

Financial Frictions and the Persistence of History: A Quantitative Exploration

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Abstract

This paper presents a quantitative model of economic transitions. We explicitly model resource misallocation and financial frictions to explain observed transitional dynamics that are not consistent with the standard neoclassical growth theory. When calibrated to empirical evidence on resource misallocation and financial frictions in less developed countries, our model economy converges slowly to the steady state—it typically takes four times as long to cover half the distance to the steady state as the neoclassical benchmark. The interest rate and investment-to-output ratio start low and rise over time in the early phases of economic development. In addition, the model generates an endogenous TFP dynamics, reflecting the gradual unwinding of misallocation along transitions.

Keywords: Financial frictions; Development dynamics

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Recent quantitative research has deepened our understanding of cross-country differences in economic development. Output-per-worker differences across countries have been mainly attributed to the low total factor productivity (TFP) in less developed countries (Hall and Jones, 1999; Klenow and Rodríguez-Clare, 1997). It has recently been recognized that misallocation of resources across production units is an important source of the low TFP in less developed countries (Hsieh and Klenow, 2007). Furthermore, reallocation of resources over time explains a significant part of the observed TFP dynamics (Hsieh and Klenow, 2007; Young, 1995).

There, however, are few quantitatively-oriented models of such resource reallocation processes. In this paper, we explicitly model resource misallocation and financial frictions to quantitatively evaluate their impact on the dynamics of economic development.

Our model can explain a set of development facts that the standard neoclassical growth theory can not. The neoclassical growth model predicts swift convergence to the steady state, staggeringly high real interest rates in the early stages of development, and decreasing investment-to-output ratios over time. However, most economies' growth experiences defy all three predictions. After going through an exhaustive list of modified neoclassical growth models, King and Rebelo (1993) conclude that neoclassical transition dynamics can only play a minor role in explaining observed growth experiences.

Our main result shows that financial frictions and capital misallocation are keys to understanding the observed economic transitions. With misallocation of initial resources, an economy produces and invests less than it would otherwise. Over time, this misallocation is unwound and the economy becomes more productive. Financial frictions delay such efficient reallocation, and prolong the impact of initial conditions. One consequence is that the economy converges to the steady state at a slow pace. With empirically-plausible financial frictions and misallocation of the initial resources, our model economy typically takes four times as long to cover half the distance to the steady state as the perfect-credit (or neoclassical) benchmark. The behavior of the interest rate and investment-to-output ratio along the delayed transition is also consistent with the growth dynamics in the data. Our model generates rich dynamics for these variables, determined by the degree of financial frictions and initial misallocation. Typically, both the real interest rate and the investment rate rise over time in the early stages of economic growth.

In addition, our model generates endogenous dynamics for TFP. Unlike in the standard growth model, our economy's aggregate output is a function of the entire joint distribution of wealth and entrepreneurial ability, beyond the aggregate capital stock. An economy with more misallocation of wealth to entrepreneurial ability will have a lower aggregate output than another with the same aggregate capital but a better allocation of wealth to ability. As the initial misallocation is unwound over time, the endogenous dynamics of the ability-wealth distribution in the model is reflected on the imputed TFP series. With initial misallocation and financial frictions consistent with data from less developed countries, the model generates TFP growth of four percent per year during the first 10 years of the transition.

Given the importance of the misallocation of initial resources in understanding transition dy-

namics, we construct our initial (pre-transition) condition in a way that reflects the reality in less developed economies. In particular, we use our model to structurally interpret empirical evidence of Hsieh and Klenow (2007) on resource misallocation across production units in China, India and the US. Through this procedure, we not only obtain an empirically relevant initial condition for transitions, but can also quantify the direct contribution of financial frictions to resource misallocation. We find that financial frictions alone are directly responsible for between a quarter and a half of the total misallocation in less developed countries.

Quantitative Framework. We incorporate entrepreneurship and financial frictions into an otherwise-standard neoclassical model. In our model, individuals choose whether to operate an individual-specific technology—become entrepreneurs—or to supply labor for a wage in each period. This occupation choice allows for endogenous entry and exit in and out of the production sector, which are an important channel of resource reallocation over time. Individuals differ in their productivity as an entrepreneur and in their wealth, with the latter being endogenously determined by forward-looking saving decisions. We model financial frictions as arising from imperfect enforceability of contracts, which in turn gives rise to collateral constraints. These constraints limit efficient reallocation of capital across entrepreneurs. In particular, a talented would-be entrepreneur who is born poor will have to work for a wage until she has accumulated enough net worth to overcome the financial frictions and operate her technology at an efficient scale.

We model economic development as a transition from a steady state with financial *and* non-financial frictions to one where non-financial frictions are absent. Non-financial frictions are introduced because financial frictions alone cannot fully account for the resource misallocation and hence the low output and TFP observed in less developed countries. Following a recent literature (Guner et al., 2006; Hsieh and Klenow, 2007; Restuccia and Rogerson, 2007), we model non-financial frictions with producer-specific taxes/subsidies on output that distort the marginal productivity of factors an individual producer faces. Such taxes and subsidies are called idiosyncratic output distortions. The economic transition is triggered by a market-oriented reform that eliminates all these idiosyncratic output distortions: The economy then embarks on a transition driven by efficient reallocation of economic resources. We assume, as is consistent with empirical evidence, that financial frictions remain even after such a reform, with the consequence that financial frictions determine the pace of the reallocation and hence of the transition. In our model, financial frictions stem from the weakness in broader institutions—contract enforceability. Given the persistent and slow-moving nature of institutions (Acemoglu et al., 2005), financial frictions cannot be eradicated as quickly as other idiosyncratic distortions such as sector and size specific taxes/subsidies. Indeed, in policy circles, the removal of idiosyncratic taxes/subsidies are categorized as “first-generation” reforms, while domestic financial markets are considered to fall into the domain of “second-generation” reforms.¹

¹Second-generation reforms comprise institutional reforms aimed at enhancing transparency and good governance in financial markets and in corporate sectors (Camdessus, 1999; Navia and Velasco, 2003).

We calibrate the model by matching its stationary equilibrium to data on standard macroeconomic aggregates, external financing, and establishment-size distribution, among others. Economies in our analysis differ from one another in their degrees of financial frictions and in their initial (mis)allocation of economic resources—which are, as noted above, constructed using empirical evidence from less developed countries (Hsieh and Klenow, 2007). This approach enables us to assess the quantitative implications of financial frictions on the dynamics of economic development in an empirically-relevant context.

Related Literature. We build on the theoretical literature that counts financial frictions as a central issue on economic development—see Banerjee and Duflo (2005) for an exhaustive review of this literature. We develop this idea in ways that are empirically useful, by studying the transitional dynamics and the stationary equilibria of a broader class of quantitatively-oriented models with financial frictions.

Giné and Townsend (2004) and Jeong and Townsend (2005, 2007) have pioneered quantitative analysis for this class of models. They estimate and calibrate some models in this literature to the growth experience of Thailand. We share their interest in studying the role of financial frictions on transitional dynamics. However, we abstract from financial deepening which is the main driving force of their transition dynamics. Instead, we emphasize how the joint distribution of ability and wealth evolve endogenously over time under financial frictions, starting from an initial condition characterized by misallocation of economic resources.²

Christiano (1989) and King and Rebelo (1993) point out that the neoclassical transitional dynamics is inconsistent with the observed growth experiences. They also study whether modified versions of the neoclassical growth model can account for the observed dynamics. The modifications include non-homothetic preferences, adjustment costs and a broader notion of capital, but all of them lead to some counterfactual implications for investment rates, interest rates and/or relative prices of installed capital and new investment goods. More recently, Chen et al. (2006) reconcile the neoclassical growth model with the post-war growth experience of Japan. They feed into the neoclassical model the realizations of the measured TFP path as an exogenous process, and show that the resulting dynamics is consistent with the data. In this context, we view our paper as an attempt at providing a theory of the TFP dynamics along the transitional paths based on the interaction of financial frictions and the initial misallocation of economic resources.

More recently, the disappointing growth experiences of post-communist countries have motivated many researchers to study economic transitions. This literature focuses on the reallocation of factors from state to private enterprises, with a particular emphasis on worker flows and labor market frictions (Blanchard, 1997). Our contention is that capital and entrepreneurial talents were inefficiently aligned during the communist era, and that financial frictions delayed efficient realloca-

²More specifically, we incorporate into the model forward-looking endogenous saving decisions and heterogeneity in returns to capital across entrepreneurs, both of which they abstract from. They do assume heterogeneity across individuals in the fixed setup cost of starting a business.

tion of capital even after the liberalization.³ Atkeson and Kehoe (1997) also attribute the delayed transition of these economies to misallocation of capital. In their model, capital cannot be swiftly reallocated across firms because it takes time for new private firms to accumulate complementary organizational capital.

A disparate literature in macroeconomics studies the stationary equilibria and transition dynamics of related models featuring heterogeneity and financial frictions. Aiyagari (1994) shows how introducing uninsurable idiosyncratic risks leads to a larger aggregate capital stock and to a well-defined invariant distribution of wealth. Huggett (1997) studies the transition dynamics of Aiyagari's economy, but finds only small quantitative differences from those of a representative-agent model. The case with aggregate shocks is studied by Krusell and Smith (1998). They show that, for the cases with idiosyncratic labor risk, a strong approximate aggregation result holds—that is, the distribution of wealth does not matter for aggregate dynamics in the stochastic stationary equilibrium.

With the issue of heterogeneity and transition dynamics seemingly resolved, some researchers have focused on the difficulty of these incomplete-market models in matching the highly-skewed wealth distribution in the US. More recently, Cagetti and De Nardi (2006) and Quadrini (2000) incorporate financial frictions into models with individual-specific technologies (entrepreneurship), and show that these elements explain the empirical wealth distribution. Intuitively, if there are financial frictions, highly-talented entrepreneurs will self-finance and hold a large ownership stake in their own businesses, which translates into a fat right tail of the wealth distribution.⁴ This literature primarily focuses on the wealth distribution of the stationary equilibria, and hence does not study the impact of financial frictions on the process of economic development.

Finally, the way we model financial frictions is also related to the macroeconomic literature on credit multipliers (Bernanke and Gertler, 1989; Bernanke et al., 1999; Kiyotaki and Moore, 1997). This literature focuses on how financial frictions transmit and propagate shocks at the business-cycle frequency, while our analysis pertains to longer-run economic phenomena.

1 Some Facts on Economic Development

In this section we discuss observed patterns of macroeconomic dynamics in transition economies. We also present evidence on resource misallocation and financial frictions in less developed economies. These facts motivate our theoretical framework.

