Lack of Selection and Limits to Delegation: Firm Dynamics in Developing Countries*

Ufuk Akcigit
University of Pennsylvania and NBER

Harun Alp
University of Pennsylvania

Michael Peters
Yale University

October 8, 2014

Abstract

Firm dynamics in poor countries show striking differences to those of rich countries. While some firms indeed experience growth as they age, many firms are simply stagnant in that they neither exit nor expand. We interpret this fact as a lack of selection, whereby producers with little growth potential survive because innovating firms do not expand enough to force them out of the market. Our theory stresses the role of limited delegation of managerial tasks and the acquisition of managerial time. If managerial effort provision is non-contractible, entrepreneurs of will benefit little from delegating the decision power to outside managers, as they spend most of their time monitoring their managerial personnel. As the return to managerial time is higher in big firms, improvements in the degree of contract enforcement will raise the returns of growing large and increase the degree of creative destruction and firm selection. To discipline the quantitative importance of this mechanism, we incorporate such incomplete managerial contracts into an endogenous growth model and calibrate it to firm level data from India. Improvements in the process of delegation can explain a sizable fraction of the difference between US and Indian lifecycles of plants.

Keywords: Development, growth, selection, competition, firm dynamics, contracts, management, entrepreneurship.

JEL classification: O31, O38, O40

STILL PRELIMINARY!!!

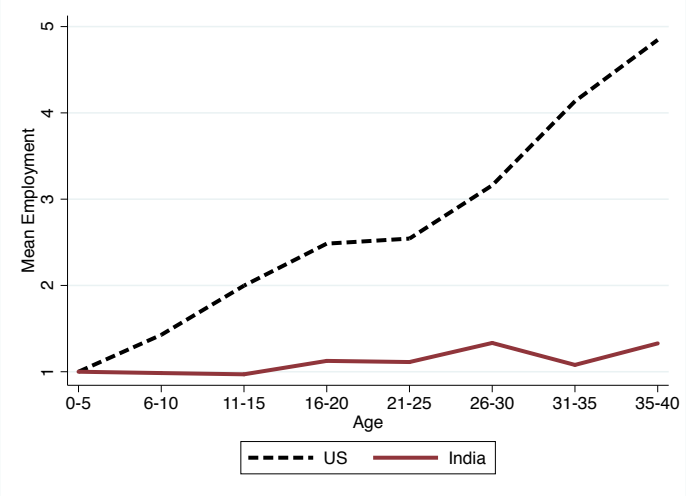
*We thank the seminar and conference participants at the Productivity, Development & Entrepreneurship, and Macroeconomics Within and Across Borders Meetings at the NBER Summer Institute, Yale, LSE, OECD/NBER Conference on Productivity and Innovation, Minnesota Macro, Penn State, Kauffman Entrepreneurship Conference, London Macroeconomics Conference, Cologne Workshop on Macroeconomics, SKEMA Growth Conference, and UPenn Growth Reading Group for helpful comments, and Nick Bloom, Francesco Caselli, Matthew Cook, Jeremy Greenwood, John Haltiwanger, Chang-Tai Hsieh, Daniel Keniston, Pete Klenow, Sam Kortum, Aart Kraay, Rasmus Lentz, Giuseppe Moscarini, Luis Serven, Yongs Shin, and Silvana Tenreyro for very valuable feedback. Chang-Tai Hsieh and Pete Klenow have kindly provided some of their data for this project. Akcigit gratefully acknowledges financial support from the World Bank and thanks the Cowles Foundation and the Becker Friedman Institute for the great hospitality during some parts of this project.

1 Introduction

Recent empirical literature on firm dynamics has documented striking differences across countries. While firms in rich countries experience rapid growth conditional on survival, firms in poor countries remain small and do not grow (Hsieh and Klenow (2014), see also Figure 1). Those firms that manage to grow rapidly force the bad firms to exit, generating a *selection* mechanism in rich countries. Firm growth comes with additional needs, such as restructuring within the firm and delegation of certain tasks to new managers. A major obstacle in developing countries is the lack of trust to non-family members and the weakness of the legal system, making the number of male family members the best predictor of firm size (Bloom, Eifert, McKenzie, Mahajan, and Roberts, 2013). These observations raise the following important questions: How do institutions affect a business owner's decision to delegate managerial tasks to outside managers? What is the link between delegation and firm growth? How do institutions affect aggregate productivity through firm selection and firm dynamics? This paper is an attempt to answer these questions both theoretically and empirically.

To answer these questions, we proceed in three steps. First, we build a new theory of endogenous technical change with the following key features: Firms are heterogenous in terms of their growth potentials (for the selection margin), managers are used as an additional factor of production to capture the role of managers in the production process, firm owner can chose to delegate some of the managerial tasks by hiring outside managers, and finally contractual frictions will be affected by the quality of institutions in the economy. In the second step, we test various unique predictions of the model using Indian manufacturing establishments. In the fianl step, we calibrate the model in order to quantify the importance delegation and contractual frictions in understanding the life-cycle differences of firms across India and the US.

FIGURE 1: LIFE-CYCLE OF ESTABLISHMENTS IN THE US AND IN INDIA



Notes: The underlying data is taken from Hsieh and Klenow (2014). Each line represents the average employment of establishments within the corresponding age bin. See Section 3 for further details on the data.

The existence of stagnant firms is not peculiar to the Indian economy. There are also many firms in the US which don't grow and they also seem to do it deliberately. As documented by Hurst and Pugsley (2012), around 75% of the surveyed small businesses do not want to grow "big".

The fact that scarce factors are occupied by small firms with no growth perspective is not a major problem in the US economy, since through competition, many of these small business are forced to exit by expanding firms as illustrated in Table 1 and their factors are reallocated to the growing firms.

Table 1: Life-cycle Employment Trends of the US Firms

	0-10 Years Old	*10-25 Years Old*
Share of firms with < 20 workers	85.5%	71.5%
Share of aggregate employment in firms with < 20 workers	34.6%	16.0%

Source: Hurst and Pugsley (2012), Tables 2A and 2B, 2005 Business Dynamics Statistics Database.

Table 1 shows that among young firms, small firms (with less than 20 workers) account for 86% of the total count and 35% of the employment share. These numbers decline dramatically when it comes to the mid-aged firms. This is due to the massive reallocation of factors that takes place among firms in the US economy (Foster, Haltiwanger, and Krizan, 2001, 2006; Acemoglu, Akcigit, Bloom, and Kerr, 2013). This selection margin is hardly present in the Indian economy, as illustrated in Figures 2 and 3.

Figure 2 studies the same Indian data as Figure 1 but from a slightly different angle. Instead of looking at the average employment in each age bin, Figure 2 first selects the largest 5% establishments by each age bin and reports the average employment of those selected group. In other words, it reports the average employment of the "best establishments" by each age group. Clearly, at the upper tail of the size distribution, there are firms that are growing over their life cycle, however their growth is not strong enough to create the strong reallocation and selection that we observe in the US economy. Indeed, Figure 3 reports the share of establishments with at most 2 workers and the striking result is that there is almost no decline in the share of small firms over the life cycle, in other words, the Indian economy suffers from lack of selection of good firms.

Why is the degree of creative destruction, whereby innovative firms replace stagnant firms, so low in India? To answer this question, Bloom, Eifert, McKenzie, Mahajan, and Roberts (2013) collect micro-level evidence from Indian textile firms. Their findings are quite intruiguing: Firm expansion is mainly constrained by the limited managerial span of control. Only the members of the owning family are given the decision-making positions in the firm. Non-family members are simply not trusted and therefore managerial tasks are not delegated. Legal environment is a leading cause for limited delegation. If an Indian firm owner caught an outside manager stealing or shirking, she would have very little formal recourse as the court cases take very long and require additional bribes (Bloom, Eifert, Heller, Jensen, and Mahajan, 2009). Therefore Bloom, Eifert, McKenzie, Mahajan, and Roberts (2013) find that one of the best predictor of firm size in India is the number of male family members. Relatedly, Bloom, Sadun, and Van Reenen (2012) find that in countries with stronger rule of law, firms are larger and more decentralized with many of the managerial tasks being delegated to outsiders.

