage is lower than in the closed-economy transition.

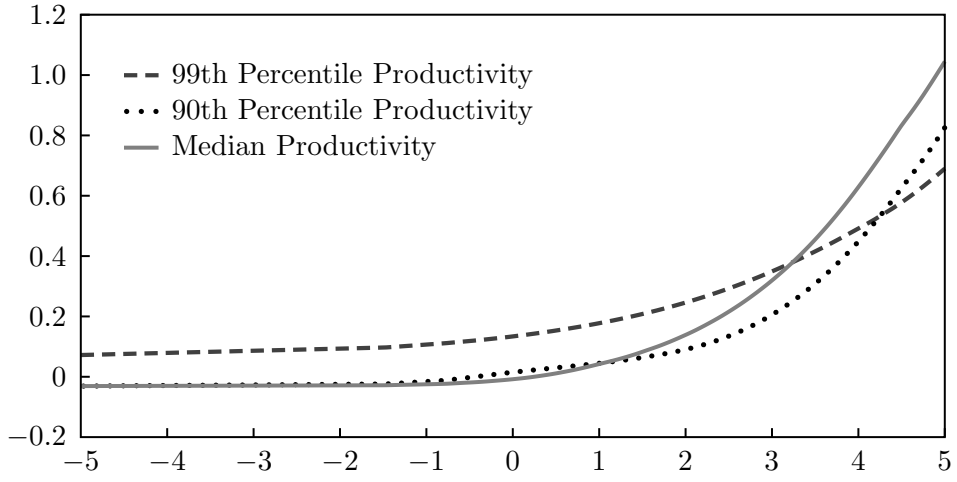

Fig. 7: Welfare Gains from Capital Account Liberalization

In Figure 7, we report the welfare differences between the two reform scenarios, correctly accounting for the transition phase. The horizontal axis is the log of an individual's wealth relative to the mean on the eve of the reform. Each curve corresponds to an entrepreneurial productivity level, also immediately before the reform. For example, the dashed line is for those individuals who are more talented than all but one percent of the population.

The vertical axis is the welfare difference in units of permanent consumption. A positive number means that this particular type of individual—where type is defined as one's wealth and entrepreneurial productivity at the time of the reform—is better off if the removal of idiosyncratic distortions is accompanied by the opening up of capital accounts. Similarly, a negative number means that the individual is better off if the removal of idiosyncratic distortions is implemented in a closed-economy environment.

We find that not everyone benefits from the concurrent capital account liberalization. The wealthy directly benefit from capital account liberalization, which instantaneously give them a higher return—the world interest rate—on their financial wealth. High-ability individuals, who will eventually choose to be entrepreneurs and will likely become wealthy, are also better off with the open-economy reform. Even the talented-but-poor individuals, because they get rich over time, benefit from the higher interest rate: The left tail of the dashed line lies above zero. On the other hand, lower-ability individuals, who will choose to be workers, are better off with the closed-economy reform, unless they start out very wealthy (solid line). This is because of the lower wage in the open economy.

To sum up, the very wealthy and entrepreneurs are but a small fraction of the population, and the vast majority would prefer the elimination of idiosyncratic distortions with capital account controls firmly in place.

4 Concluding Remarks

Our quantitative framework shows that, following a reform that eliminates idiosyncratic distortions in a small open economy with local financial frictions, there will be a rise in TFP accompanied by capital outflows. The rising TFP reflects the efficient reallocation of capital and entrepreneurial talent, a process drawn out by frictions in local capital markets. Capital outflows are caused by the rise in domestic saving—driven by entrepreneurs' permanent-income saving behavior and self-financing motive—and by the initial drop and sluggish rebound of domestic investment. The latter is also a consequence of local financial frictions. From our analysis in Sections 3.2.1 and 3.2.2, we conclude that one needs to first evaluate the workings of local financial institutions when projecting the effects of economy-wide reforms that reduce idiosyncratic distortions.

While our model successfully explains the joint dynamics of TFP and capital flows during the most prominent growth acceleration episodes, the magnitude of capital outflows predicted by the model is too large relative to the data. From this angle, now the puzzle is why capital does not flow out faster from economies with underdeveloped domestic financial markets. This can be easily addressed by modeling the reforms as a more gradual and less drastic

process, and/or by incorporating the development of domestic financial markets over time. These features would clearly be a more realistic description of the actual developing country experiences, and can be easily incorporated into our framework, as demonstrated in Section 3.3.