³In the communist economies, the allocation of capital was as likely to be determined by the distribution of power as by productivity. See Blanchard (1997) and Roland (2000) and the references therein. Calvo and Coricelli (1992) argue that credit market frictions inhibited efficient reallocation of capital in Poland after the liberalization.

⁴Entrepreneurship has implications for the level of aggregate capital stock as well. In models with idiosyncratic risks on returns to individual-specific technologies, there are two opposing forces. The precautionary saving motive will push up the aggregate capital stock in the stationary equilibrium, while the uncertainty will discourage investment in the risky technology and hence capital accumulation. Angeletos (2007) works out the conditions for either force to prevail.

1.1 Transitional Dynamics of Asian Miracles

We first discuss the transitional dynamics of Asian economic miracles. In particular, we study those economies that fundamentally reformed their economic system at some point and then underwent a sustained period of fast transitional growth. These economies are: China, India, Indonesia, Japan, Korea, Malaysia, Singapore, Taiwan and Thailand.⁵ They all belong to the top decile of economies in terms of average growth rates during the 1970–2000 period. In addition, each of these economies either implemented structural reforms as defined in the Sachs and Warner (1995) panel of economic liberalizations,⁶ or demonstrates a statistically-significant structural break in its economic growth during the 1950–2000 period.

We date the beginning of the transition period as the earlier of the structural reform dates constructed by Sachs and Warner (1995)—and updated by Wacziarg and Welch (2003)—and the structural breaks in growth rates identified by Jones and Olken (2008). Most of the breaks identified by Jones and Olken, who use the methodology of Bai and Perron (2003), are in the neighborhood of a Sachs and Warner liberalization date.⁷

Figure 1 presents the main features of the transitional dynamics of these economies. For a given economy, year 0 on the horizontal axis is its date of structural reform or break, and hence the beginning of its economic transition. Note that a point on the horizontal axis therefore corresponds to different calendar years for different countries. The top left panel shows the evolution of the per-capita output relative to the US for each country and for the average (thick solid line) of these economies. All these economies exhibit large and persistent output gains, which appear protracted when seen through the lens of the neoclassical growth theory. A typical calibration of the neoclassical model predicts that it takes only four to six years to cover half the distance to the steady state. The data suggests a half-life of at least 15 years. As shown in the bottom left panel, the output gains are partly explained by significant productivity gains. Note that the standard neoclassical model—where TFP is an exogenously-given process—has nothing to say about the TFP dynamics.

The top right panel depicts the behavior of investment-to-output ratios. In a neoclassical model, the investment-to-output ratio decreases over time. In the data, investment rates actually start low and rise in the early stages of transitions. Only in latter stages of transitions, are investment rates decreasing as predicted by the standard theory.

Finally, as shown in the bottom right panel, these economies are characterized by low levels of financial development as measured by the ratio of external finance to GDP. For comparison,

⁵From the set of fast growing Asian economies, we exclude Hong Kong, which does not have a clear structural break or a large-scale liberalization in our sample period.

⁶Even though the Sachs and Warner indicator was originally constructed as a measure of openness to international trade, following Rodríguez and Rodrik (2000), our interpretation is that these indicators serve as a proxy for a wide range of policy and institutional differences, where trade liberalization is just one part of a government’s overall reform plan for integrating its economy with the world system. Other aspects of such a program almost always include price liberalization, budget restructuring, privatization, and deregulation.

⁷In particular, for China and Thailand, their structural breaks exactly coincide with well-documented reform episodes: 1978 and 1986, respectively.

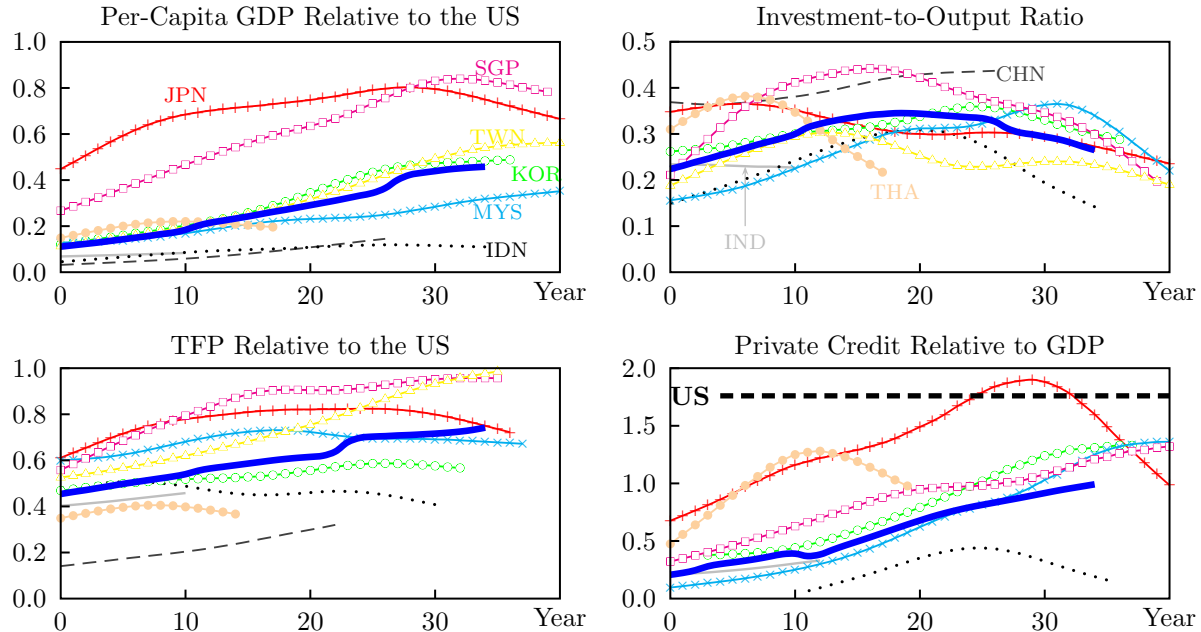


Fig. 1: Transitional Dynamic from the Asian Miracles. Per-capita GDP relative to the US and investment-to-output ratio are PPP numbers from the Penn World Table (Version 6.1). We construct TFP series as a residual using per-capita GDP from the PWT, per-capita capital stock series constructed from the inventory method, and per-capita human capital from years of education (Barro and Lee, 2000; Cohen and Soto, 2007). Private credit to GDP series are from Beck et al. (2000). Year 0 on the horizontal axis for each economy corresponds to the earlier of the structural reform dates (Sachs and Warner, 1995; Wacziarg and Welch, 2003) and the structural breaks in growth identified by Jones and Olken (2008). The nine economies are: China (CHN), India (IND), Indonesia (IDN), Japan (JPN), Korea (KOR), Malaysia (MYS), Singapore (SGP), Taiwan (TWN) and Thailand (THA). The thick solid line is the unweighted average series. All series are Hodrick-Prescott filtered.

the average of this ratio for the US during the 1970–2000 period is 1.75 (dashed line). From the evolution of this indicator, one can see that financial deepening is achieved only in latter phases of transitions. The average across countries of the external finance to GDP ratio during the first 20 years of transitions is less than 0.5. The two exceptions are Japan, which started with a high level of financial development, and Thailand, which reformed its financial sector early in its transition (Townsend, 2008).

Similar facts are true for other transitional episodes. In the case of post-communist transitions of Eastern Europe, which collectively experienced a structural break as the communist bloc disintegrated, per-capita output relative to the US stagnated for a decade following economic liberalizations. In addition, investment-to-output ratios were increasing over time, and TFP growth played an important role in the early stages of transitions. These economies are also characterized by a low level of financial development.⁸

1.2 Resource Misallocation and Credit Market Imperfections

In our theory, the distribution of resources across productive units is a key determinant of the dynamics of an aggregate economy. Here we discuss evidence on resource misallocation and credit

⁸Data for these economies are available upon request.

market imperfections in less developed countries.

Recent work by Hsieh and Klenow (2007) is of particular interest to us. Using micro data on Chinese and Indian manufacturing establishments, they quantify the extent of resource misallocation in these economies. They use data from the last two decades, a period during which these economies have undergone significant transformations. Compared to the US, China and India have substantially larger dispersions in marginal products of labor and capital across plants within narrowly-defined industries. These dispersions in marginal products are attributed to taxes/subsidies that are specific to individual producers and distort the marginal products of factors. These producer-specific taxes/subsidies are called idiosyncratic distortions. These idiosyncratic distortions and the resulting resource misallocation account for 25–40% of the TFP difference between China and the US. The figure is 50–60% for India. This evidence, together with the recent quantitative exercises by Guner et al. (2006) and Restuccia and Rogerson (2007), leads us to focus on idiosyncratic distortions as the source of the low initial per-capita output and TFP in less developed countries. Bartelsman et al. (2006) also provide related empirical evidence.

Cross-country differences in financial development are well documented as well. Beck et al. (2000) and King and Levine (1993) show that aggregate measures of credit and financial development are strongly correlated with output per capita, while La Porta et al. (1998) document that these financial indicators are also correlated with underlying differences in broader institutions such as contract enforcement and creditor protection. Micro-level evidence includes recent work on Thailand by Townsend (2008), and Banerjee and Munshi (2004), who show that access to capital varies across communities in the garment industry in India. Again, see Banerjee and Duflo (2005) for a survey of this literature.

The evidence discussed in this section leads us to explore a model incorporating heterogeneous producers, initial misallocation and financial frictions to explain the observed transition experiences.

2 Model

We study economies with individual-specific technologies and imperfect credit markets. Individuals choose either to operate an individual-specific technology—i.e. become entrepreneurs, or to work for a wage. This entrepreneur-worker occupation choice allows for endogenous entry and exit in and out of the production sector, which are an important channel of resource reallocation. Imperfection in credit markets is modeled with a collateral constraint on capital rental that is proportional to an individual's wealth.

Individuals are heterogeneous with respect to their entrepreneurial ability and wealth. Our model generates endogenous dynamics for the joint distribution of ability and wealth. This ability-wealth dynamics will prove to be crucial for understanding macroeconomic transitions. In addition, heterogeneity in entrepreneurial ability is essential in modeling how resource misallocation leads to lower output and TFP.

Our model economy is closed to goods and capital flows. This assumption is a good approxima-

tion of the early experiences of the transition economies in Figure 1, with the exception of Korea and Singapore.

Heterogeneity and Demographics. Individuals live indefinitely, and are heterogeneous with respect to their wealth a_t and their entrepreneurial ability e_t . An individual’s ability follows a stochastic process. In particular, individuals retain their ability from one period to the next with probability ψ . With probability $1 - \psi$, an individual draws a new entrepreneurial ability. It is assumed that this ability shock is i.i.d. over time and across individuals, with the implication that ψ controls the persistence of ability. The ability distribution is assumed to have a discrete support \mathcal{E} . We denote by $\mu(e)$ the measure of type- e individuals in the invariant distribution of ability. We denote by $G_t(e, a)$ the cumulative density function for the joint distribution of ability and wealth at the beginning of period t . By convention, $G_t(a|e)$ denotes the cumulative wealth distribution among type- e entrepreneurs, with $G_t(e, a) = \sum_{\epsilon \in \mathcal{E}, \epsilon \leq e} \mu(\epsilon) G_t(a|\epsilon)$. The population size is normalized to one, and there is no population growth.