Our goal in this paper is to study the implications of managerial delegation and firm selection on firm dynamics and the aggregate economy. Our analysis proceeds in three steps. First, motivated by the empirical observations described above, we build a new endogenous technical change model with heterogenous firms in the tradition of Klette and Kortum (2004). We model firm dynamics as the outcome of creative destruction, whereby firms expand into new product lines by investing in

FIGURE 2: LIFE-CYCLE OF TOP-5% FIRMS BY AGE

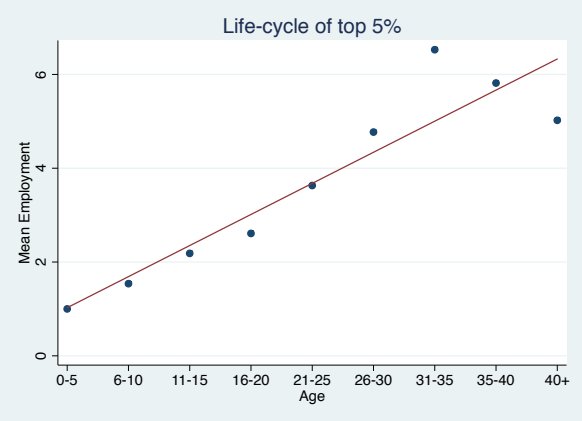
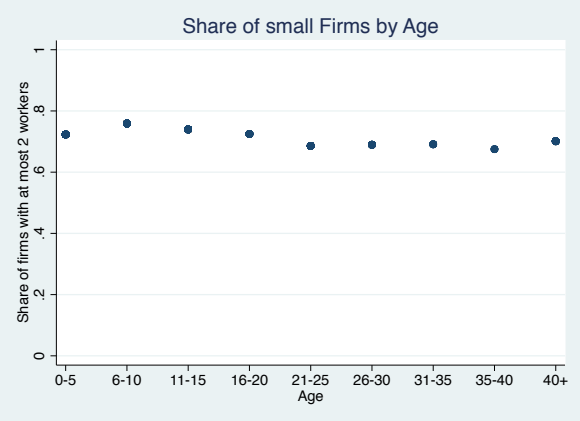


FIGURE 3: SHARE OF FIRMS WITH ≤ 2 WORKERS



Notes: The data comes from Indian Manufacturing Plants (ASI and NSS). Figure 2 plots the average employment of top-5% plants in terms of their employments within the corresponsing age bin. Figure 3 plots the share of establishments with less than or equal to 2 workers within the corresponding age bin. See Section 3 for further details on the data.

productivity-enhancing activities. To study the importance of selection, we allow for two types of firms. While high-type firms have the potential to grow by investing in technological improvements, low-type firms are endowed with an inefficient innovation technology, which makes them remain small. Managerial effort is an input into the production technology. Firm owners have limited time endowment, therefore owner-run firms run into span of control problem in the spirit of Lucas (1978). Owners can overcome the span of control problem by choosing to delegate managerial tasks to outsiders, but the net return to delegation depends critically on the rule of law and human capital of the managers. Therefore, in our model, owners endogenously choose to whether to hire outside managers and if they do, how many managers to hire. The model predicts a threshold firm size below which firms are run only by their owners and this threshold depends on the country-specific institutional parameters. One of the interesting findings of the theoretical model is that the firm-level diminishing returns (due to the span of control problem) is overcome by the managerial delegation and the firm value becomes linear in firm size beyond that delegation size threshold. The slope of this linear value function is determined by the net benefit of delegation and dictates the dynamic incentives to firm growth.

The second part of our analysis consists of a number of validation exercises using Indian micro-level data. For instance our model predicts that in countries where the rule of law is stronger, firms decide to hire more outside managers both at the extensive and the intensive margin, a result that is strongly supported by the data. Another interesting prediction of the model is that controlling for firm size, if the owner has bigger time endowment (for instance through larger family size), she will hire less outside managers.

The third part of our analysis consists of the quantitative investigation of the model. In this section, we first calibrate our model to the Indian data. A neat result of the theoretical model is that the net benefit to delegation is summarized by a single parameter and that single parameter has a very large impact on the share of the workforce that works as managers. Next, keeping all other parameters at the Indian levels, we recalibrate this single parameter to match the share of

managers in the US economy. This exercise shows us that if the Indian firms were able to obtain the US-level benefit of delegation, the life-cyle gap that was shown in Figure 1 would have been closed by 50%. This quantitatively large impact comes from the fact that all good-type but stagnant firms are incentived by the higher return to expansion through delegation and the selection margin is vitalized by the growing firms. In an extension of the analysis, we further show that 70% of the benefit of delegation comes from the stronger rule of law of the US economy. In contrast, human capital differences between US and Indian managers cannot account for these differences in the efficiency of delegation.

Related Literature The idea that managerial inputs are crucial for the process of firm dynamics has a long tradition in development economics. Of particular importance is the seminal work of Penrose (1959), who argues not only that managerial resources "create a fundamental and inescapable limit to the amount of expansion a firm can undertake at any time" but also that it is precisely this scarcity of managerial inputs that prevents the weeding out of small firms as "the bigger firms have not got around to mopping them up" (Penrose (1959, p. 221)). Recently, a series of papers by Bloom and Van Reenen have provided empirical support for this view. First, they show that managerial practices differ across countries (Bloom and Van Reenen (2007, 2010)). Second, as described earlier, they suggest that it is not merely differences in managerial technology (or human capital) that determine managerial efficiency, but that contractual imperfections are likely to be at the heart of why firms in poor countries might be "management constrained."

On the theoretical side, this paper provides a new theory of firm dynamics in developing countries.[1] While many recent papers have aimed to measure and explain the static differences in allocative efficiency across firms,[2] there has been little theoretical work explaining why firm dynamics differ so much across countries. A notable exception is the work by Cole, Greenwood, and Sanchez (2012), who argue that cross-country differences in the financial system will affect the type of technologies that can be implemented. Like them, we let the productivity process take center stage. However, we turn to the recent generation of micro-founded models of growth, in particular Klette and Kortum (2004). While such models have been built to study firm dynamics in developed economies (Lentz and Mortensen (2005, 2008), Akcigit and Kerr (2010), Acemoglu, Akcigit, Bloom, and Kerr (2013)), this is not the case for developing countries.[3] We believe endogenous technical change models are a natural environment for studying this question, as they focus on firms' productivity-enhancing investment decisions. We believe that models of endogenous growth have been under-utilized in the development literature, partly because of a lack of data to discipline these models, and partly because early models of endogenous growth have been mainly constructed to model innovation decisions of firms in developed countries.[4] Hence, these early models have been harmonized with terminologies such as innovation, R&D, patent protection, and innovation policy, which do not seem to properly capture the reality of firms in developing countries. For the

[1] An overview of some regularities of the firm size distribution in India, Indonesia and Mexico is contained in Hsieh and Olken (2014).

[2] The seminal papers for the recent literature on misallocation are Restuccia and Rogerson (2008) and Hsieh and Klenow (2009). As far as theories are concerned, there is now a sizable literature on credit market frictions (Buera, Kaboski, and Shin, 2011; Moll, 2010; Midrigan and Xu, 2010), size-dependent policies Guner, Ventura, and Xu (2008), monopolistic market power (Peters, 2013) and adjustment costs (Collard-Wexler, Asker, and De Loecker, 2011). A synthesis of the literature is also contained in Hopenhayn (2012) and Jones (2013).

[3] An exception is Peters (2013), who applies a dynamic Schumpeterian model to firm-level data in Indonesia.

[4] A major impediment to bringing the first-generation models of endogenous growth to the data is that these were aggregate models, which do not have direct implications at the firm level (Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1991).

remainder of this paper, we therefore refer to innovation in a broad sense, capturing not only the implementation of new ideas but also a variety of costly productivity-enhancing activities, encompassing also training, reorganization or the acquisition of high-quality complementary factors.

We focus on inefficiencies in the interaction between managers and owners of firms to explain the differences in firms' demand for expansion. Hence, particularly relevant contributions are Caselli and Gennaioli (2012) and Powell (2012). Caselli and Gennaioli (2012) also stress the negative consequences of inefficient management. Their focus is on the efficiency of the "market for control", i.e., the market where (untalented) firm owners are able to sell their firms to (talented) outsiders. With imperfect financial markets, such transactions might not take place as outsiders might be unable to secure the required funds.[5] Our economy does not have any exogenous heterogeneity in productivity so that there is no notion of *static* misallocation. In contrast, we argue that managerial frictions *within* the firm reduce growth incentives and hence prevent competition from taking place sufficiently quickly on product markets. Such within-firm considerations are also central in Powell (2012), who studies an economy where firms ("owners") need to hire managers as inputs to production but contractual frictions prevent owners from committing to pay the promised managerial compensation after managerial effort has been exerted. He studies the properties of the optimal long-term relational contract in a stationary equilibrium, whereby owners are disciplined to keep their promises through reputational concerns. There are two important differences from our paper. First, Powell (2012) studies an economy where firm productivity is constant, i.e., there is no interaction between contractual frictions in the market for managers and firms' innovation incentives. Second, while he studies the implications of *owners* not being able to write contracts on their wage promises, we focus on *managers* not being able to contractually commit themselves to their choice of effort. This difference is important in that it determines the distribution of costs of imperfect legal systems. While in our model, contractual frictions will especially hurt *large* firms, for which hold-up is costly, Michael Powell's model implies that *small* producers will be particularly affected, as they have little reputational capital to pledge.

The remainder of the paper is organized as follows. The next section presents evidence on the two main ingredients of our theory. In particular, we present three regularities of managerial employment across countries and use Indian micro data to show the importance of our assumption on innovating and stagnant firms. In Section 2 we describe the theoretical model. Section 3 contains the quantitative analysis. We first calibrate the model to the Indian micro data and then consider the two policy exercises discussed above. Section 4 concludes.

2 The Model

We consider a firm-based model of endogenous technical change in the spirit of Klette and Kortum (2004). We augment this framework with three ingredients:

1. Entrepreneurs are heterogeneous in their innovation potential.

2. Both managerial time and labor time are inputs for production and individuals can either work as production workers or managers.

3. Firm owners are endowed with fixed amount of managerial time and owners can choose to delegate managerial tasks to outside managers, subject to the contractual frictions.

[5] Another reason for untalented owners to *not* sell their firm is that individual wealth can substitute for managerial incompetence if financial markets are imperfect. Hence, financial frictions will also reduce the supply of firms and not only the demand from credit-constrained outsiders.