Also, our analysis does not distinguish capital flows by type, e.g., debt contracts vs. foreign direct investment. In recent years, we have observed developing countries accumulating debt claims on foreigners while receiving foreign direct investment (Lane and Milesi-Ferretti, 2007). We conjecture that an extension of our model that allows for the joint mobility of capital and entrepreneurial talent can explain such a pattern. As in the current paper, we would observe capital in the form of debt contracts flow out of economies with underdeveloped local financial markets. At the same time, there will be wealthy foreign entrepreneurs who can bring in their own capital or collateral into developing countries to take advantage of their lower factor prices. This extension will also enable us to study the migration of talented-but-undercapitalized entrepreneurs into countries with more developed local financial markets, a phenomenon resembling what is often referred to as "brain drain."

Appendix: Notes on Economic Reforms

In Figure 8, we re-visit the six countries' time-series of TFP, saving rates, and investment rates from Figure 2, but plot them country by country.

We then briefly describe the six large reform episodes that took place during the 1980s and the 1990s. We emphasize the three dimensions of reforms that are relevant to our model: reduction of idiosyncratic distortions, capital account liberalization, and domestic financial market reform.

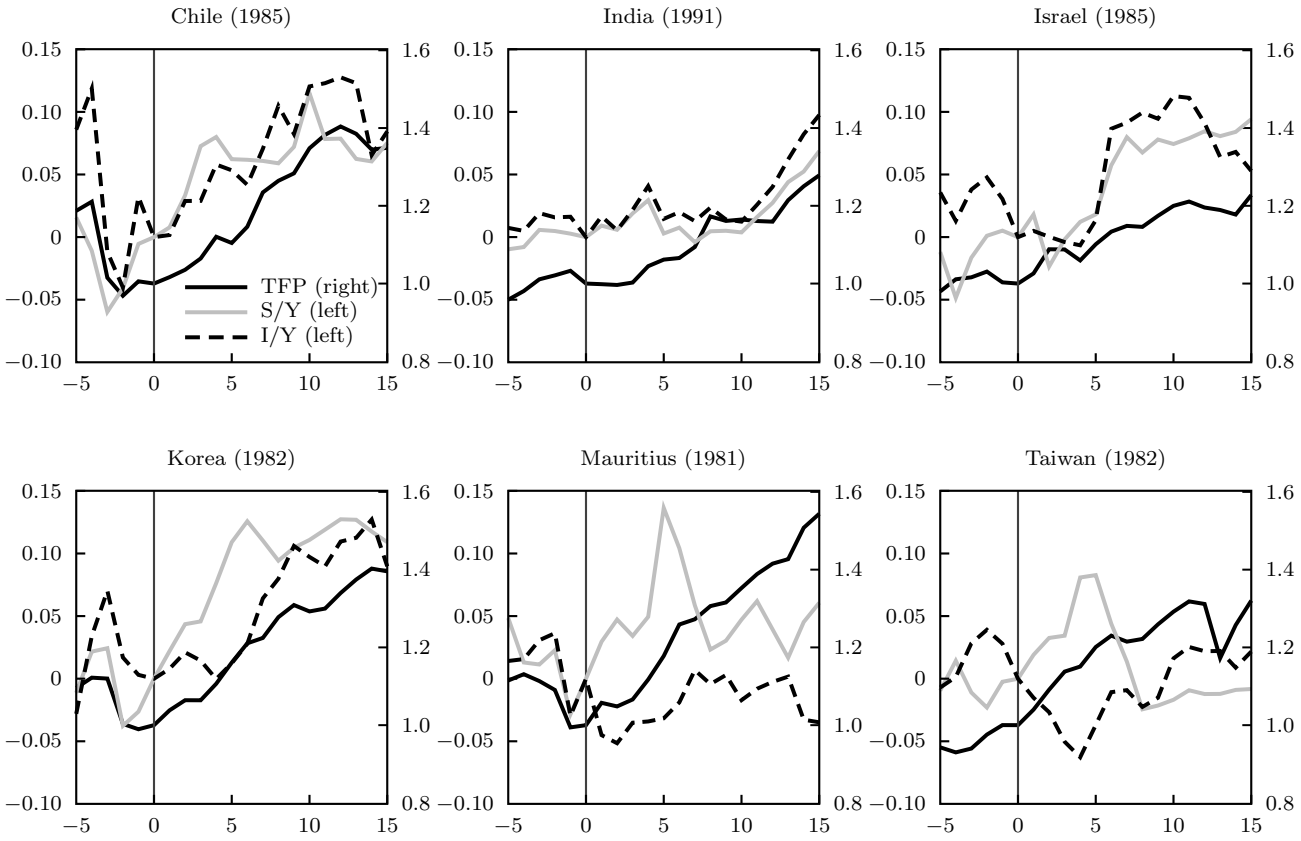

Fig. 8: TFP, Saving Rates, and Investment Rates. Year 0 on the horizontal axis is the year of reform implementation, which is shown in parentheses next to the country name. Saving and investment rates are point deviations from their respective year-0 levels, and should be read off the left axis. TFP is normalized to one in year 0, and should be read off the right axis.