Preferences. Individuals discount their future utility with a discount factor β . The preferences over contingent plans for the consumption sequence of an individual in period t are represented by expected utility:

$$\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} u(c_s).$$

Technologies. In any given period, individuals can choose either to work for a wage or to operate an individual-specific technology. We label the latter option as entrepreneurship. We assume that an entrepreneur with talent e who uses k units of capital and hires l units of labor produces according to a production function $f(e, k, l)$, which is assumed to be homogeneous of degree one, strictly increasing in all its arguments, and strictly concave in capital and labor, with $f(0, k, l) = 0$ and $\lim_{e \rightarrow \infty} f(e, k, l) = \infty$.

Credit Markets. Productive capital is the only financial asset in the economy. There is a perfectly-competitive financial intermediary that receives deposits and rents capital to entrepreneurs. The interest rate is r_t , and the rental cost of capital is $r_t + \delta$, where δ is a depreciation rate.

We assume that entrepreneurs’ capital rental (k) is limited by a collateral constraint $k \leq \lambda a$, where a is financial wealth and λ measures the degree of credit frictions, with $\lambda = +\infty$ corresponding to perfect credit markets, and $\lambda = 1$ to financial autarky where all capital has to be self-financed by entrepreneurs.

Our specification captures the common prediction from models of limited contract enforcement—that is, the amount of credit is limited by individuals’ wealth. At the same time, its parsimoniousness enables us to analyze quantitative effects of financial frictions on aggregate dynamics without

losing tractability. This same specification has been widely used in the literature on financial frictions and entrepreneurship (Buera, 2006; Evans and Jovanovic, 1989), and in the one on credit frictions and business cycles (Bernanke et al., 1999).

Our collateral constraint can be derived from the following limited enforcement problem. Consider an individual with financial wealth a (deposited in the financial intermediary) at the beginning of a period. Assume that she rents k units of capital. Then she may choose to abscond with a fraction $(1/\lambda)$ of the rented capital. The *only* punishment is that she will lose her financial wealth a deposited in the intermediary. In particular, she will not be excluded from any economic activities in the future. Actually she is allowed to instantaneously deposit the stolen capital k/λ and continue being a worker or an entrepreneur. Note that λ in this context measures the degree of rental contract enforcement, with $\lambda = +\infty$ corresponding to perfect enforcement and $\lambda = 1$ to zero enforcement. In the equilibrium, the financial intermediary will rent capital only to the extent that no individual will renege on the rental contract, which implies a collateral constraint $k/\lambda \leq a$ or $k \leq \lambda a$.

It should be noted that we focus on within-period borrowing, or capital rental, for production purposes. We do not allow borrowing for intertemporal consumption smoothing in our model, which implies $a \geq 0$.

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

$$\begin{aligned} \max_{\{c_s, a_{s+1}\}_{s=t}^{\infty}} \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} u(c_s) \\ \text{s.t. } c_s + a_{s+1} \leq \max\{w_s, \pi(a_s; e_s, w_s, r_s)\} + (1 + r_s)a_s, \quad \forall s \geq t \end{aligned} \quad (1)$$

where e_t , a_t and the sequence of wages and interest rates $\{w_s, r_s\}_{s=t}^{\infty}$ are given, and $\pi(a; e, w, r)$ is the profit from operating an individual technology. This indirect profit function is defined as:

$$\pi(a; e, w, r) = \max_{l, k \leq \lambda a} \{f(e, k, l) - wl - (\delta + r)k\}.$$

The input demand functions are denoted by $l(a; e, w, r)$ and $k(a; e, w, r)$.

A type- e individual with current wealth a will choose to be an entrepreneur if profits as an entrepreneur, $\pi(a; e, w, r)$, exceed income as a wage earner, w . This occupational choice can be represented by a simple policy function. Type- e individuals decide to be entrepreneurs if their current wealth a is higher than the threshold wealth $\underline{a}(e)$, where $\underline{a}(e)$ solves:

$$\pi(\underline{a}(e); e, w, r) = w.$$

For some e , there may not exist such an \underline{a} . In particular, if e is too low, then $\pi(a; e, w, r) < w$ for all a . Intuitively, individuals of a given ability choose to become entrepreneurs if they are wealthy enough to run their businesses at a profitable scale. Similarly, individuals of a given wealth choose to become entrepreneurs only if their ability is high enough.

If the wage and the interest rate are constant, $w_t = w$ and $r_t = r$ for all t , as is the case in a stationary equilibrium of this economy, then the recursive formulation of the sequence problem (1) is given by the following Bellman equation:

$$\begin{aligned} v(a; e) &= \max_{c, a'} \{u(c) + \beta \mathbb{E}[v(a'; e') | e]\} \\ \text{s.t. } c + a' &\leq \max\{w, \pi(a; e, w, r)\} + (1+r)a. \end{aligned} \quad (2)$$

Competitive Equilibrium. Given $G_0(e, a)$, a competitive equilibrium in this economy consists of sequences of joint distribution of ability and wealth $\{G_t(e, a)\}_{t=1}^\infty$, allocations $\{c_s(e_t, a_t), a_{s+1}(e_t, a_t), l_s(e_t, a_t), k_s(e_t, a_t)\}_{s=t}^\infty$ for all $t \geq 0$, and prices $\{w_t, r_t\}_{t=0}^\infty$ such that:

1. Given $\{w_t, r_t\}_{t=0}^\infty$, e_t , and a_t , $\{c_s(e_t, a_t), a_{s+1}(e_t, a_t), l_s(e_t, a_t), k_s(e_t, a_t)\}_{s=t}^\infty$ solves the individuals' problem in (1) for all $t \geq 0$;
2. Labor and capital markets clear at all $t \geq 0$, which by Walras' law implies goods market clearing as well:

$$\begin{aligned} \sum_{e \in \mathcal{E}} \mu(e) \left[\int_{\underline{a}(e, w_t, r_t)}^{\infty} l(a; e, w_t, r_t) G_t(da|e) - G_t(\underline{a}(e, w_t, r_t) | e) \right] &= 0, \\ \sum_{e \in \mathcal{E}} \mu(e) \left[\int_{\underline{a}(e, w_t, r_t)}^{\infty} k(a; e, w_t, r_t) G_t(da|e) - \int_0^{\infty} a G_t(da|e) \right] &= 0, \end{aligned}$$

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

$$\begin{aligned} G_{t+1}(a|e) &= \psi \int_{u \leq a} \int_{a'(e, v)=u} G_t(dv|e) du \\ &\quad + (1 - \psi) \mu(e) \sum_{e_-} \int_{u \leq a} \int_{a'(e_-, v)=u} G_t(dv|e_-) du. \end{aligned}$$

3 Quantitative Exploration

The central objective of this paper is to construct a quantitative model of development dynamics—the transition of economies from a steady state with low output per capita to one with higher output per capita. Our approach is to calibrate the model parameters using information on steady states only. We then let the model generate transition dynamics, and see whether they are consistent with empirical evidence on economic transitions.

We assume that all the economies we consider have the same preference, technology and endowment of entrepreneurial ability. Economies differ from one another in their initial conditions (resource allocation) for the transitions, and also in their degrees of financial frictions. This way, we can isolate the impact of initial conditions and financial frictions on transition dynamics.

We first calibrate the common parameters by matching the stationary equilibrium of the benchmark economy to the US data on standard macroeconomic aggregates, establishment-size distribution and dynamics, income inequality, and firms' external financing.

Then we construct initial conditions for economic transitions based on data from less developed economies. Here we face two challenges. Firstly, aggravating financial frictions alone in our model cannot generate large enough misallocation and hence low enough TFP and output that we observe in less developed economies. Following a recent literature emphasizing the role of idiosyncratic distortions (Guner et al., 2006; Hsieh and Klenow, 2007; Restuccia and Rogerson, 2007), we incorporate non-financial distortions into our model, which interact with financial frictions to generate sufficiently large misallocation and low TFP and output. The second challenge is that the initial condition for transition dynamics in our framework is the joint distribution of entrepreneurial ability and wealth: $G_0(e, a)$ in the definition of a competitive equilibrium in Section 2. Although we do have empirical evidence on financial and non-financial distortions (Beck et al., 2000; Hsieh and Klenow, 2007), we lack direct quantitative evidence on ability-wealth distributions. Here we exploit the fact that our model provides a theory of ability-wealth distributions—one that has proven successful in explaining key features of the wealth inequality in the US (Cagetti and De Nardi, 2006; Quadrini, 2000). When financial and non-financial distortions in our model are calibrated to empirical evidence, we obtain a stationary distribution of ability and wealth, which we use in turn as the initial condition for transition exercises. In summary, our initial condition itself is a steady state of an economy with financial and non-financial distortions calibrated to empirical evidence on less developed economies.

The rest of this section is organized as follows. We first calibrate the common parameters, and discuss how each parameter is identified (Section 3.1). We then study how an economy’s stationary equilibrium responds to different degrees of financial frictions, while holding constant all other aspects of the model (Section 3.2). In Section 3.3, we study transition dynamics. We first start with an initial condition (resource allocation) and a degree of financial frictions that are consistent with data from less developed economies. We then try an alternative initial condition and a different degree of financial frictions and show how the two—financial frictions and initial resource misallocation—interact and influence an economy’s transition to the stationary equilibrium. Once the transition dynamics results are presented, we describe how we use the data on financial and non-financial distortions from less developed economies to construct an empirically-plausible initial steady state (Section 3.4). In Section 3.5, we provide more insights into how microeconomic heterogeneity—ability-wealth distribution—influences macroeconomic dynamics.

3.1 Calibration

We first describe the parametrization of the benchmark model, and then discuss the calibration of the parameters that are common across economies. For the sake of clarity, we choose a parsimonious parametrization that follows as much as possible the standard practices in the literature.

We choose a period utility function of the isoelastic form:

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}.$$

We assume that an entrepreneur with talent e who hires k units of capital and l units of labor produces according to the following Cobb-Douglas production function:

$$f(e, k, l) = e^\nu (k^\alpha l^{1-\alpha})^{1-\nu}, \quad (3)$$

where ν is the share of output going to the entrepreneur, with $1 - \nu$ known as the span-of-control parameter (Lucas, 1978). Accordingly, $1 - \nu$ represents the share of output going to the variable factors. Out of this, fraction α goes to capital, and $1 - \alpha$ goes to labor.