The first two items allow us to meaningfully speak about a process of selection. It is the last ingredient that will determine how quickly this process will take place. To sustain innovation incentives, entrepreneurs have to delegate eventually to not run out of managerial time, which they can provide on their own behalf. We will be thinking of the degree of contractual frictions as our main source of variation across countries. However, we will also allow for differences in human capital and will use the cross-country data to distinguish between these different margins.

More precisely, we think of an economy that is populated by two types of agents: workers and entrepreneurs. Entrepreneurs are endowed with production possibilities ("firms") and have the capacity to grow their firms through innovation. Entrepreneurs come in two types, which differ in their innovation costs: while high types can perform innovation activities and hence generate sustained productivity growth through creative destruction, low types are not capable of starting a thriving business in that they have no talent for innovation. Hence, our model is a heterogeneous firm model, where firms do not differ in their exogenous TFP (as in Lucas (1978)), but where firms differ in the efficiency of innovation. The process of creative destruction, which is ignited by the high types, determines how long low types can remain in business. Hence, at the heart of our selection process is the demand for growth of high types.

Entrepreneurs combine their technology with two inputs of production: workers and managerial effort. By increasing the amount of managerial effort, firms can increase the efficiency of their physical production factors. Hence, well-managed firms have high "x-efficiency" in that they combine their technology and their production workers more effectively. While workers are simply hired in a frictionless spot market, the provision of managerial effort is more involved. In particular, managerial services can either be provided solely by the entrepreneur himself or can be acquired on the market by delegating decision power to specialized manager. Specialized managers are useful in that they can add to the supply of managerial resources within the firm. However, the interaction between entrepreneurs and managers is subject to contractual frictions, which will taint the efficiency with which managers can be employed. This has important dynamic ramifications: because large firms will - endogenously - be more likely to delegate, the incentives to grow large are low when contracts are hard to enforce. Hence, the demand for creative destruction will - endogenously - be low and the economy will be sclerotic for two reasons. First, low types, i.e., firms without any growth potential, will survive for a long time conditional on entry. Second, contractual frictions reduce the demand for outside managers, both by reducing managerial demand of firms of a given size and by changing the stationary distribution of firm size toward smaller firms.

For simplicity we assume that both managers and entrepreneurs are short-lived. More precisely entrepreneurs live for one period and then hand over the firm to their offspring, who also live for one period. This is isomorphic to an environment where entrepreneurs are infinitely lived but have a planning horizon of only one period. This is useful for analytical tractability and captures all the economic intuition.

2.1 Preferences and Technology

The final good is a composite of a continuum of intermediate goods, and produced with the Cobb-Douglas technology under perfect competition:

$$\ln Y_t = \int_0^1 \ln y_{jt} dj,$$

where y_{jt} is the amount of product j produced at time t. To save notation, the time subscript t will be dropped henceforth when it causes no confusion.

Production of intermediate goods takes place by heterogeneous firms and uses both production workers and managers. In particular, the production function for good j at time t is given by

$$y_{jf} = q_{jf}\mu\left(e_{jf}\right)l_{jf},$$

where q_{jf} is the firm-product specific production technology, $\mu\left(e_{jf}\right)$ is functional form that translates managerial effort e_j supplied by firm f in product line j into managerial efficiency units for production, and l_{jf} is the number of workers employed for producing intermediate good j.

Each intermediate good j is produced by a firm that has the highest productivity in line j, and that firm also acts as a monopolist. One of the new ingridients of the current model, which is also the main focus of our analysis, is the provision of the managerial effort in production. In order to keep the focus on the determination of the managerial effort, here we skip the lenghty details of the market structure. It can be shown that the profit in each line j is a concave function of the managerial effort e_j and the elasticity, and determined by the parameters σ as follows:

$$\pi_{jt} = e_j^{\sigma} Y_t \tag{1}$$

i.e. profits are a simple power-function of managerial effort. Section 5.1 provides the necessary details that endogenously leads to the exact expression of (1).

There is measure 1 of individuals who can work as production workers or managers. Let us denote the number of production workers and managers hired in line j by l_j and m_j, respectively. Then the labor market clearing condition will be

$$1 = \int_0^1 \left(l_j + m_j\right) dj.$$

Definition of a Firm In this model, a firm is a collection of product lines (as in Klette and Kortum (2004)). Figure 4 illustrates examples of two firms in the economy. In this example, firm f_1 owns 5 lines and f_2 owns 3. Firms can expand into a new product line j' by introducing a better version of what the current incumbent in j' produces. We will describe innovation and firm growth in Section 2.3.

Entrepreneur (owner) Firms are owned by entrepreneurs. Each entrepreneur has a fixed $T > 0$ units of managerial effort, e. If an entrepreneur who owns a firm with n product lines decides to run her firm alone, then she will have $e_j = T/n$ managerial effort for each line. This implies that the normalized profit from each product line is $\tilde{\pi}_{jt} \equiv \pi_{jt}/Y_t = (T/n)^{\sigma}$ and the instantenous firm value is $\tilde{V}^{self}(n) = n\tilde{\pi}_j$:

$$\tilde{V}^{self}(n) = T^{\sigma} n^{1-\sigma} \tag{2}$$

Figure 5 illustrates the value of a firm that is run only by its owner. The value is increasing in the number of product lines n but at a decreasing rate. This is due to the fact that the owner has a fixed time endowment T and runs into span of control problem as it was described in the seminal paper by Lucas (1978).

2.2 Delegation

An owner can delegate some of the managerial task to outside managers by paying a wage rate of w to each. The cost of hiring an outside manager is the wage rate w that will be paid to the manager and the time that the owner has to spend to monitor her but the benefit is the additional

FIGURE 4: DEFINITION OF FIRMS

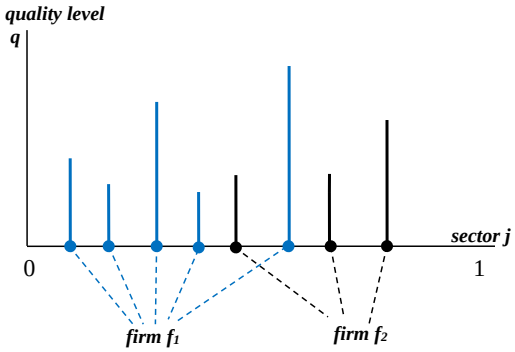
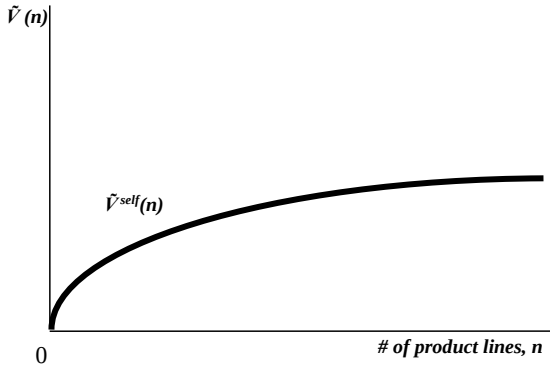


FIGURE 5: VALUE OF AN OWNER-RUN FIRM



managerial effort that the outside manager provides. We denote the *net benefit of delegation* per manager by ξ which is in terms of managerial effort units e. In other words, an owner that has n product lines over whch she distributes her time equally, and hires m_j managers per each line j has a total managerial effort in line j equal to $e_j = T/n + m\xi$ per line but has to pay $m_j w$ in return.

The net benefit of delegation ξ can depend on various country-specific characteristics, such as the strength of rule of law, human capital, or the quality of the monitoring technologies. In the following subsection, we provide a micro-founded game to illustrate how the level of ξ might depend on those country characteristics. Uninterested readers can take ξ as given and skip to Section 2.2.2 where the owner's delegation problem is described.

2.2.1 Delegation with contractual frictions

As it was described in the Introduction, delegation of tasks to outside managers has both monetary and monitoring time costs. A major concern for the business owners (especially in India) is the fact that outside managers can misbehave and the weak legal system prevents the owner to seek their rights to punish the manager who does not deliver the promise. Therefore the owners themselves need to invest time to monitor the magaers. To capture these considerations, we consider the following scenario: Both managers and owners each have one unit of time at their disposal. While owners can provide T units of effort during that time interval, managers can provide η units of effort. One can also think that η would be related to the *human capital* of the outside managers.