Chile, 1985 Following the debt and banking crisis of the early 1980s, in 1985 the Chilean government started a round of reforms (Bosworth et al., 1994). These included the privatization of state-owned enterprises and firms taken over during the 1982 financial collapse, and the reversal of protective measures imposed during the crisis. This wave of reforms not only

reinforced the broad movement toward a more market-oriented allocation of resources that had started in the mid 1970s, but also remedied some shortcomings of the earlier reforms—e.g., the earlier process of privatization allowed the formation of business conglomerates through the sale of state-owned assets, which were purchased with financing provided by the state with funds obtained by abusing the implicit bank deposit insurance. The reforms of 1985 proved to be longer-lasting. We interpreted these series of reforms as more credible efforts at removing/reducing idiosyncratic distortions in the context of our model.

Controls on capital outflows that had been imposed in 1982 were removed in 1985, although restrictions on short-term capital inflows remained.

At the time of the 1985 reform, the domestic financial markets were still reeling from the financial crisis of 1982. While the financial system developed significantly in the following decade, financial intermediation remained relatively limited through the mid 1990s.

India, 1991 Following a balance of payment crisis, in 1991 India embarked on a broad set of reforms (Kochhar et al., 2006). These reforms included the abolition of industrial licensing and the narrowing of the scope of public sector monopolies to a much smaller number of industries; trade liberalization which included elimination of import licensing and progressive reduction of non-tariff barriers; the liberalization of investment in important services, such as telecommunications; and limited financial sector reforms.

Deregulation of capital flows began in 1991, with the liberalization of inward foreign direct and portfolio investment. Exchange rates were unified in 1993, and current account convertibility was achieved by 1994.

Gradual domestic financial sector reforms started in the mid 1990s, including the removal of controls on capital issues, and freer entry for domestic and foreign private banks. However, credit control remained throughout the 1990s.

Israel, 1985 In 1985 a successful stabilization plan was put into place. As a consequence of budget adjustments and subsequent reforms, the principal markets (capital, foreign exchange, and labor) underwent important changes (Ben-Bassat, 2002). Government interventions in production factor markets and in finances were significantly reduced. The share of government expenditure in the GDP declined by 20 percentage points in the first ten years of the reform. More important, the composition of the budget changed from an emphasis on subsidies to "priority" industries and regions, into broader investment in infrastructure. Earlier protectionist tendencies were slowly reverted. In 1985 a free-trade agreement with the US was signed, and by 1990 all non-tariff barriers on imports from "third countries" were abolished and replaced with uniform tariffs. In 1992 a process of lowering these tariffs

started.

Controls on capital flows that had been imposed in 1970 began to be reversed in 1987, and the liberalization was more or less completed by 1998. The remaining restrictions pertain to overseas investment by institutional investors and forward transactions.

Distortions to domestic financial markets remained significant until the mid 1990s. Directed credit, regulated interest rate, public ownership of major banks lasted until the mid 1990s.

Korea, 1982 In the second half of the 1970s, the Korean government embarked on a large-scale program subsidizing heavy and chemical industries. This was a form of import substitution, and the beneficiaries were steel, petrochemical, nonferrous metals, shipbuilding, electronics, and machinery industries. This experiment ceased and began to be reversed in 1981 (Leipziger, 1997). The failed industrial policy led the government to delegate the role of investment planning to the private sector. Entry of small and medium-sized firms was deregulated from the early 1980s. The sector/industry-specific taxes were replaced by flat-rate value-added taxes in the late 1970s.

Controls on capital flows were eased first in 1979 (inward), then in 1982 (inward), and then again in 1985 (inward and outward).

Rampant distortions of the financial markets remained until the mid 1990s. Directed lending and regulated interest rates—often thought of as the legacy or the "scar" from the industrial policies of the 1970s—were phased out beginning in 1995 to join the OECD, and in 1998 to meet the IMF conditionality in the aftermath of the East Asian financial crisis.