The entrepreneurial ability e^ν is assumed to be a discretized version of a Pareto distribution whose probability density is $\eta e^{-\nu(\eta+1)}$ for $e^\nu \geq 1$. Each period, an individual may retain her previous entrepreneurial ability with probability ψ . With probability $1 - \psi$, she draws a new ability realization from the Pareto distribution given above, independently of her previous ability. Obviously, ψ controls the persistence of ability, while η determines the dispersion of ability in the population.

We now need to specify eight parameter values: two technological parameters α, ν ; the depreciation rate δ ; two parameters describing the process for ability, ψ and η ; the degree of financial frictions λ ; the subjective discount factor β and the reciprocal of the intertemporal elasticity of substitution σ .

We let $\sigma = 1.5$ following the standard practice. The one-year depreciation rate is set at $\delta = 0.058$. We impose $\alpha(1 - \nu) = 0.30$ to match the aggregate share of capital. We are thus left with five parameters: λ, ν, η, ψ , and β . We calibrate them to match five relevant moments in the US data: the ratio of external finance to GDP; the employment share of the top decile of establishments (by number of employees); the share of income generated by the top five percentile of earners; the exit rate of establishments; and the real interest rate.

The second column of Table 1 shows the value of these moments in the US data. The external finance to GDP ratio is obtained by dividing the sum of externally-financed capital of the private non-household sector from the Flow of Funds data by GDP. When calculating this ratio, we take a midpoint (1.75) of a narrow measure of external finance defined as credit market liabilities (1.33) and an upper bound obtained by treating all the assets of the corporate sector as externally financed (2.15). The top decile of establishments—measured by employment—in the US accounts for 63 percent of the total employment. We target the income share of the top five percentile earners (0.30) as reported by Cagetti and De Nardi (2006) and Castañeda et al. (2003), and an annual job destruction rate (establishment exit rate) of 10 percent which is roughly what Davis et al. (1996) report for the U.S. manufacturing sector. Finally, as the target real interest rate, we pick four percent per year.

The third column of Table 1 shows the moments simulated from the calibrated model. Even though in the model economy all five moments are jointly determined by the five parameters (fourth column), each moment is primarily affected by one particular parameter. The last column of the table shows the elasticity of each moment to the corresponding parameter.

We briefly discuss the identification and the interpretation of some of the parameter values.

	US Data	Model	Parameter	Elasticity
Ratio of External Finance to GDP	1.75	1.76	$\lambda = 5.0$	0.07
Top 10% Employment	0.63	0.63	$\eta = 6, \nu = 0.18$	-1.01, -1.04
Top 5% Income	0.30	0.31		-0.59, -0.22
Exit Rate	0.10	0.11	$\psi = 0.87$	-2.7179
Interest Rate	0.04	0.04	$\beta = 0.91$	-10.27

Table 1: Calibration

The degree of financial frictions are inferred to be low—a relatively high value of $\lambda = 5.0$, mainly reflecting the large fraction of intermediated capital in the US economy. Given the span-of-control parameter $1 - \nu$, the tail parameter of the ability distribution η can be inferred from the tail of the employment distribution (top decile of establishments): Less dispersion in ability distribution (a higher η) implies lower employment concentration. We can then infer ν from the income share of the top five percentile of earners: Top earners are mostly entrepreneurs (both in the US data and in the model), and ν controls the share of income going to the entrepreneurial input.⁹ These two parameters are calibrated at $\eta = 6$ and $\nu = 0.18$. The parameter $\psi = 0.87$ leads to an annual establishment exit rate of 11% in the model. Finally, the model requires a discount factor $\beta = 0.91$ to match the interest rate of four percent.

3.2 Results for the Stationary Equilibrium

We first study the long-run effects of financial frictions. In Figure 2, we consider how allocations and prices of the stationary equilibria respond to changes in the collateral constraint parameter λ . Note that a lower λ means more financial frictions, with $\lambda = 1$ corresponding to zero external financing and $\lambda = +\infty$ to perfect credit markets.

The top left panel shows the effect of the collateral constraint on aggregate output and capital. Both variables are measured relative to their values in the benchmark ($\lambda = 5.0$). Financial frictions have sizable effects on these variables: As we shut down financial intermediation, output drops by 30 percent. Nevertheless, this exercise shows that financial frictions alone are not enough to account for the output gap between developed and less developed economies.

Economies with worse credit markets have lower wages and interest rates (top right panel). The lower interest rate in the general equilibrium follows from entrepreneurs' lower demand for capital because of tighter collateral constraints, and also from their higher savings rate because of the need for self-financing.

⁹This argument would hold exactly in a frictionless economy. With financial frictions, parts of entrepreneurial income are payments for internally-financed capital. In this case, a larger ν leads to lower income concentration (with an elasticity of -0.22), since it implies lower returns to scale and hence lower wealth concentration. The latter in turn leads to a lower concentration of returns to capital held by entrepreneurs and hence of entrepreneurial income. If we increase ν while adjusting η to hold constant employment concentration, income concentration actually increases (with an elasticity of $0.39 = 0.59 \times 1.04 / 1.01 - 0.22$).

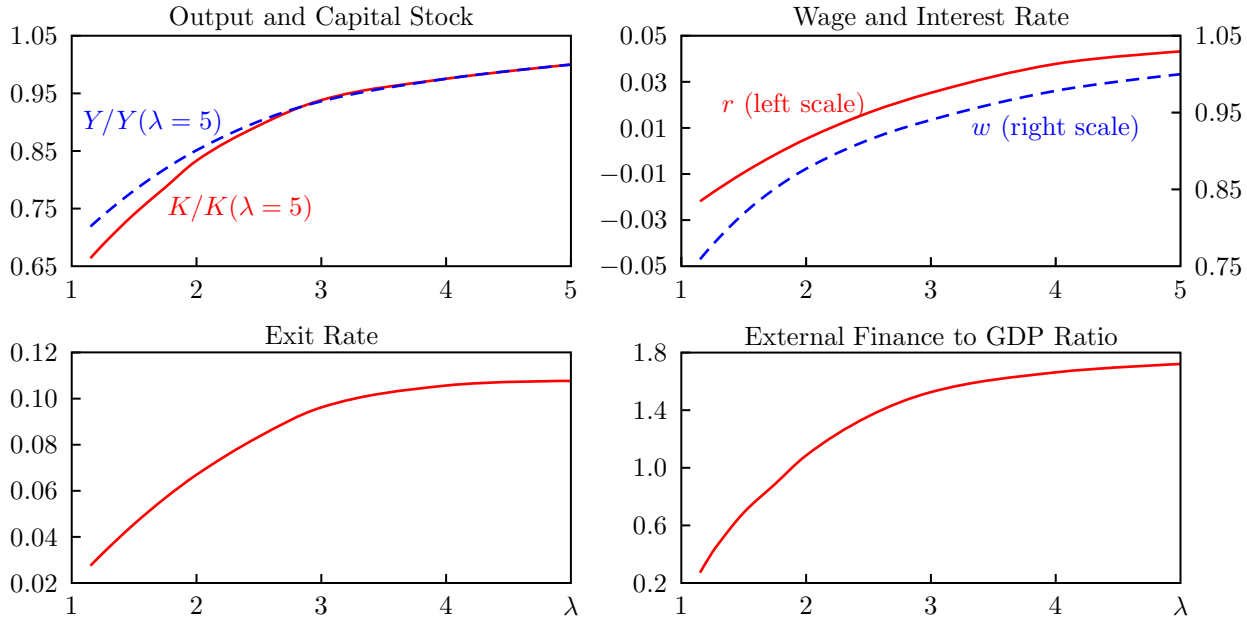


Fig. 2: Effect of Financial Frictions (λ , Horizontal Axis) on the Stationary Equilibrium. We compute stationary equilibria that correspond to various values of λ , while holding all other parameters fixed as in Table 1. Six moments of interest are plotted against the degree of financial frictions, λ . Output, capital stock and wage are normalized by their levels in the benchmark stationary equilibrium with $\lambda = 5$. Note that a lower λ implies more financial frictions.

Economies with more financial frictions also have a substantially lower exit rate of businesses (bottom left panel). In our model, occupation choice is determined by wealth and entrepreneurial ability.¹⁰ With more financial frictions, wealth becomes relatively more important in this choice, and entrepreneurs who are hit with negative ability shock but are wealthy—who would choose to exit and become a worker in an environment with less financial frictions—are more likely to remain in business, driving down the exit rate. Accordingly, with more financial frictions, the fraction of entrepreneurs in the population rises, and the average ability of active entrepreneurs declines.

Note that the variation in the collateral constraint (λ) spans a large range of external finance to GDP ratios (bottom right panel). This result is consistent with the empirical evidence in Beck et al. (2000), where the bottom quartile of the cross-country distribution of external finance to GDP ratios is 0.13, while the figure for the US is as high as 1.75.

3.3 Results for the Transitional Dynamics

We now show that misallocation of resources and financial frictions jointly determine macroeconomic dynamics. We study the transition dynamics of an economy under financial frictions. The initial state of this transition exercise should be thought of as an economy stuck in a low-output steady state owing to financial *and* non-financial distortions. This initial condition is calibrated to less developed country data on such distortions. In Section 3.4, we discuss in detail how we

¹⁰With perfect credit markets, entrepreneurial ability is the sole determinant of occupation choice, as is shown in Section 3.5.

construct an empirically-plausible initial condition. At this point, we would like to emphasize that this initial condition embodies the degree of resource misallocation in a typical less developed economy.¹¹

The economic transition is assumed to be triggered by an economic reform that eliminates all non-financial distortions at once. Financial frictions remain. Using the terminology in the introduction, the transition is initiated by an economy-wide “first-generation” reform on idiosyncratic distortions, but is completed prior to a “second-generation” reform on financial frictions. This is consistent with what we observe in the Asian miracles: All those economies experienced structural reforms or breaks that led to a period of high growth, while financial deepening materialized only in the latter stages of their transitions (Figure 1).

A couple of comments are in order. In reality, reforms are implemented gradually. If we were to model gradual elimination of distortions, we would generate even slower transitions and would fit the transitional data in Figure 1 even more closely. We choose an all-at-once reform to show that financial frictions by themselves can substantially protract the effect of initial misallocation and slow down the speed of transitions. Similarly, if we introduce exogenous changes in financial frictions (λ) over time, there would be additional dynamics especially in the latter stages of transitions. We choose to hold the degree of financial frictions constant over time so that we can focus on the transitional dynamics driven endogenously by the evolution of the ability-wealth distribution.