Managerial effort provision, however, is subject to contractual frictions. For simplicity, we assume that the manager can decide to either provide effort, in which case his contribution to the firms' time endowment is η, or shirk, in which case he adds no human capital to the firm:

$$e_j^{manager} = \begin{cases} \eta \text{ if work,} \\ 0 \text{ if shirk.} \end{cases}$$

Crucially, the managers' effort choice is not perfectly contractible but the entrepreneur has to monitor the manager and has to rely on the legal system in case she catches the manager shirking. We assume that if the manager spends s units of effort in monitoring a manager, she will catch a shirking manager with probability ϕs. Here ϕ simply captures the quality of the monitoring technology in the country. Whenever the manager shirks and the owner catches her, the owner can go to court and sue the manager for the managerial wage w. To model differences in the efficiency of the legal system, we assume that in such case, the court (rightly) decides in the owner's favor

with probability $\kappa \in [0,1]$. Hence one can think of μ as the proxy for the rule of law in the country. Finally, the demand for shirking arises because shirking carries a private benefit bw, where $b < 1$.[6]

Now we are ready to solve for the equilibrium of this simple game. If the entrepreneur spends s units of time monitoring the manager, the manager does not shirk if and only if

$$w \geq bw + w\left(1 - \kappa\phi s\right),$$

where $(1 - \kappa\phi s)$ is the probabilty that the manager is not required to return his renumeration despite not having shirked. This incentive constraint implies that the manager puts effort as long as $s \geq \frac{b}{\kappa\phi}$. Clearly the owner will never employ a manager without inducing effort. Hence, the owner will spend

$$s = \frac{b}{\kappa\phi} \tag{3}$$

units of time monitoring the manager. Note that the expression (3) has two major implications:

1. Improvements in the contractual system will reduce the time necessary to monitor as $\frac{\partial s}{\partial \kappa} < 0$,
2. improvements in the efficiency of monitoring ϕ, will also substitute for the time required to provide sufficient incentives.

Given the equilibrium of this game, the net *benefit of delegation* in terms of managerial effort is simply the manager's effort η minus the effort cost of monitoring s in (3) such that the overall managerial effort in a line j is

$$e_j = \frac{T}{n} - m_j \frac{b}{\phi\kappa} + m_j\eta. \tag{4}$$

This expression implies that by hiring m_j managers for line j, the owners brings $m_j\eta$ units of managerial effort, yet she also has spend $m_j b/(\phi\kappa)$ units of effort from her own time to monitor those managers. Hence, the overall net benefit of delegation per manager can be summarized by

$$\xi\left(\kappa, \eta, \phi\right) \equiv \eta - \frac{b}{\phi\kappa} \tag{5}$$

Note that the benefit of delegation is increasing in rule of law κ, human capital η, and the monitoring technology ϕ.

2.2.2 Value of a firm with Delegation

Given the net benefit of delegation ξ, we can now solve the owner's problem. Consider a firm with n products and let us denote the set of firm f's product lines by $\mathcal{J}_f$ such that $|\mathcal{J}_f| = n$. Given (1), the owner maximizes the total profits of the firm by choosing the optimal number of outside managers

$$V(n) = \sum_{j \in \mathcal{J}_f} \max_{m_j \geq 0} \left\{ \left(\frac{T}{n} + \xi m_j \right)^{\sigma} Y_t - w_t m_j \right\} \tag{6}$$

This expression is intuitive. The owner allocates T/n units of her time on each product line. In addition, by hiring m outside managers, she can obtain an overall managerial efficiency of $T/n + m_j\xi$ but has to pay mw overall to managers.[7] The solution to this maximization problem is provided in the following proposition.

[6] The necessity to the the private benefit being proportional to the wage (or any other variable that grows in proportion to the aggregate productivity) arises in order to make the contract stationary.

[7] Note that in this maximization problem we already imposed the optimality condition that the owner is going to allocate the same amount of time in each line (T/n).

Proposition 1 *Consider the maximization in (6) and let us define the normalized wage rate as $\omega \equiv w_t/Y_t$. Firms below a certain size cut-off $n < n^*$ do not hire outside managers and run only by their owners such that*

$$m_j = 0 \text{ if } n < n^* \equiv \left\lceil T\left(\frac{\omega}{\sigma\xi}\right)^{\frac{1}{1-\sigma}} \right\rceil. \tag{7}$$

Conditional on being above the threshold $n \geq n^*$, firms hiring decision is equal to

$$m_j = \left[\frac{\sigma}{\omega}\right]^{\frac{1}{1-\sigma}} \xi^{\frac{\sigma}{1-\sigma}} - \frac{T}{\xi n} \qquad \text{if } n \geq n^*. \tag{8}$$

Proof. This follows trivially from the first order condition of (6). ■

The intuition for these results are provided in Figures 6 and 7.

FIGURE 6: DELEGATION IN DIFFERENT-SIZED FIRMS

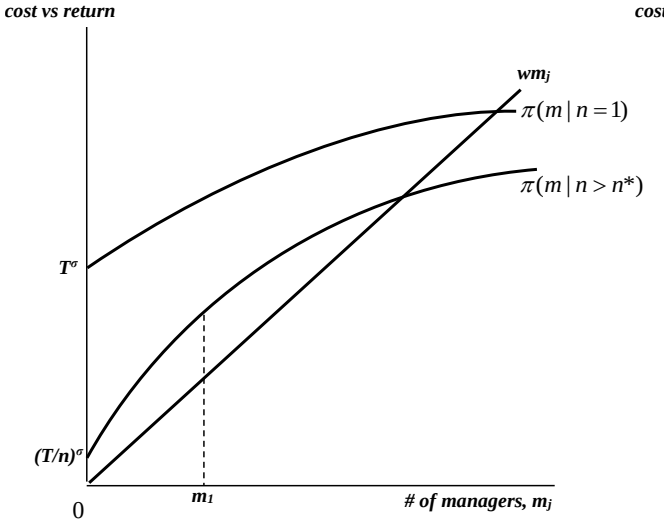
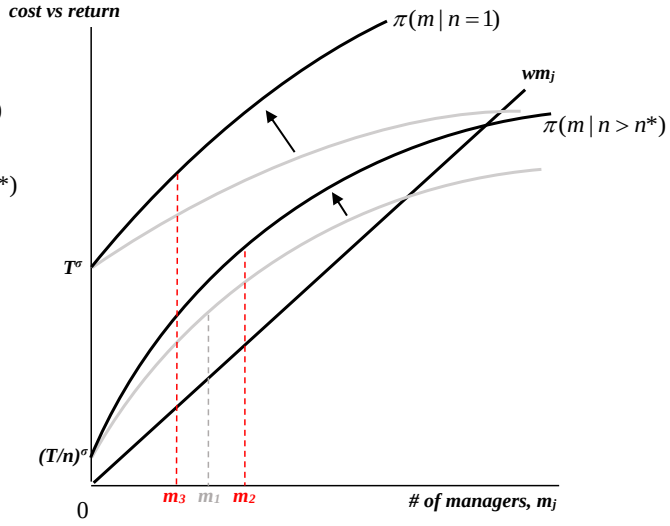


FIGURE 7: IMPACT OF AN INCREASE IN NET BENEFIT ξ



If the owner runs a small firm ($n = 1$ in Figure 6), then the owner can invest her entire managerial time in the firm which then lowers the marginal return from hiring an outside manager. This can be seen from the fact that the slope at $m = 0$ is lower than wage rate, hence a small firm does not hire an outside manager. A large firm with $n > n^*$, on the other hand, hires outside managers until the marginal return from the last manager is equal to the market wage rate. That determines the equilibrium number of managers hired by an $n-$product firm.

The result in (7) implies that small firms do not hire outside managers. The threshold size for hiring is increasing in owner's time T and the monetary cost of hiring a manager ω and it is decreasing in the net benefit of delegation ξ. Similar comperative statics hold for the intensive margin as well. Hence the following predictions follow.

Prediction 1 *Small firms do not hire managers. Conditional on hiring managers, number of outside managers increases in firm size.*

Prediction 2 *Controlling for firm size n, in countries with higher ξ (due to stronger rule of law, for instance) firms hire more outside managers.*

Prediction 3 *Controlling for firm size n, more manager time T implies less outside managers, both at the extensive and intensive margins.*

Next we turn to the resulting value function which will determine the innovation incentives of firms. The following proposition specifies its exact functional form.

Proposition 2 *Consider the above economy. Under the optimal delegation decisions of (7) and (8), the equilibrium normalized value of an $n-$product firm is:*

$$\tilde{V}(n) = \begin{cases} \tilde{V}^{self}(n) & for \quad n < n^* \\ \tilde{V}^{manager}(n) & for \quad n \geq n^* \end{cases}$$

where $\tilde{V}^{self}(n)$ is the value of owner-run n-product firm,

$$\tilde{V}^{self}(n) = T^{\sigma} n^{1-\sigma}$$

and $\tilde{V}^{manager}(n)$ is the value of a delegating n-product firm,

$$\tilde{V}_t^{manager}(n) = \frac{\omega T}{\xi} + n(1-\sigma)\left(\frac{\xi\sigma}{\omega}\right)^{\frac{\sigma}{1-\sigma}}. \tag{9}$$

Proof. Directly follows from substituing (7) and (8) into (6). ■

Note that the interesting result here is the fact the value function is linear in firm size n. This is an important implication that suggests that the owner can fight against diminishing returns by delegating to outside managers. Not surprisingly, the slope of this value function, i.e., the incremental gain from firm growth, directly depends on the net benefit of delegation ξ. On the other hand, the incremental gain from firm growth is decreasing in the wage bill of the manager ω.

Theorem 1 *An owner-run firm's value function features diminishing returns, whereas delegation results in a constant returns value function.*

Figure 8 illustrates this result. When a firm is run only by the owner, the firm runs into diminishing returns in size n, as in Lucas (1978). Delegation, on the other hand, has a constant return. Therefore the owner decides to delegate once the firm size hits a certain size threshold n^*. The value function becomes linear as in Klette and Kortum (2004) after n^*, letting the owner overcome the diminishing returns in size.