Mauritius, 1981 Starting with the negotiation of a structural adjustment loan with the World Bank in 1980, a process of reform began that progressively removed various distortions (Gulhati and Nallari, 1990; Dabee and Greenaway, 2001). The theme of the reforms was to move away from a focus on import substitution, which accounted for 80 per cent of manufacturing investment during 1978–81. These reforms included the elimination of price controls, quantity restrictions on imports, and export taxes on sugar. Also included was a gradual reduction of tariffs. As part of these reforms, the government eliminated the differential tax treatment for companies under various special regimes, e.g., export promotion zones and import substitution regimes. Especially in the sugar industry (a major player well into the 1980s), most size-dependent policies were abandoned, leading to consolidations and productivity gains.

Capital account liberalization began in 1981, although it was a gradual process. Exchange rates were unpegged and managed-floated since 1983.

Domestic financial market reforms began towards the end of the 1980s, with interest rate liberalization in 1988. However, pricing and allocation of funds were heavily influenced by the central bank well into the late 1990s. The government's share of domestic commercial bank credit remained at 30–35 per cent until the late 1980s, and then dropped to 25 per cent by the mid 1990s.

Taiwan, 1982 Much like Korea during the mid 1970s, Taiwan's response to the first oil shock in 1974 was to increase the government's involvement in the economy. The government increased spending on infrastructure (railways, roads, and airports) and implemented policies to replace imported intermediate capital goods with domestically-produced materials. The beneficiaries of such import-substitution policies were petrochemical, machinery, and steel industries. At the same time, trade barriers went up, reversing the decades-long trend of trade liberalization. With their eighth four-year plan (1982–86), the emphasis of the economic policy fell again on liberalization and internationalization, removing many of the industrial policies of the late 1970s (Leipziger, 1997).

Foreign exchange rate and capital account liberalizations took place during the mid 1980s.

Throughout the second half of the twentieth century, domestic financial markets served as instruments for the government's industrial policy. Domestic financial market liberalization started in 1989, with controls on bank loan/deposit rates abolished. New entries into the banking sector were not allowed until 1992–95. Financial markets were still tightly regulated even in the late 1990s, although privatization of some financial institutions and more liberalization began in 1994–95.

References

Aoki, K., G. Benigno, and N. Kiyotaki (2007): "Capital Flows and Asset Prices," Manuscript, London School of Economics.

——— (2009): "Adjusting to Capital Account Liberalisation," Manuscript, London School of Economics.

Bartelsman, E. J., J. Haltiwanger, and S. Scarpetta (2009): "Cross Country Differences in Productivity: The Role of Allocation and Selection," Working Paper 15490, National Bureau of Economic Research.

Beim, D. O. and C. W. Calomiris (2001): *Emerging Financial Markets*, New York: McGraw-Hill.

Ben-Bassat, A. (2002): *The Israeli Economy, 1985-1998: From Government Intervention to Market Economics*, Cambridge, MA: MIT Press.

Bosworth, B. P., R. Dornbusch, and R. Labán (1994): *The Chilean Economy: Policy Lessons and Challenges*, Washington, DC: The Brookings Institution.

Boyd, J. H. and B. D. Smith (1997): "Capital Market Imperfections, International Credit Markets, and Nonconvergence," *Journal of Economic Theory*, 73, 335–364.

Bridgman, B., S. Qi, and J. James A. Schmitz (2009): "The Economic Performance of Cartels: Evidence from the New Deal U.S. Sugar Manufacturing Cartel, 1934–74," Staff Report 437, Federal Reserve Bank of Minneapolis.

Buera, F. J., J. P. Kaboski, and Y. Shin (2011a): "Finance and Development: A Tale of Two Sectors," *American Economic Review*, 101, 1964–2002.

Buera, F. J., B. Moll, and Y. Shin (2011b): "Well-Intended Policies," Manuscript.

Caballero, R. J., E. Farhi, and P.-O. Gourinchas (2008): "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates," *American Economic Review*, 98, 358–393.

Camdessus, M. (1999): *Second Generation Reforms: Reflections and New Challenges*, available at http://www.imf.org/external/np/speeches/1999/110899.HTM.

Carroll, C. D., J. Overland, and D. N. Weil (2000): "Saving and Growth with Habit Formation," *American Economic Review*, 90, 341–355.

Caselli, F. and J. Feyrer (2007): "The Marginal Product of Capital," *Quarterly Journal of Economics*, 122, 535–568.

Castro, R. and G. L. Clementi (2009): "The Economic Effects of Improving Investor Rights in Portugal," *Portuguese Economic Journal*, 8, 59–97.