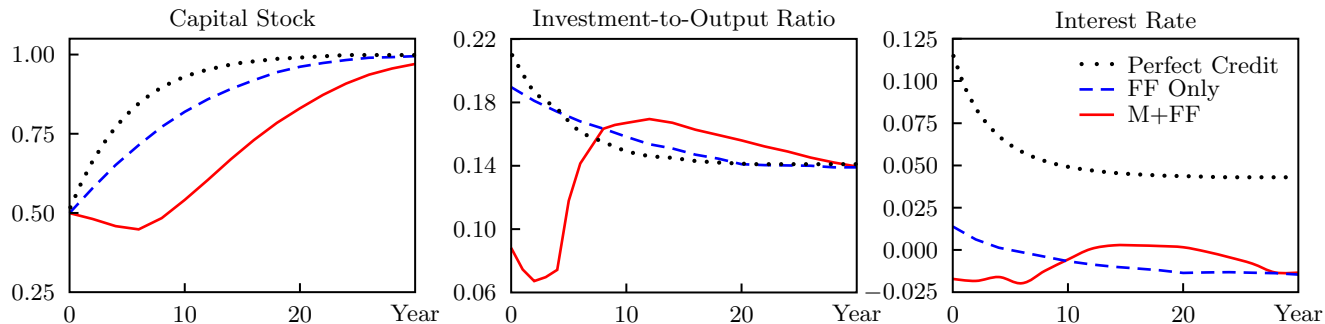


Fig. 3: Transition Dynamics with Financial Frictions. There are two initial ability-wealth distributions, one for M+FF and the other for FF Only. The initial condition for FF Only is obtained by halving the support of the wealth distribution in the stationary equilibrium with $\lambda = 1.3$. The initial condition for M+FF is calibrated to less developed country data and hence has more resource misallocation. The two economies then converge under the same degree of financial frictions ($\lambda = 1.3$) to the same steady state. The dotted lines depict the evolution with perfect credit markets, where initial ability-wealth distributions do not matter. The capital series (left panel) for the perfect-credit economy is normalized by its own steady-state level, which is about 50% higher than the steady-state capital of M+FF and FF Only.

In Figures 3 and 4, the solid line (labeled M+FF) represents the transition dynamics of this typical less developed economy after the reform. The financial frictions in this economy is parameterized with $\lambda = 1.3$, which is consistent with the external finance to GDP ratio (0.5) of the Asian economies during the first half of their transitions. In this economy with initial misallocation and

¹¹In our model, a measure of the misallocation is the correlation between entrepreneurial ability and wealth. The initial condition that we construct has a correlation coefficient of -0.01 between the two variables, which is quite lower than what it would be (0.15) in the absence of non-financial distortions.

financial frictions (M+FF, solid line), even after the elimination of all non-financial distortions, only a certain fraction of the misallocated capital can be reallocated instantaneously to more productive entrepreneurs because of collateral constraints. The misallocation can be undone only over time, as the high-ability types accumulate wealth to overcome the collateral constraints, and the low-ability types retire from entrepreneurial activities. Therefore, for a prolonged period of time, this economy is less productive than one without misallocation, and it converges to the steady state at a slower pace. In the early transitional periods of M+FF, a large fraction of resources are controlled by low-ability types, as can be read from the low ability-wealth correlation. Given that low-ability types' return to capital and hence savings rate is lower than high-ability types', aggregate savings rate is lower than in an economy without misallocation. This explains both the initially-lower investment-to-output ratio and the slow transition to the steady state for M+FF.

Note in particular that the aggregate capital stock in M+FF contracts initially before it rebounds. With enough misallocation, there are very rich low-ability entrepreneurs, who realize that they will cease to be entrepreneurs once the high-ability types self-finance and operate their technologies. Now they have no need for self-financing, and their earnings as a worker, wage, will increase in the future. For these reasons, they run down their assets, bringing down the aggregate level of capital in the economy until their dissaving is more than offset by the asset accumulation of high-ability types. The investment-to-output ratio mirrors this explanation.

One main point of King and Rebelo (1993) is that the neoclassical model's prediction on interest rates is inconsistent with data. The right panel of Figure 3 shows that, with financial frictions and misallocation of initial resources, we generate interest rates that are much lower than in a perfect-credit economy. In the early stages, the demand for capital is restricted by credit constraints—the poor high-ability types cannot use much capital because they have negligible financial wealth. As the high-ability types accumulate financial wealth, their demand for capital increases, while the supply of capital by the low-ability, and hence low-saving, types declines. These two forces lead to a gradual rise in the equilibrium interest rate, before they are eventually overtaken by the neoclassical dynamics—increasing capital stock decreases marginal product of capital and hence the interest rate.

Another important feature of the transition is the endogenous TFP dynamics. Misallocation of resources reduces the measured TFP. As the initial misallocation is unwound over time for M+FF, the imputed TFP rises about 4.2% per year during the first 10 years of the transition, although there is no change on the technology side—the marginal distribution of entrepreneurial ability is invariant over time and common across our economies. This result is consistent with what Hsieh and Klenow (2007) report on China, and also with the large inter-sectoral reallocation of production factors that Young (1995) see in the East Asian miracles.

To understand the respective role of initial resource misallocation and financial frictions, we consider a different transition exercise. In particular, we consider an alternative initial condition that has the same marginal distribution of entrepreneurial abilities and aggregate capital stock, but less misallocation. We obtain this by halving the wealth of everyone in the stationary equilibrium

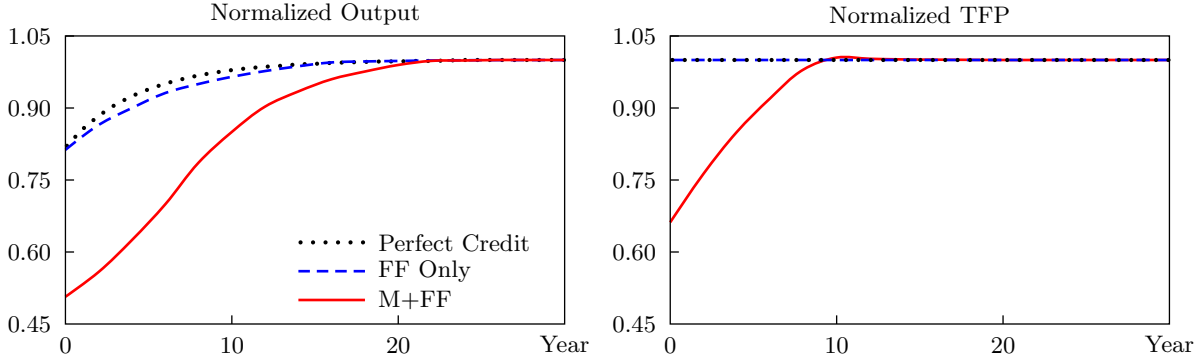


Fig. 4: Output and TFP with Financial Frictions. We plot the aggregate output and the imputed TFP—calculated using the standard growth accounting—for the two initial distributions under $\lambda = 1.3$. The dotted lines depict the evolution with perfect credit markets. The output and TFP for the perfect-credit economy are respectively normalized by their steady-state values. The steady-state output and TFP with perfect credit markets are higher than their $\lambda = 1.3$ counterparts by 35% and 18%, respectively.

with $\lambda = 1.3$. There are no other frictions besides collateral constraints in the economy. Note that, loosely speaking, this initial condition has no more misallocation than its eventual steady state does.¹² In Figures 3 and 4, this transition is represented by the dashed line (labeled FF Only).

Compared to M+FF, FF Only converges to the steady state much faster. The half-life of aggregate capital stock is 9 years, about half of M+FF’s 17.5 years. Investment-to-output ratio and interest rate is decreasing over time, as in the neoclassical model.

Although FF Only and M+FF have the same initial stock of aggregate capital, the aggregate output for FF Only is initially much higher than in M+FF, as FF Only has less misallocation than M+FF to begin with. This is reflected in the measured TFP. As FF Only has no more misallocation than its eventual steady state—and hence there is no obvious reallocation of resources for more productive uses, it is not surprising that the imputed TFP remains constant over the course of the transition. In summary, although the two transitions are under the same degree of financial frictions ($\lambda = 1.3$) and they both arrive at the same steady state, the transition dynamics are very different.

We now try to isolate the role of financial frictions, by examining a perfect credit benchmark. With perfect credit markets, wealth distribution (beyond aggregate capital stock) does not affect aggregate capital accumulation or aggregate output. This aggregation result is shown in Section 3.5. Also note that the perfect-credit benchmark has a higher level of steady-state output and capital than the stationary equilibrium with $\lambda = 1.3$, as can be deduced from Figure 2. For ease of comparison, we study the transition from an initial condition with half the steady-state capital stock to the steady state with perfect credit markets (dotted lines, Figures 3 and 4).

The perfect-credit benchmark is essentially a neoclassical model as in Huggett (1997). The transition dynamics are therefore characterized by fast convergence to the steady state (a half-life of four years), decreasing interest rate and investment-to-output ratio over time. The imputed TFP

¹²In terms of our measure of misallocation, this initial condition has an ability-wealth correlation coefficient of 0.15, clearly higher than -0.01.

series is constant over time, as the ability distribution is time-invariant and hence the aggregate production function does not change over time (Section 3.5).

We briefly summarize the transitional dynamics results. The initial misallocation of resources—reflecting the reality in less developed countries—and financial frictions jointly generate aggregate dynamics that are broadly consistent with observed economic transitions (Figures 3 and 4). We emphasize that it is the interaction between initial misallocation and financial frictions that is instrumental in understanding development dynamics. Financial frictions alone without realistic initial misallocation (FF Only) do have level effects on output, capital, interest rate, and investment rate, but fail to generate transition dynamics qualitatively different from the neoclassical dynamics. On the other hand, without financial frictions, initial misallocation will be instantaneously undone, and we revert to the neoclassical case (Perfect Credit).¹³

With financial frictions, initial misallocation can be unwound only over time, and the effect of the initial misallocation—which was brought about by distortions in the past—remains for a prolonged period time, even after the non-financial distortions are all gone. We call this the persistence of history.

Now we will show how we construct an initial condition that are quantitatively consistent with empirical evidence on misallocation of resources in less developed economies.

3.4 Calibrating the Initial Steady State

In Section 3.3, we studied the transitional dynamics of an economy that starts from an initial condition characterized by misallocation of resources. Our claim there was that the degree of misallocation in our initial condition falls into an empirically-plausible range. In this subsection we describe how we construct this initial condition from data on less developed economies.