Clearly the slope of the linear portion is important and determines when delegation will take place. In countries where the net benefit of delegation is larger (i.e., ξ is larger), the return to delegation is bigger and the slope of the linear portion of the value function is steeper. Hence, owners decide to delegate earlier as illustrated in Figure 9. For instance, stronger rule of law or higher human capital by managers will imply higher value of ξ which then results in more delegation of managerial tasks.

2.3 Dynamics

In this model, growth stems from two margins: entry and innovation by incumbent firms. We describe these processes next.

FIGURE 8: VALUE FUNCTION UPON DELEGATION

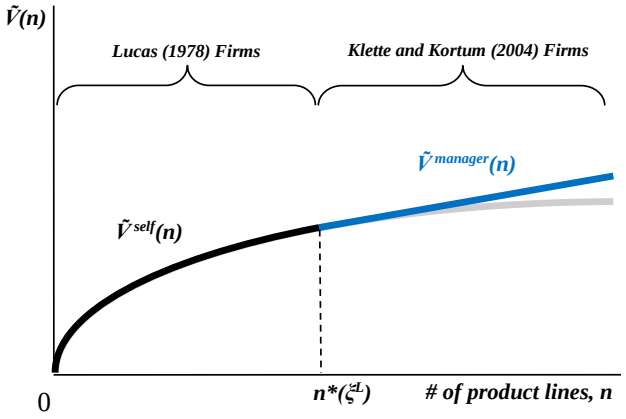
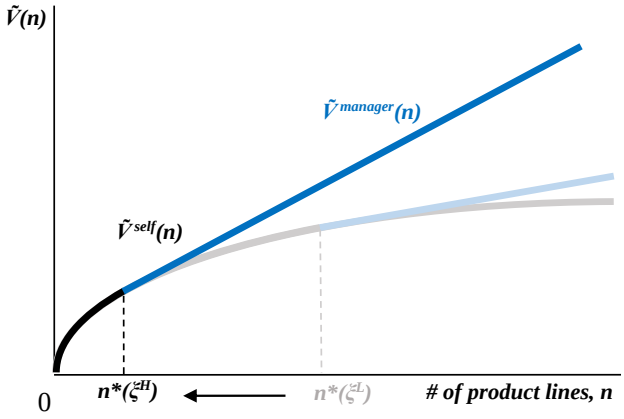


FIGURE 9: VALUE FUNCTION WITH INCREASED ξ



Entry In order to focus on the process of selection (or lack thereof), we assume that a measure N of entrepreneurs entering the economy at each point in time. This can be thought of as an exogenous flow of business ideas to outsiders, who enter the economy as new entrepreneurs. Importantly, entrants are heterogeneous and are either of high or low types as discussed above. Formally, upon entry, each new entrant draws a firm type $\theta \in \{\theta_H, \theta_L\}$ from a Bernoulli distribution, where

$$\theta = \begin{cases} \theta^H & \text{with probability } \alpha \\ \theta^L & \text{with probability } 1-\alpha \end{cases}.$$

Incumbent Innovation The type of the firm determines its innovation productivity or growth potential. In particular, each firm is endowed with an innovation technology. If a firm of type θ with n products in its portfolio invests R units of the final good in R&D, it generates a flow rate of innovation of

$$X(R;\theta,n) = \theta \left[\frac{R}{Q}\right]^{\zeta} n^{1-\zeta}. \tag{10}$$

Hence, θ parameterizes the efficiency of innovation resources. For simplicity we assume that $\theta_L = 0$, i.e. low types will never be able to grow and we can focus on the high types' decisions. The other terms in the innovation technology are the usual scaling variables in many models of growth. Because we denote innovation costs in terms of the final good, the scalar $Q(t)$ is required to keep the model stationary and the presence of n implies that the costs of innovation do not scale in firm size.

After entry decisions have taken place, firms can try to innovate. Letting $V_i(n,t)$ be the value of having a firm of type i with n products (to be defined below), the value of an incumbent of type i with n products prior to the innovation stage is given by

$$X_n^* = \arg\max_{X_n} \left\{ V_i(n,t) + X_n \left[V_i(n+1,t) - V_i(n,t)\right] - Q\left[\frac{X_n}{\theta n^{1-\zeta}}\right]^{\frac{1}{\zeta}} \right\}, \tag{11}$$

where the last term is simply the cost function of innovation that is implied directly by the production function in (10). Hence the profit-maximizing innovation rate per peroduct line, $x_n = X_n/n$ is given by

$$x_n^* = \Delta_n^{\frac{\zeta}{1-\zeta}} \theta^{\frac{1}{1-\zeta}} \zeta^{\frac{\zeta}{1-\zeta}}, \tag{12}$$

where Δ_n denotes the marginal return to innovation as

$$\Delta_n \equiv \frac{V(n+1) - V(n)}{Q}. \tag{13}$$

Equations(12) and (13) are crucial equations in that they link firms' innovation incentives to the *slope* of the value function V_n in Figures 8 and 9. Hence, in the absence of delegation, diminishing returns will lower the incentives to expand as firm size increases. The fact that owners start to delegate beyond a certain size increases the incentives to expand relative to no delegation case. However, how much owners gain from delegation, i.e. the level of ξ, effects how much delegating firms will be willing to expand. This implies that in countries where the rule of law of stronger, firms will be willing to expand more due to higher returns to expansion. Another important implication is about the firm growth and firm size relationship. Innovation incentives are declining more in firm size in lower ξ countries than the ones with high ξ, which implies that the average firm growth will decline faster in size when ξ is lower.

Prediction 4 *Firm growth decreases in firm size, more so in countries with lower ξ.*

2.4 Flow Equations and the Stationary Distribution

The key force that pushes firms out of the market is *creative destruction*: Firms lose products if they are replaced by either new entrants or successful incumbents. To study the aggregate consequences of selection, we need to keep track of the share of product lines belonging to high and low types respectively. Let us denote the share of the product lines that belong to $n-$product high type firms by Ψ_n^H and the share of the product lines that belong to all low type firms by Ψ^L. Then

$$\Psi^L + \sum_{n=1}^{\infty} \Psi_n^H = 1. \tag{14}$$

Let us denote the aggregate creative destruction, i.e., the rate at which the producer of a given product is replaced, by τ. Creative destruction can happen by new entry at the rate N or by an $n-$product incumbent at the rate x_n per line. Therefore,

$$\tau \equiv \sum_{n=1}^{\infty} x_n \Psi_n^H + N. \tag{15}$$

In order to pin down the steady-state values of each product line share Ψ^L and Ψ_n^H, we now express the flow equations that equate the outflows from to inflows into each state:

$$\begin{array}{rrl} \underline{\text{STATE}}: & \underline{\text{OUTFLOW}} = & \underline{\text{INFLOW}} \\ \Psi^L: & \Psi^L \tau = & (1-\alpha) N \\ \Psi_1^H: & \Psi_1^H \tau = & \alpha N \\ \Psi_{n\geq 1}^H: & \Psi_n^H n \left[\tau + x_n\right] = & \Psi_{n-1}^H \left[n-1\right] + \Psi_{n+1}^H \tau \left[n+1\right] \end{array} \tag{16}$$

In the first line, the left-hand side denotes the total number of low-type products that *exit* the economy which happens at the rate τ, and the right-hand side shows the number of products that *enter* the economy as products of low type firms. Similarly, the amount of entry into the economy by high types must be equal to the amount of exit from the economy of high-type producers which is described in the second line.

Finally the third line specifies the outflows and inflows for all high-type product lines with $n \geq 1$. The outflow from each product line can happen in two ways: Either the owner of the product line will lose one of its n product lines at the total rate of $n\tau$, or the owner will come up with a new innovation at the rate $X_n = nx_n$ in which case the product line will now belong to an $(n+1)-$product firm. Likewise, the inflow can occur in two ways: Either firms with $n-1$ lines grow to being an $n-$line firm which happens at the rate $(n-1)x_{n-1}$ or the $(n+1)$ firms lose one product against another competitor at the rate $(n+1)\tau$.

For given innovation schedules $\{x_n\}$ and entry rate N, (14)-(16) fully characterize the stationary distribution of the economy. As x_n is only dependent on Δ_n (see (12)), (14)-(16) are also sufficient to solve for the dynamic evolution of the economy given a schedule of *marginal returns* $\{\Delta_n\}_n$. It is precisely this marginal return schedule that we will construct from the decision of owners to delegate some tasks to outside managers.

Now we can also express the evolution of the size of any given high-type firm with $n-$products. After a small time interval dt the number of products will evolve as follows:

$$n(t+dt) = \begin{cases} n(t)+1 \text{ with probability } X_n dt, \\ n(t)-1 \text{ with probability } n\tau dt, \\ n(t) \text{ with probability } 1 - X_n dt - n\tau dt. \end{cases}$$

3 Quantitative exercise

We now take the model to the data to gauge the quantitative importance of this mechanism. Our strategy is as follows. We first calibrate the model to the Indian microdata. In particular, we target different moments of the process of firm-dynamics of the Indian manufacturing sector so that the model matches the Indian life-cycle by construction. As stressed in the theory, the crucial parameter for firms' demand for delegation is the management multiplier ξ, which we discipline by forcing the model to match the managerial employment share in India. We think of this multiplier as a reduced form parameters at the country level, which depends on various country-characteristics - in our particular micro-foundation it depends on the strength of the legal system κ, the level of managerial human capital η and the efficiency of the monitoring technology ϕ. Hence, from the micro-variation within a country, we cannot identify these individual components but only ξ itself. To quantify the explanatory power of this delegation margin, we hence proceed in two steps. First, we study the implications of ξ for the life-cycle of manufacturing plants. To discipline the exercise, we treat ξ as a country-fixed effect and calibrate it the cross-sectional distribution of managerial employment shares, i.e. for each country we calibrate ξ to perfectly match the particular countries share of managerial personnel. The resulting change in the implied firm-dynamics is - through the lens of the model - the causal effect of changes in delegation benefits and hence answers the question what fraction of the observed difference in firm performance our mechanism can explain, once it is disciplined to be consistent with the managerial employment shares across countries. This exercise, is deliberately silent on the underlying source of variation in these benefits of delegation and is hence not a policy parameter with well-defined counterfactual experiments.