Castro, R., G. L. Clementi, and G. MacDonald (2004): "Investor Protection, Optimal Incentives, and Economic Growth," *Quarterly Journal of Economics*, 119, 1131–1175.

Coate, S. and S. Morris (1999): "Policy Persistence," *American Economic Review*, 89, 1327–1336.

Dabee, R. and D. Greenaway (2001): *The Mauritian Economy*, New York: Palgrave.

Feldstein, M. (1999): "A Self-Help Guide for Emerging Markets," *Foreign Affairs*, 78, 93–109.

Fernandez, R. and D. Rodrik (1991): "Resistance to Reform: Status Quo Bias in the Presence of Individual-Specific Uncertainty," *American Economic Review*, 81, 1146–55.

Gertler, M. and K. Rogoff (1990): "North-South Lending and Endogenous Domestic Capital Market Inefficiencies," *Journal of Monetary Economics*, 26, 245–266.

Gourinchas, P.-O. and O. Jeanne (2006): "The Elusive Gains from International Financial Integration," *Review of Economic Studies*, 73, 715–741.

——— (2007): "Capital Flows to Developing Countries: The Allocation Puzzle," Working Paper 13602, National Bureau of Economic Research.

Gulhati, R. and R. Nallari (1990): *Successful Stabilization and Recovery in Mauritius*, Washington, DC: World Bank.

Guner, N., G. Ventura, and Y. Xu (2008): "Macroeconomic Implications of Size-Dependent Policies," *Review of Economic Dynamics*, 11, 721–744.

Hausmann, R., L. Pritchett, and D. Rodrik (2005): "Growth Accelerations," *Journal of Economic Growth*, 10, 303–329.

Hopenhayn, H. A. and R. Rogerson (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *Journal of Political Economy*, 101, 915–938.

Hsieh, C.-T. and P. Klenow (2009): "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 124, 1403–1448.

Kaminsky, G. L. and S. L. Schmukler (2008): "Short-Run Pain, Long-Run Gain: Financial Liberalization and Stock Market Cycles," *Review of Finance*, 12, 253–292.

Kochhar, K., U. Kumar, R. Rajan, A. Subramanian, and I. Tokatlidis (2006): "India's Pattern of Development: What Happened, What Follows?" *Journal of Monetary Economics*, 53, 981–1019.

Krueger, A. (1993): *Political Economy of Policy Reform in Developing Countries*, Cambridge, MA: MIT Press.

Lane, P. R. and G. M. Milesi-Ferretti (2007): "External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," *Journal of International Economics*, 73, 223–250.

Leipziger, D. M. (1997): *Lessons from East Asia*, Ann Arbor, MI: University of Michigan Press.

Lucas, Jr., R. E. (1990): "Why Doesn't Capital Flow from Rich to Poor Countries?" *American Economic Review*, 80, 92–96.

Matsuyama, K. (2005): "Credit Market Imperfections and Patterns of International Trade and Capital Flows," *Journal of the European Economic Association*, 3, 714–723.

Mendoza, E. G., V. Quadrini, and J.-V. Ríos-Rull (2009): "Financial Integration, Financial Deepness and Global Imbalances," *Journal of Political Economy*, 117, 371–416.

Mishkin, F. S. (2003): "Financial Policies and the Prevention of Financial Crises in Emerging Market Countries," in *Economic and Financial Crises in Emerging Market Countries*, ed. by M. Feldstein, Chicago: University of Chicago Press, 90–130.

Obstfeld, M. (2008): "International Finance and Growth in Developing Countries: What Have We Learned," Working Paper 34, Commission on Growth and Development.

Prasad, E. S., R. G. Rajan, and A. Subramanian (2007): "Foreign Capital and Economic Growth," *Brookings Papers on Economic Activity*, 38, 153–230.

Restuccia, D. and R. Rogerson (2008): "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics*, 11, 707–720.

Roland, G. (2000): *Transition and Economics: Politics, Markets, and Firms*, Cambridge: MIT Press.

Sandri, D. (2009): "Growth and Capital Flows with Risky Entrepreneurship," Manuscript, International Monetary Fund.

Song, Z., K. Storesletten, and F. Zilibotti (2011): "Growing like China," *American Economic Review*, 101, 196–233.

Sowell, T. (1990): *Preferential Policies: An International Perspective*, New York: William Morrow.

Stulz, R. M. (2005): "The Limits of Financial Globalization," *Journal of Finance*, 60, 1595–1638.

Townsend, R. M. (2010): *Financial Systems in Developing Economies: Growth, Inequality and Policy Evaluation in Thailand*, Oxford: Oxford University Press.