An initial condition in our framework is a joint distribution of ability and wealth: $G_0(e, a)$, as defined in Section 2. The challenge is that there is no direct quantitative evidence on this joint distribution. We can overcome this difficulty by using quantitative evidence on resource misallocation that has become recently available, and by utilizing the fact that our model endogenously generates joint distributions of wealth and ability.¹⁴

We think of our initial condition as the joint ability-wealth distribution in a steady state under financial *and* non-financial frictions. These frictions can be modeled with idiosyncratic distortions, or producer-specific taxes and subsidies (τ_{yi}, τ_{ki}) , that transform the static profit-maximization problem of an entrepreneur into:

$$(1 - \tau_{yi}) e^\nu \left(k_i^\alpha l_i^{1-\alpha} \right)^{1-\nu} - w l_i - (1 + \tau_{ki}) (\delta + r) k_i.$$

Note that τ_{ki} is a reduced-form representation of the financial frictions in our economy. This

¹³If the financial frictions are very mild (e.g. $\lambda = 5.0$ as in the US), we obtain results that are very similar to our perfect-credit exercise. In particular, initial ability-wealth distributions have small effects on macroeconomic dynamics, and the transitions are very neoclassical. These additional results are available upon request.

¹⁴Cagetti and De Nardi (2006) and Quadrini (2000) show that models with entrepreneurship and financial frictions are useful for understanding wealth distributions in data.

specification is identical to the theoretical framework that Hsieh and Klenow (2007) use to quantify idiosyncratic distortions in Chinese and Indian manufacturing sectors. In particular, they define and measure a geometric average of output and capital distortions: $\tau = (1 + \tau_k)^{(1-\nu)\alpha} / (1 - \tau_y)$.¹⁵ They find that idiosyncratic distortions in these economies are large, with a standard deviation of 0.63–0.86 log points (compared with 0.42 in the US), and are positively correlated with establishments’ productivity, with a correlation coefficient of 0.66–0.70 (0.46 in the US). In Table 2 we reproduce these moments for China, India and the US. More dispersion of τ and a stronger positive correlation between τ and individual productivity translate into lower TFP and output (Guner et al., 2006; Hsieh and Klenow, 2007; Restuccia and Rogerson, 2007).

	$std[\log(\tau)]$	$corr[\log(e^\nu), \log(\tau)]$	$corr[e^\nu, a]$
US	0.42	0.46	...
China/India	0.63–0.86	0.66–0.70	...
$\lambda = 5.0, \tau_y \equiv 0$	0.13	0.40	0.16
$\lambda = 1.3, \tau_y \equiv 0$	0.23	0.84	0.15
$\lambda = 1.3, \tau_y \neq 0$	0.34	0.63	-0.01

Table 2: Measured Distortions

The fourth row ($\lambda = 5.0, \tau_y \equiv 0$) of Table 2 represents our benchmark economy calibrated to the US. The standard deviation of the log idiosyncratic distortions in this benchmark economy is only 0.13. Note that, while there is no τ_y , the mild financial frictions generate some non-zero τ_k ’s. Given that the dispersion of the idiosyncratic distortions in China and India is 0.21–0.44 log points higher than that in the US (0.63–0.86 v. 0.42), our initial condition for the transition exercise—representing a typical less developed economy—should ideally have a standard deviation of $\log \tau$ between 0.34 and 0.57 (0.21+0.13 and 0.44+0.13).¹⁶ As shown in the same fourth row of the table, our benchmark economy has a correlation coefficient of 0.40 between log ability and log idiosyncratic distortion, which is comparable to the US data. Our initial steady state, were it to be consistent with the developing-country data on distortions, should have a correlation coefficient around 0.66.

Now we impose a τ_y process, along with more financial frictions ($\lambda = 1.3$, again a number consistent with the external finance to GDP figure for a typical less developed economy) onto our benchmark calibration (Table 1), and use our model to compute the stationary equilibrium.¹⁷ In particular, we choose the τ_y process in a way that, among the active entrepreneurs in the stationary

¹⁵Hsieh and Klenow assume monopolistically-competitive firms that use constant returns to scale technologies and face isoelastic demands. It can be shown that their measured distortions are isomorphic to the ones in our framework.

¹⁶There are two reasons for omitting non-financial distortions (τ_y) in our benchmark economy and instead targeting the difference in the dispersion of distortions. First, parts of the measured distortions may be measurement errors that affect the data from China, India and the US in a similar way. Second, the benchmark calibration (Section 3.1) is cleaner without τ_y ’s.

¹⁷We specify a process for distorted entrepreneurial abilities $\tilde{e} = (1 - \tau_y)e$. The process for distorted abilities \tilde{e} is described by a probability distribution $\varphi(\tilde{e}|e)$, summarizing the probability with which an individual with ability $e \in \mathcal{E}$ is assigned a distorted ability $\tilde{e} \in \tilde{\mathcal{E}}$. The support of the distorted abilities is a transformation of that of the true abilities, $\tilde{\mathcal{E}} = \mathcal{T}(\mathcal{E})$. We assume that the distorted ability and the true ability are equally persistent.

equilibrium, the standard deviation of log distortions (τ) is 0.34 and the correlation coefficient between log ability and log distortions is slightly lower than 0.66. An additional target moment is the steady state capital stock, which is set to be half the level in the stationary equilibria with $\lambda = 1.3$ and $\tau_y \equiv 0$ (financial frictions only). Note that, to be conservative, we choose to match the lower bound of the standard deviation estimate:¹⁸ A higher standard deviation implies more misallocation in the steady state and hence bigger effects on transition dynamics. The bottom row ($\lambda = 1.3, \tau_y \neq 0$) of Table 2 is the stationary equilibrium that closely matches all three targets. In computing the stationary equilibrium, we also obtain the corresponding distribution of ability and wealth. The implied ability-wealth correlation coefficient is -0.01, much lower than those of the economies without non-financial distortions (0.15–0.16). This joint distribution of wealth and ability is the initial condition for our transition exercise in Section 3.3.

The second-to-last row of Table 2 corresponds to an economy with financial frictions but no τ_y . This represents the new stationary equilibrium that the economy in Section 3.3 will reach, once all the idiosyncratic output distortions are eliminated. The standard deviation of log τ in the economy is 0.23, or 0.1 log points higher than in the US benchmark. Given the difference in this quantity between China or India and the US (0.21–0.44), one can conclude that financial frictions alone (no τ_y) account for between a quarter (0.1/0.44) and a half (0.1/0.21) of the total distortions in the developing country.

3.5 Aggregate Impact of Ability-Wealth Distribution

In this section, we attempt to provide more insights into how microeconomic heterogeneity—individuals’ ability and wealth—affects macroeconomic dynamics in our economy with financial frictions. We first explore how aggregate output is determined in our economy, and then show how individuals’ saving decisions and hence aggregate savings are affected by financial frictions.

With perfect credit markets, our model economy is isomorphic to a standard neoclassical growth model with the aggregate production function given by:

$$F(K) = \max_{e_m, 0 \leq \iota \leq \mu(e_m)} f \left(\sum_{e > e_m} \mu(e)e + \iota e_m, K, \sum_{e < e_m} \mu(e) + \mu(e_m) - \iota \right)$$

where K is the aggregate capital stock. Furthermore, if the individual technology is of the Cobb-Douglas form, $f(e, k, l) = e^\nu (k^\alpha l^{1-\alpha})^{1-\nu}$, the aggregate production function simplifies to:

$$F(K) = A(\mu) K^{\alpha(1-\nu)}, \tag{4}$$

$$A(\mu) = \max_{e_m, 0 \leq \iota \leq \mu(e_m)} \left(\sum_{e > e_m} \mu(e)e + \iota e_m \right)^\nu \left(\sum_{e < e_m} \mu(e) + \mu(e_m) - \iota \right)^{(1-\nu)(1-\alpha)},$$

where $A(\mu)$ embodies the effect of the distribution of entrepreneurial ability on aggregate output. This aggregate production function reflects optimal allocations of individuals to occupations—workers and entrepreneurs—and of capital and labor to active entrepreneurs.

¹⁸Note that parts of the difference in the dispersion of distortions may be attributable to measurement errors.

With financial frictions, however, aggregate output is not a simple function of aggregate factors of production as in Equation (4). Instead, aggregate output is now a function of the entire joint distribution of wealth and entrepreneurial ability:

$$Y = \tilde{F}(G(e, a); \lambda). \quad (5)$$

While Equation (4) is a proper production function—one that prescribes the maximum output that can be obtained with a given amount of capital and labor, Equation (5) is an equilibrium object describing the aggregate output in an economy with a given distribution of resources and a market structure.

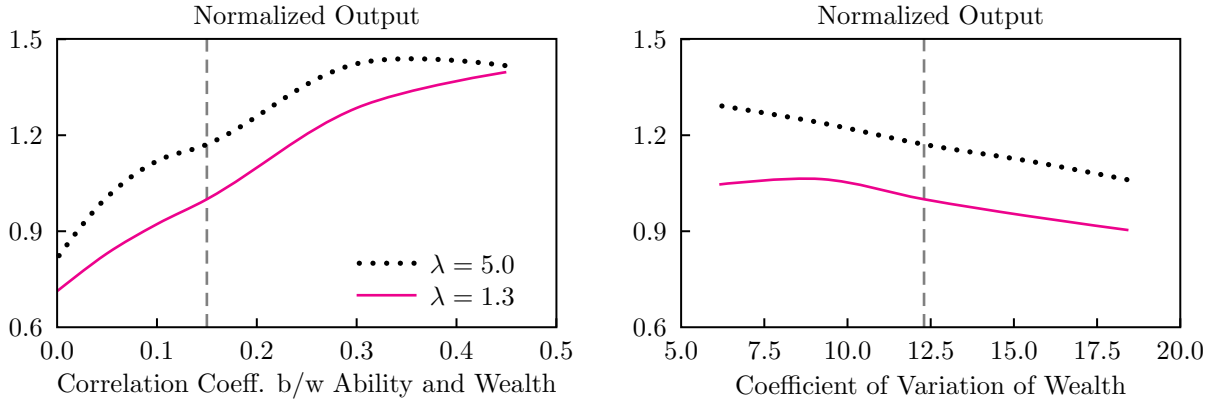


Fig. 5: Aggregate Output as a Function of the Joint Distribution of Wealth and Entrepreneurial Ability. For various ability-wealth distributions, we compute the aggregate output in the corresponding *static* equilibria under $\lambda = 1.3$ (solid lines) and $\lambda = 5.0$ (dotted lines). The output is then normalized by that of the benchmark distribution under $\lambda = 1.3$. The left panel plots aggregate output against the coefficient of correlation between ability (e^ν) and wealth of a given distribution. These distributions have the same marginal distribution of ability and wealth. The correlation coefficient of ability and wealth in the benchmark equilibrium is 0.15, which is represented by a dashed vertical line. In the right panel, we vary the dispersion of wealth while holding its mean and correlation with ability fixed. The coefficient of variation of wealth in the benchmark distribution is 12.3, represented by a dashed line.