To make progress in that dimension, we than decompose such delegation benefits into various components. In line with our micro-foundation, we focus on the variation induced by differences in the legal system and by managerial human capital. Exploiting the variation in these two fundamentals and the calibrated delegation benefits, we can then further decompose the explanatory power of the legal system on firms' life-cycle through its effect on delegation benefits and also consider counterfactual exercises, like improving India's legal system holding human capital constant.

3.1 Data

Indian Micro Data We are using two major sources of data about Indian manufacturing establishments. The first source is the Annual Survey of Industries (ASI) and the second is the National Sample Survey (NSS). The ASI is an annual survey of manufacturing enterprises. It covers all plants employing ten or more workers using electric power and employing twenty or more workers without electric power. For our analysis we use only the cross-sectional data in 1995 to make it comparable to our sample of the NSS. For an economy like India, the ASI covers only a tiny fraction of producers, as most plants employ far fewer than twenty employees. To overcome this oversampling of large producers in the ASI, we complement the ASI data with data from the NSS. The National Sample Survey is a survey covering different aspects of socio-economic life in India. Every five years, however, Schedule 2.2 of the NSS surveys a random sample of the population of manufacturing establishments without the minimum size requirement of the ASI. While these producers are (by construction) very small, they still account for roughly 30% of aggregate output in the manufacturing sector. We use the NSS data for the year 1994/95 and merge it with the ASI using the sampling weights provided in the data. For a more detailed description and some descriptive statics, we refer to Hsieh and Olken (2014). In terms of the data we use, we mostly focus on the employment side. In particular, we draw on the information on age and employment to study the cross-sectional age-size relationship. Additionally, we use the information on managerial personnel and family size to provide some direct evidence on friction in managerial hiring. To compare the implications of our theory with data from the US, we also complement these data sets using the summary statistics on the US economy from Hsieh and Klenow (2014).

Cross Country Data To discipline the benefits of delegation across countries and identify the underlying fundamental determinants we draw on the information of official census disseminated by IPUMS-International. This data provides us with consistent measures of occupational categories, sectors of employment educational attainment for millions of workers around the world. We aggregate this micro-data at the country level and focus on the cross-country variation in 2001 (which is the year, where we have the largest cross-section). Hence, we can calculate the share of managers, their human capital and the share of self-employed for around 70 countries of the world. We try to conform with our measure of managers to our theory. Our main source of information relies on the harmonized occupational titles according to ISCO (International Standard Classification of Occupations). We identify managers as members of the occupation "Legislators, senior officials and managers". As our theory stresses frictions in delegation between entrepreneurs and *outside* managers, we then use more detailed occupational data to reclassify all self-employed as non-managers. Additionally, we also drop all government officials. To calculate human capital, we adopt the usual approach to translate observed years of schooling into human capital unit using Mincerian returns.[8] Hence, we get a measure of human capital at the individual level so that we can calculate human capital stocks by narrowly defined occupational group. In particular we are going to use the human capital by managerial workers as the empirical counterpart of the theories parameter η. We further augment this data with data on the rule of law by the World Bank and match it to the Penn World Tables to exploit additional controls at the country level.

[8] See Appendix for details.

3.2 Calibrating the Model to the Indian Microdata

In the model, we have eight parameters to calibrate. On the production side, we require the delegation benefits (ξ), the elasticity of profits with respect to managerial effort (σ), the human capital ("time") of entrepreneurs (T) and the level (θ) and convexity (ζ) of the innovation technology. The process of entry is parameterized by the constant entry flow rate (z) and the share of high types in the economy (α). Finally, we also need to parametrize the step-size of innovations (γ). We calibrate these parameters using the Indian microdata. While all parameters are calibrated jointly, we intuitively identify these parameters from the following moments.[9] The delegation benefits ξ, our main parameter of interest, is mostly identified from the aggregate employment share of managers in the population, as ξ directly affects the demand for managerial personnel. The three parameters σ, α and θ are mostly identified from three dynamic moments, namely the plants life-cycle (i.e. average employment of firms 26-30 years old), the aggregate importance of old firms (i.e. the employment share of 26-30 year old firms) and the aggregate growth rate. While the σ and θ directly determine innovation incentives for high-type firms and hence are important for firm's life-cycle and the aggregate growth rate, αmeasures the importance of stagnant producers at the time of entry and therefore affects mainly the aggregate share employment share of old firms. The entrepreneurial time endowment T is mostly informed by the importance of firms who do not delegate, which we proxy by the employment share of self-employed firms, i.e. firms with one employee. In the model, this moment is essentially driven by the delegation cutoff n^*, which is proportional to T (see Proposition 2). To calibrate the innovation step-size γ, we target firms' profitability (or average mark-ups) as γ measures the degree to which producing firms are subject to limit pricing.[10] Finally, we calibrate the flow rate of entry z to match the entry rate in the data. The one parameter, where we do not feel to have enough information for is the convexity of the innovation technology ζ, which would be identified from innovation spending relative to firm output. Following a long-standing micro R&D literature, we take the curvature of the innovation production function to be $\zeta = 0.5$, which implies a quadratic cost function. The resulting parameters and moments are reported in Tables 2 and 3.

Moment	**Data**	**Model**
mean employment for 26-30 year old firms	1.25	1.31
employment share of 26-30 year old firms	0.05	0.04
employment share of self-employed firms	0.65	0.57
share of managers in workforce	0.033	0.033
entry rate	0.085	0.080
aggregate growth rate	0.02	0.019
profitability	0.17	0.19

TABLE 2: MOMENTS TARGETED FOR INDIAN FIRMS

As seen in Table 2, the model does a relatively good job to match salient features of the data. The model generates slightly too much economic dynamism, in that both mean employment of old firms is somewhat too high and the employment share of self-employed firms is slightly too low. Overall, however, Table 2 shows that the model replicates our moments of interest relatively

[9] A more detailed description of our calibration is contained in the Appendix.

[10] Again we refer to the Appendix for the details of the equilibrium pricing game between incumbent firms and the competitive fringe.

Parameter	Meaning	Value
ξ	benefit of delegation	0.17
σ	curvature of efficiency	0.4
T	entrepreneur's managerial time	0.03
z	entry flow rate	0.05
γ	innovation step size	1.24
θ	innovativeness	1.14
α	share of high type	0.06

TABLE 3: PARAMETER CALIBRATION FOR INDIAN FIRMS

well. This is also seen in Figure 10, where we compare the entire implied life-cycle profile with the one observed in the data. The model essentially matches the observed flat life-cycle - in fact the non-calibrated age bins are matched even better than our calibrated number for the 26-30 year old firms in Table 2.

We can now use the model, to understand better the importance of selection or the lack thereof. The theory stresses that the life-cycle profile in Figure 10 masks the heterogeneity across firms, whereby some producers do grow - but not sufficiently to affect the aggregate life-cycle profile. To see this mechanism in the calibrated model, consider Figure 11, which shows both the average life-cycle profile from Figure 10 and the life-cycle profile of high types, i.e. firms with growth potential.[11] While the overall life-cycle profile of firms is completely flat as seen in the data, there is a subgroup of firms that have a positively sloped profiles and see their employment increase by a factor of 3.

FIGURE 10: LIFE CYCLE OF INDIAN FIRMS

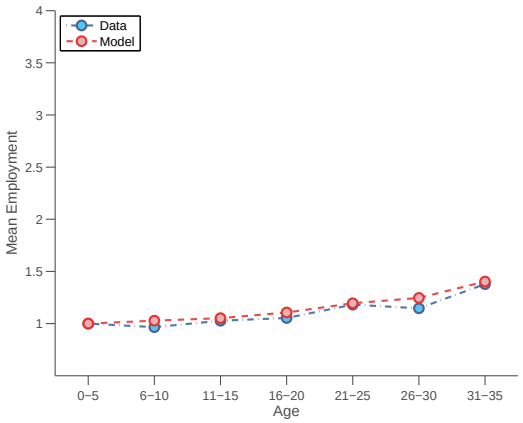
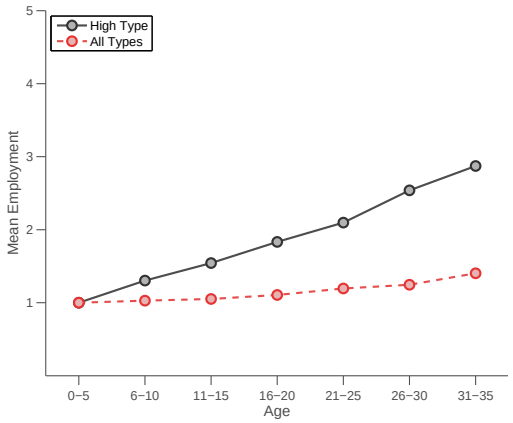


FIGURE 11: LIFE CYCLE OF INDIAN FIRMS



The main argument of this paper is that it is this slope, which is too low in that these firms are hampered by an unfavorable managerial environment as captured by low managerial benefits ξ. As seen in Figures 8 and 9, improvements in the efficiency of delegation will keep innovation incentives high and hence prevent firms from running into decreasing returns quickly. Hence, increases in ξ will make innovative firms grow faster, which in turn will induce a steeper slope of the life-cycle profile. Additionally, growing firms force other firms to exit earlier, which in turn will increase the degree of selection and hence decrease the share of small firms as a cohort ages. In the calibrated model, this relationship is seen in Figure 12, where we show the relative size of firms at age 30 as a function of the delegation benefits ξ. Hence, qualitatively, the model predicts that plants'

[11] The life-cycle of low types is of course entirely flat, as they - by construction - do not see any growth at all.

FIGURE 12: DELEGATION BENEFITS AND THE LIFE-CYCLE OF PLANTS

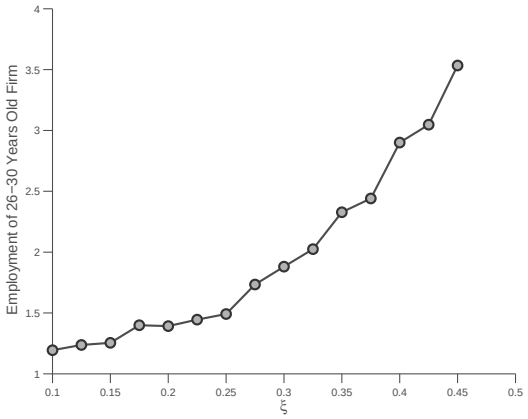
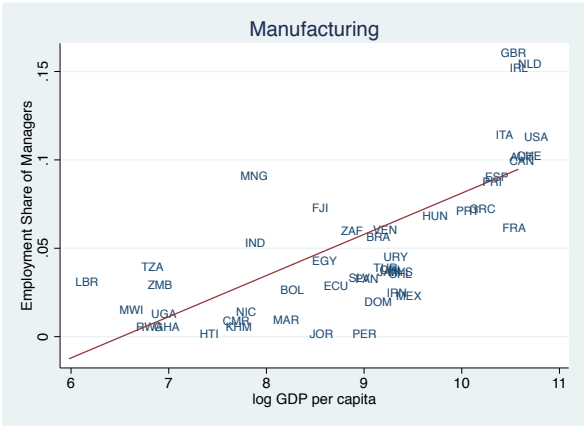


FIGURE 13: MANAGERIAL EMPLOYMENT ACROSS COUNTRIES



life-cycle in the US should be much steeper if the US is indeed characterized by better delegation benefits. Wether this mechanism is also powerful quantitatively depends of course on the discipline we impose on the variation in ξ. This is the subject of the next section.

3.3 Comparison to the US

How much of the difference in firms' life-cycle between India and US is due to a more seamless mode of delegation in the US? More specifically, what would the life-cycle look like if were to move from the delegation benefits in India (ξ_{IND}) to the ones in the US (ξ_{US}) holding all other parameters constant. Our empirical strategy is as follows. Our main source of identification for ξ stems from the aggregate importance of managerial workers. Using the occupational identifiers in the international census data, we can measure this managerial employment share for a broad cross-section of countries. In Figure 13 we show the cross-sectional variation in the importance of managerial personnel across countries. In particular, managerial employment is much more common in more developed economies. It is systematic variation in the importance of managers, which we are going to use to discipline our quantitative analysis.

As a baseline, we are going to impose the identification assumption that the *entirety* of the cross-sectional dispersion in managerial employment is driven by underlying differences in delegation

benefits ξ.[12] Under this assumption we can identify ξ for each country given the data on managerial employment shares shown in Figure 13.[13] For the particular case of the US, the result of this exercise is contained in Table 4.

	Share of Managers	ξ
US	0.147	0.37
India	0.033	0.17

TABLE 4: PARAMETER CALIBRATION FOR US

Our calibration result depicts a significant difference in the managerial environment between the two countries: the benefit of delegation for US firms is more than twice as much that for Indian firms (Table 4).

The case of the US is an interesting one, because we can contrast the model's implication for the life-cycle with the actual data reported in Hsieh and Klenow (2014). Figure 14 shows the implication of these differences for the resulting life cycle profile for US firms and the actual data. While firms in the US grow by a factor of around four, the model predicts an increase of around 2.5. Hence, variation in the benefits of delegation can - when disciplined by the variation in managerial employment shares between the US and India - explain roughly $\frac{2.5-1}{4-1} = 50\%$ of the observed in employment in the US economy by age 31-35.

FIGURE 14: LIFE CYCLE OF US FIRMS

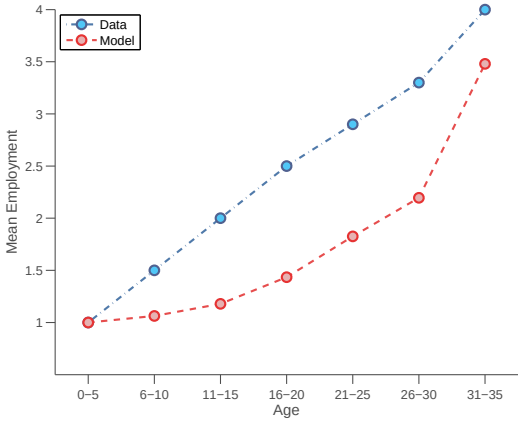
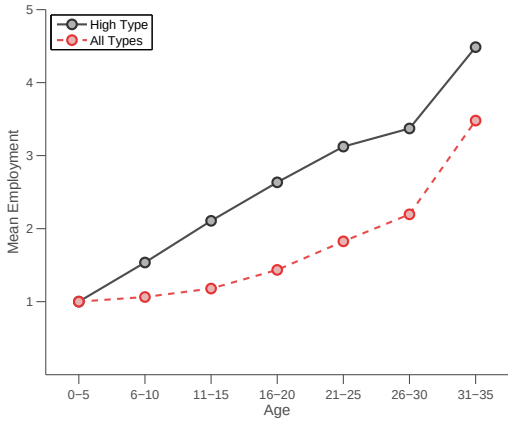


FIGURE 15: LIFE CYCLE OF US FIRMS

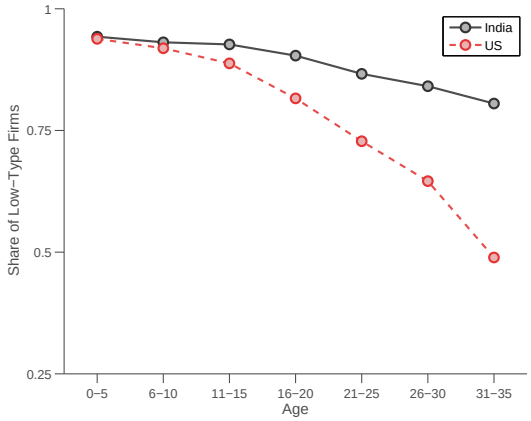


Two important channels through which higher benefit of delegation in US result in a steeper life cycle profile for the overall economy are worth to emphasize. First, by comparing Figure 11 and 15, our calibration implies that high-type firms in US grows faster on average compared to the high-type Indian firms.This is simply due to the fact that US firms with the growth potential have a higher incentive to expand thanks to a better managerial environment. This directly contributes to have a steeper life cycle for the overall economy. Second, faster growing high-type firms create a

[12] We will come back to this assumption in Section 3.5 below and explicitly allow other margins of the model to also differ across countries.

[13] Conceptually, this exercise is very similar to the quantitative strategy adopted by Buera, Kaboski, and Shin (2011) in the context of a model with credit market frictions. There, the sole variation across countries is assumed to lie in the quality of the financial system. To discipline the variation in financial systems across countries, Buera, Kaboski, and Shin (2011) target the cross-country variation in the debt-to-GDP ratio, which is an endogenous outcome of the model. In our case, we envision the source of variation stemming from delegation benefits and identify ξ from the cross-country variation in managerial employment shares, which is also an endogenous outcome of the model.

FIGURE 16: SELECTION MECHANISM IN INDIA AND THE US



strong selection mechanism: with faster growing high-type firms, it is less likely for low-type firms to survive. In other words, better managerial environment creates a composition effect in favor of growing firms, reducing the share of non-growing firms in the economy and making the life cycle profile even steeper. To see clearly how the selection differs between India and the US through the lens of the model, Figure 16 plots the share of low type firms within a cohort as it ages. The starker decline in the US is a sign of the stronger selection, as opposed to the weak selection margin in the Indian economy.

Figure 17 extends this analysis to the entire world. In particular, we show the model's implication for cross-country relationship between the managerial employment share and implied "steepness" of the life-cycle profile, i.e. the size of 30 year old firms relative to new entrants. Recall that the slope of this locus is identified through the mapping between the observable managerial share and the benefits of delegation, which are identified from the firm-level data in India. As seen clearly in the Figure: given the variation of the importance of managerial personnel across countries, the model is able to deliver sizable differences in the life-cycle across firms. We unfortunately have only little firm-level data to confront this quantitative implication with reality. However, Hsieh and Klenow (2014) report this particular moment for some additional economies and we highlight these observations in the Figure.