Figure 5 captures some aspects of Equation (5) by showing how equilibrium aggregate output behaves as a function of ability-wealth distributions. A point on the horizontal axis corresponds to a particular exogenously-given ability-wealth distribution. The dashed vertical lines correspond to our benchmark distribution for this exercise, which is the invariant distribution with $\lambda = 1.3$ and no τ_y . For a given joint distribution of ability and wealth, we solve for the *static* competitive equilibrium with two different degrees of financial friction: $\lambda = 5.0$ and $\lambda = 1.3$.

In the left panel of Figure 5, starting with the benchmark distribution that has an ability-wealth correlation coefficient of 0.15, we vary the ability-wealth correlation while keeping the marginal distributions of wealth and of ability unchanged. It can be seen that aggregate output is sensitive to the correlation between wealth and ability.¹⁹ A lower ability-wealth correlation implies that more

¹⁹We obtain distributions with lower correlation of wealth and ability by randomly reallocating wealth for a subset of individuals. With more random reallocation, the correlation of wealth and ability goes down. To obtain distributions with a larger correlation, we mix the original distribution of wealth with a distribution where each individual can operate her technology at the respective efficient (or unconstrained profit-maximizing) scale.

high-ability entrepreneurs are poor and hence financially constrained, resulting in lower aggregate output. With less financial frictions ($\lambda = 5.0$, dotted line), there is more instantaneous reallocation of resources, and hence the aggregate output is higher for any given ability-wealth distribution.

In the right panel, starting from the benchmark distribution, we vary the unconditional variance of wealth while keeping the ability-wealth correlation coefficient and the marginal distribution of ability unchanged. Aggregate output is not affected as much as in the left panel, implying that what matters most for aggregate output is the degree of ability-wealth misallocation, measured here by their correlation coefficient. In summary, Figure 5 shows how ability-wealth distribution and financial frictions jointly determine aggregate output in our economy.

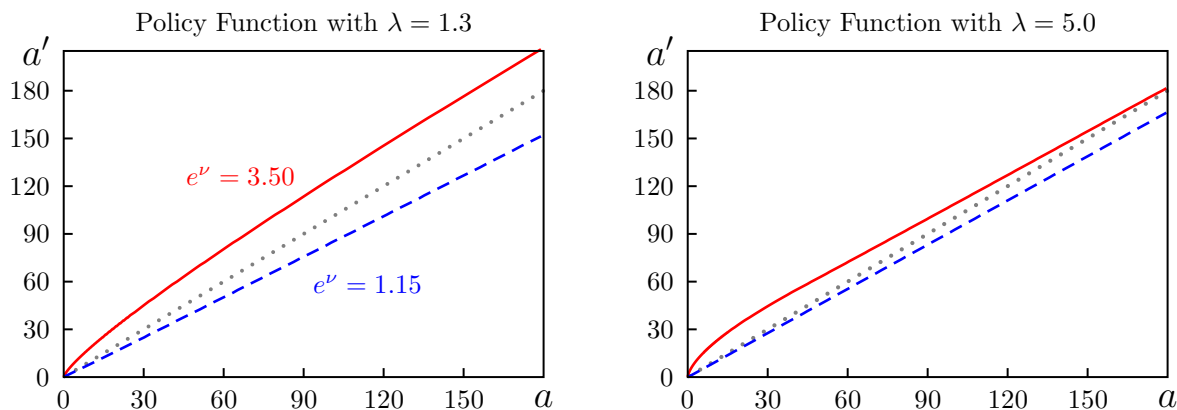


Fig. 6: Policy Functions in Stationary Equilibria. We plot individuals' choice of the next period asset holdings against their current holdings in stationary equilibria. Individuals with different entrepreneurial abilities have different policy functions. The solid lines correspond to individuals with the highest entrepreneurial ability in our discretization, while the dashed lines are for the median ability individuals. The 45-degree line is delineated with dots. Left panel is for the stationary equilibrium with $\lambda = 1.3$, and the right for the one with $\lambda = 5.0$.

While Figure 5 underlines the *static* interaction between financial frictions and ability-wealth distribution, Figure 6 shows their *dynamic* interactions. The solid lines are the policy function (next period's asset holdings as a function of current wealth) of the most productive entrepreneurs (e_{\max}^{ν}) in our economy. The dashed lines are that of the median entrepreneurial ability types. These are policy functions in the stationary equilibrium under $\lambda = 1.3$ (left panel) and under $\lambda = 5.0$ (right panel). The first thing to note is that different ability types have markedly different policy functions. While the median-ability type mostly dissaves, the high-ability type is keen on accumulating wealth—especially so when poor owing to her self-financing needs, as can be seen from the slope of the policy function. Clearly, it is important to know how the aggregate capital stock is distributed across different ability types if one wants to predict the dynamics of aggregate capital. This difference in individual savings rate across types helps explain the behavior of aggregate savings rate (investment-to-output ratio) in the early phases of transitions with initial misallocation, where high-ability types tend to be poorer than low-ability types (Figure 3).

With a lower degree of financial frictions ($\lambda = 5.0$, right panel), the difference in the policy functions across ability types diminishes. In the extreme case of perfect credit markets, all the types

will have policy functions with approximately equal slopes, and hence how wealth is distributed will not matter for aggregate dynamics (Krusell and Smith, 1998).

4 Concluding Remarks

In this paper, we incorporate financial frictions and entrepreneurship into an otherwise-standard neoclassical growth model, and quantify the role of financial frictions and resource misallocation in economic development. We find that financial frictions have a large impact along the transition to the steady state, when capital is misallocated initially. Our model economy converges slowly to the steady state, with the interest rate, investment rate and TFP starting low and rising over time.

We view this paper as a first step in building quantitative models to better understand the dynamics of development after growth-enhancing reforms. One commonly-held view on the income differences across countries is that there are barriers to adopting more productive modern technologies in poor countries (Hall and Jones, 1999; Parente and Prescott, 2000). Our model can be applied to study what will happen when such barriers are torn down. The magnitude and the speed of capital reallocation from traditional sectors to modern sectors will be determined by the existing resource misallocation across sectors—barriers inevitably imply misallocation—and the degree of financial frictions.

In this context, our work is also complementary to the literature that explains cross-country income differences with institutions (Acemoglu et al., 2005). In particular, our result on transition dynamics predicts that the adverse impact of inefficient institutions will outlast them by decades. The post-communist transition of Eastern Europe is a relevant example, given the rampant resource misallocation during the communist era and the abrupt liberalizations that followed. For another example, many Latin American economies' disappointing performance after market-oriented reforms in the 1990s (Cole et al., 2005; Morley et al., 1999; Mukand and Rodrik, 2005) can be partly explained by the slow reallocation of capital toward more efficient technologies.

Finally, while we have focused on the transitional dynamics of economic miracles, one can use our framework to analyze economic “disasters.” In our framework, an economic disaster can be engineered by introducing new idiosyncratic distortions into an economy with financial frictions. This interpretation is consistent with the recent experiences of Venezuela documented in Hsieh et al. (2008).

A Numerical Algorithm

A.1 Computing the stationary equilibrium

Stationary Competitive Equilibrium. A stationary competitive equilibrium in this economy consists of an invariant joint distribution of ability and wealth $G_\infty(e, a)$, policy functions $c(e, a)$, $a'(e, a)$, $l(e, a)$, $k(e, a)$, and prices w, r such that:

1. Given w and r , $c(e, a)$, $a'(e, a)$, $l(e, a)$, $k(e, a)$ solve the individuals' problem (2);
2. Labor and credit markets clear, which by Walras' law implies goods market clearing as well:

$$\sum_{e \in \mathcal{E}} \mu(e) \left[\int_{\underline{a}(e, w, r)}^{\infty} l(a; e, w, r) G_\infty(da|e) - G_\infty(\underline{a}(e, w, r) | e) \right] = 0,$$

$$\sum_{e \in \mathcal{E}} \mu(e) \left[\int_{\underline{a}(e, w, r)}^{\infty} k(a; e, w, r) G_\infty(da|e) - \int_0^\infty a G_\infty(da|e) \right] = 0;$$

3. The stationary joint distribution of ability and wealth $G_\infty(e, a)$ satisfies:

$$G_\infty(a|e) = \psi \int_{u \leq a} \int_{a'(e, v)=u} G_\infty(dv|e) du$$

$$+ (1 - \psi) \mu(e) \sum_{e_-} \int_{u \leq a} \int_{a'(e_-, v)=u} G_\infty(dv|e_-) du.$$

We solve for the stationary equilibrium of this economy based on the nested fixed-point algorithm of Aiyagari (1994). The difference is that we have to iterate on both wage w and interest rate r until both labor and capital markets clear in the stationary equilibrium. We start by fixing a T , the period by which the economy must have reached the steady state. We choose T to be 200 years. We numerically verify that increasing T to 300 has virtually no effect on the invariant distribution.

1. Guess the interest rate in the invariant distribution, r^i .
2. Guess the wage in the invariant distribution, $w^{i,j}$.
3. Given the guesses on interest rate and wage, solve the individuals' problem in the stationary equilibrium—Problem (2). Given the optimal decision rule, simulate N individuals for T periods. We set $N = 160,000$.
4. Check the labor market clearing condition in period T . If there is excess labor demand (supply), choose a new wage $w^{i,j+1}$ that is greater (smaller) than $w^{i,j}$.
5. Repeat Steps 3–4 until the labor market clears in period T .
6. Check the capital market clearing condition in period T . If there is excess capital demand (supply), choose a new interest rate r^{i+1} that is greater (smaller) than r^i .
7. Repeat Steps 2–6 until the capital market also clears in period T .

A.2 Computing the transition dynamics

To compute the entire transition dynamics, we have to iterate on the wage and interest rate sequences. Taking the wage and interest rate sequences as given, we solve for the individuals'

problem—Problem (1), and then check whether labor and capital markets clear for all periods. We fix T at 100. We numerically verify that increasing T to 125 has virtually no effect on the transition dynamics.

1. Guess at an interest rate sequence $\{r_t^i\}_{t=0}^T$.
2. Guess a wage sequence $\{w_t^{i,j}\}_{t=0}^T$. Compute the value function of the stationary equilibrium, and let $v_T(a; e) = v(a; e)$. By backward induction, taking the wage sequence $\{w_t^{i,j}\}_{t=0}^T$ and the interest rate sequence $\{r_t^i\}_{t=0}^T$ as given, compute the value function $v_t(a; e)$ for $t = T-1, \dots, 0$. Using the optimal decision rule, simulate N individuals for T periods. We again set $N = 160,000$. Check whether the labor market clears in every period. Taking the individuals' capital holdings as given, construct a sequence $\{\varpi_t^{i,j}\}_{t=0}^T$ that clears the labor market for each period. Update the wage sequence: $w_t^{i,j+1} = \eta_w \varpi_t^{i,j} + (1 - \eta_w) w_t^{i,j}$, $\forall t$, with $\eta_w \in (0, 1)$. Iterate on the wage sequence until convergence.
3. Once the wage sequence converges, check whether the capital market clears in all periods. Taking the individuals' capital holdings as given, construct a sequence $\{\iota_t\}_{t=0}^T$ that clears the static capital rental market for each period. The updated interest rate sequence now will be $\eta_r \iota_t + (1 - \eta_r) r_t^i$, $\forall t$, with $\eta_r \in (0, 1)$.
4. Repeat Steps 2–3 until the interest rate sequence also converges.

As we cannot guarantee the uniqueness of a numerically-constructed competitive equilibrium, we tried many different initial guesses of the wage and interest rate sequences, as well as several values of the relaxation parameters (η_w, η_r) . All our competitive equilibria withstood these robustness checks.

References

- ACEMOGLU, D., S. JOHNSON, AND J. A. ROBINSON (2005): “Institutions as a Fundamental Cause of Long-Run Growth,” in *Handbook of Economic Growth*, ed. by P. Aghion and S. N. Durlauf, Amsterdam: Elsevier, vol. 1A, 385–472.
- AIYAGARI, S. R. (1994): “Uninsured Idiosyncratic Risk and Aggregate Saving,” *Quarterly Journal of Economics*, 109, 659–684.
- ANGELETOS, G.-M. (2007): “Uninsured Idiosyncratic Investment Risk and Aggregate Saving,” *Review of Economic Dynamics*, 10, 1–30.
- ATKESON, A. AND P. J. KEHOE (1997): “Industry Evolution and Transition: A Neoclassical Benchmark,” Working paper, National Bureau of Economic Research.
- BAI, J. AND P. PERRON (2003): “Computation and Analysis of Multiple Structural Change Models,” *Journal of Applied Econometrics*, 18, 1–22.
- BANERJEE, A. V. AND E. DUFLO (2005): “Growth Theory through the Lens of Development Economics,” in *Handbook of Economic Growth*, ed. by P. Aghion and S. N. Durlauf, Amsterdam: Elsevier, vol. 1A, 473–552.
- BANERJEE, A. V. AND K. MUNSHI (2004): “How Efficiently is Capital Allocated? Evidence from the Knitted Garment Industry in Tirupur,” *Review of Economic Studies*, 71, 19–42.
- BARRO, R. J. AND J.-W. LEE (2000): “International Data on Educational Attainment: Updates and Implications,” Working Paper 7911, National Bureau of Economic Research.
- BARTELSMAN, E. J., J. HALTIWANGER, AND S. SCARPETTA (2006): “Cross Country Differences in Productivity: The Role of Allocative Efficiency,” Manuscript, Vrije Universiteit.
- BECK, T., A. DEMIRGÜÇ-KUNT, AND R. LEVINE (2000): “A New Database on the Structure and Development of the Financial Sector,” *World Bank Economic Review*, 14, 597–605.
- BERNANKE, B. S. AND M. GERTLER (1989): “Agency Costs, Net Worth, and Business Fluctuations,” *American Economic Review*, 79, 14–31.
- BERNANKE, B. S., M. GERTLER, AND S. GILCHRIST (1999): “The Financial Accelerator in a Quantitative Business Cycle Framework,” in *Handbook of Macroeconomics*, ed. by J. B. Taylor and M. Woodford, Amsterdam: North Holland, vol. 1C, 1341–1393.
- BLANCHARD, O. J. (1997): *The Economics of Post-Communist Transition*, Oxford: Clarendon Press.
- BUERA, F. J. (2006): “Persistency of Poverty, Financial Frictions, and Entrepreneurship,” Manuscript, Northwestern University.
- CAGETTI, M. AND M. DE NARDI (2006): “Entrepreneurship, Frictions, and Wealth,” *Journal of Political Economy*, 114, 835–870.

- CALVO, G. A. AND F. CORICELLI (1992): “Stabilizing a Previously Centrally Planned Economy: Poland 1990,” *Economic Policy*, 7, 175–226.
- CAMDESSUS, M. (1999): *Second Generation Reforms: Reflections and New Challenges*, available on the internet at <http://www.imf.org/external/np/speeches/1999/110899.HTM>.
- CASTAÑEDA, A., J. DÍAZ-GIMÉNEZ, AND J.-V. RÍOS-RULL (2003): “Accounting for the U.S. Earnings and Wealth Inequality,” *Journal of Political Economy*, 111, 818–856.
- CHEN, K., A. İMROHOROĞLU, AND S. İMROHOROĞLU (2006): “The Japanese Saving Rate,” *American Economic Review*, 96, 1850–1858.
- CHRISTIANO, L. J. (1989): “Understanding Japan’s Saving Rate: The Reconstruction Hypothesis,” *Federal Reserve Bank of Minneapolis Quarterly Review*, 13, 10–25.
- COHEN, D. AND M. SOTO (2007): “Growth and Human Capital: Good Data, Good Results,” *Journal of Economic Growth*, 12, 51–76.
- COLE, H. L., L. E. OHANIAN, A. RIASCOS, AND J. A. SCHMITZ, JR. (2005): “Latin America in the Rearview Mirror,” *Journal of Monetary Economics*, 52, 69–107.
- DAVIS, S. J., J. C. HALTIWANGER, AND S. SCHUH (1996): *Job Creation and Destruction*, Cambridge, MA: MIT Press.
- EVANS, D. S. AND B. JOVANOVIĆ (1989): “An Estimated Model of Entrepreneurial Choice under Liquidity Constraints,” *Journal of Political Economy*, 97, 808–827.
- GINÉ, X. AND R. M. TOWNSEND (2004): “Evaluation of Financial Liberalization: A General Equilibrium Model with Constrained Occupation Choice,” *Journal of Development Economics*, 74, 269–307.
- GUNER, N., G. VENTURA, AND Y. XU (2006): “Macroeconomic Implications of Size-Dependent Policies,” Manuscript, Pennsylvania State University.
- HALL, R. E. AND C. I. JONES (1999): “Why Do Some Countries Produce So Much More Output per Worker than Others?” *Quarterly Journal of Economics*, 114, 83–116.
- HSIEH, C.-T. AND P. KLENOW (2007): “Misallocation and Manufacturing TFP in China and India,” Manuscript, Stanford University.
- HSIEH, C.-T., E. MIGUEL, D. ORTEGA, AND F. RODRÍGUEZ (2008): “The Price of Political Opposition: Evidence from Venezuela’s Maisanta,” Manuscript, University of Chicago.
- HUGGETT, M. (1997): “The One-Sector Growth Model with Idiosyncratic Shocks: Steady States and Dynamics,” *Journal of Monetary Economics*, 39, 385–403.
- JEONG, H. AND R. M. TOWNSEND (2005): “Growth and Inequality: Model Evaluation Based on an Estimation-Calibration Strategy,” Manuscript, University of Southern California.

- (2007): “Sources of TFP Growth: Occupational Choice and Financial Deepening,” *Economic Theory*, 32, 197–221.
- JONES, B. F. AND B. A. OLKEN (2008): “The Anatomy of Start-Stop Growth,” Forthcoming, *Review of Economics and Statistics*.
- KING, R. G. AND R. LEVINE (1993): “Finance and Growth: Schumpeter Might be Right,” *Quarterly Journal of Economics*, 108, 717–737.
- KING, R. G. AND S. T. REBELO (1993): “Transitional Dynamics and Economic Growth in the Neoclassical Model,” *American Economic Review*, 83, 908–931.
- KIYOTAKI, N. AND J. MOORE (1997): “Credit Cycles,” *Journal of Political Economy*, 105, 211–248.
- KLENOW, P. J. AND A. RODRÍGUEZ-CLARE (1997): “The Neoclassical Revival in Growth Economics: Has it Gone Too Far?” in *Macroeconomics Annual 1997*, ed. by B. S. Bernanke and J. J. Rotemberg, Cambridge: MIT Press, 73–102.
- KRUSELL, P. AND A. A. SMITH, JR. (1998): “Income and Wealth Heterogeneity in the Macroeconomy,” *Journal of Political Economy*, 106, 867–896.
- LA PORTA, R., F. LOPEZ DE SILANES, A. SHLEIFER, AND R. W. VISHNY (1998): “Law and Finance,” *Journal of Political Economy*, 106, 1113–1155.
- LUCAS, JR., R. E. (1978): “On the Size Distribution of Business Firms,” *Bell Journal of Economics*, 9, 508–523.
- MORLEY, S. A., R. MACHADO, AND S. PETTINATO (1999): “Indexes of Structural Reform in Latin America,” Serie de reformas económicas, United Nations Economic Commission for Latin America and the Caribbean, Santiago, Chile.
- MUKAND, S. W. AND D. RODRIK (2005): “In Search of the Holy Grail: Policy Convergence, Experimentation, and Economic Performance,” *American Economic Review*, 95, 374–383.
- NAVIA, P. AND A. VELASCO (2003): “The Politics of Second-Generation Reforms,” in *After the Washington Consensus: Restarting Growth and Reform in Latin America*, ed. by P.-P. Kuczynski and J. Williamson, Washington, DC: Peterson Institute, 265–303.
- PARENTE, S. L. AND E. C. PRESCOTT (2000): *Barriers to Riches*, Cambridge: MIT Press.
- QUADRINI, V. (2000): “Entrepreneurship, Saving, and Social Mobility,” *Review of Economic Dynamics*, 3, 1–40.
- RESTUCCIA, D. AND R. ROGERSON (2007): “Policy Distortions and Aggregate Productivity with Heterogeneous Plants,” Working Paper 13018, National Bureau of Economic Research.
- RODRÍGUEZ, F. AND D. RODRIK (2000): “Trade Policy and Economic Growth: A Skeptic’s Guide to the Cross-National Evidence,” in *NBER Macroeconomics Annual*, ed. by B. S. Bernanke and K. Rogoff, Cambridge, MA: MIT Press, 261–325.

- ROLAND, G. (2000): *Transition and Economics: Politics, Markets, and Firms*, Cambridge: MIT Press.
- SACHS, J. D. AND A. M. WARNER (1995): “Economic Reform and the Process of Global Integration,” *Brookings Papers on Economic Activity*, 1995, 1–118.
- TOWNSEND, R. M. (2008): “Finance in Developing Economies: Growth, Inequality, Poverty and Policy Evaluation in Thailand,” Manuscript, University of Chicago.
- WACZIARG, R. AND K. H. WELCH (2003): “Trade Liberalization and Growth: New Evidence,” Working Paper 10152, National Bureau of Economic Research.
- YOUNG, A. (1995): “The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience,” *Quarterly Journal of Economics*, 110, 641–680.