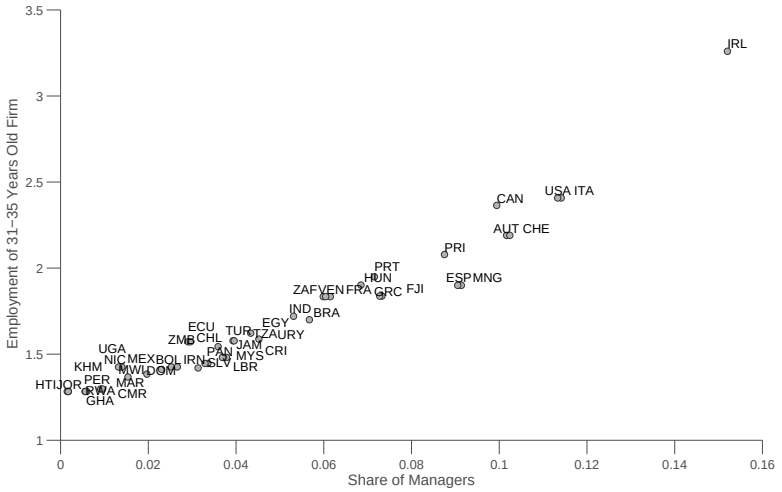
3.4 Decomposing the Benefits to Delegation into Fundaments

Given the inferred value of delegation benefits $[\xi_c]_c$, we will now explicitly decompose this "country fixed effect" into the different components using the structure of the theory. Using our particular micro-foundation, delegation benefits primarily depends on two things: the level of managerial human capital (η) and the contractual system or the state of the legal system (κ). Instead of using the particular functional form as implied by the theory, we adopt a reduced form approach, where we simply run the cross-country regression

$$\xi_c = \alpha + \varphi \times HC_c^M + \beta \times ROL_c + u_c. \tag{17}$$

where ROL_c proxies the legal system by the World Banks rule of law measure and HC_c^M is the measured managerial human capital, which we take directly from the census microdata. In Table 5 we present the results of the regression contained in (17). These results show that the cross-sectional variation across countries is to an overwhelming degree driven by the variation in legal institutions. In fact, the variation in managerial human capital is essentially orthogonal to the

FIGURE 17: MANAGEMENT AND LIFE-CYCLE GROWTH



Dep. Variable	Delegation Benefits ξ		
Rule of Law	0.168***		0.172***
	(0.029)		(0.028)
Managerial Human Capital		0.005	-0.002
		(0.006)	(0.004)
N	46	46	46
R^2	0.45	0.02	0.46

TABLE 5: PARAMETER CALIBRATION FOR US

inferred delegation benefits. Furthermore, legal institutions as measured by the role of law predict 45% of the variation in delegation benefits across countries.

This decomposition might seem surprising. One might have expected that the rule of law and the stock of human capital are highly correlated. This however is not the case. The key to understand why is to remember that we focus on *managerial* human capital. And while the average level of human capital is indeed very highly correlated with income per capita (and hence a country's legal system), the human capital within managerial occupations is not. This is clearly seen in Figure below, where we depict the correlation between income per capita and human capital - both for the economy as a whole and for the subpopulation of managers. Not only are managers a selected group in all countries, this selection becomes much stronger in poor countries - in fact so strong that there is little *systematic* variation in managerial human capital across countries. Managerial human capital has therefore little scope to explain the variation in delegation benefits, because the latter is entirely driven by managerial employment shares, which show ample systematic variation across countries (as seen in Figure 13). These results therefore suggest the interpretation that delegation benefits are low in poor countries not so much because managerial human capital is low

FIGURE 18: HUMAN CAPITAL ACROSS THE WORLD: MANAGERS VS THE WHOLE ECONOMY

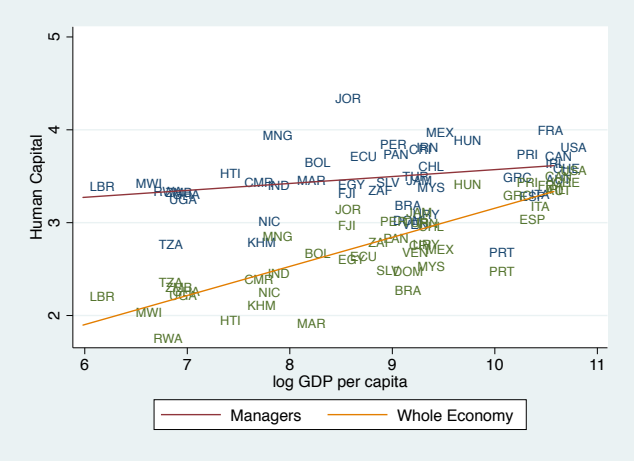
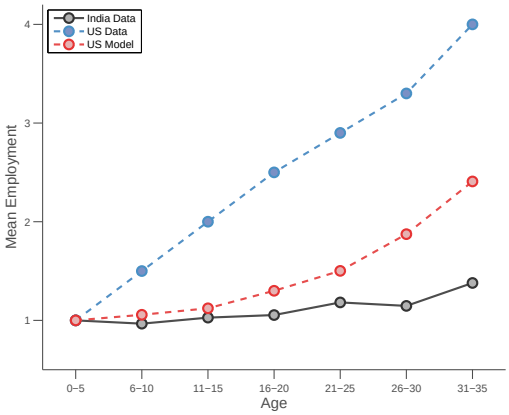


FIGURE 19: DECOMPOSING THE LIFE CYCLE PROFILE DIFFERENCE BETWEEN US AND INDIA

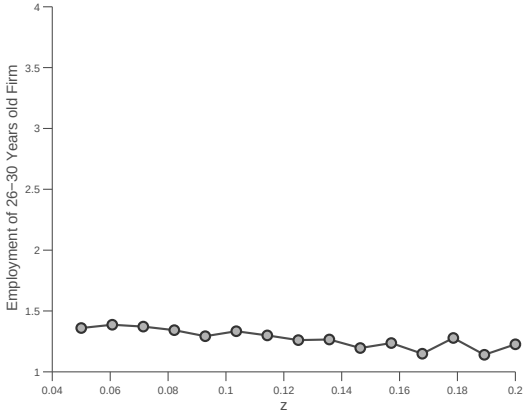


but because the legal system prevents an efficient use of managerial supplies.[14]

Given the estimated parameters $\hat{\varphi}$ and $\hat{\beta}$ we can use (17) to decompose the variation in inferred delegation benefits ξ_c into its different components. For concreteness we focus on the US and we report these decompositions in Figure 19. The grey and red line shows the data for India and the US respectively - more precisely, it shows a plants' lifecycle given the inferred delegation benefits ξ_{IND} and ξ_{US}. While this matches the life-cycle perfectly for India, it explains roughly half of the actual life-cycle pattern in the US (see Figure 14 above). The two remaining blue lines refer to two decompositions of the life-cycle. The light blue line, shows the hypothetical life-cycle of a country with the delegation benefits $\hat{\xi}_{US}$, i.e. the predicted delegation benefits for the US given its legal institutions and its level of human capital. *If* one where to assume that the regression error u_c in (17) was orthogonal to the regressors, these counterfactual life-cycle profiles had a structural interpretation. The light blue line was the life-cycle profile of India if it had both the US level of human capital and legal system. The dark blue line would correspond to India with the US level

[14]The main caveat to this interpretation is that it presumes that the marginal non-managerial worker is of a similar skill level than the average manager. We know that this cannot be the case "globally" (as we know that the average level of human capital is lower in poor countries). Hence, we implicitly assume that there are some non-managerial workers with a similar skill level, which could be hired as managers if there was sufficient demand.

FIGURE 20: ENTRY RATE z VS EMPLOYMENT PROFILE OF 26-30 YEAR-OLD FIRMS



of human capital, holding legal systems the same. According to Figures 14 and 19, we conclude that the delegation margin as such can explain 50% of the life-cycle difference between the US and India, 70% of which can be explained by the empirical variation in legal systems. The human capital margin in contrast is not important - precisely because in the data managerial human capital is uncorrelated with managerial employment shares and hence the inferred delegation benefits.

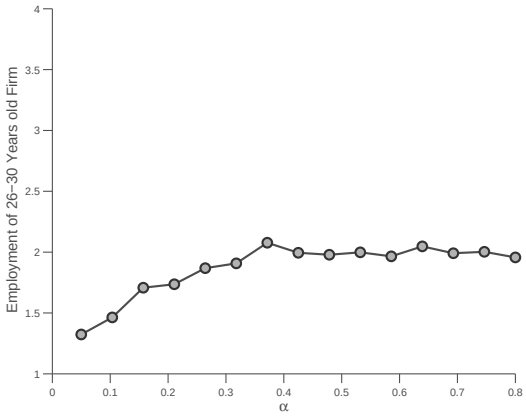
3.5 Role of Different Margins of the Model

Up to now we only allowed for a single source of heterogeneity across countries. In this section, we will analyze the role of different mechanisms on the implied firms dynamics in more detail. For this, we will examine the partial effects of various channels of the model. This will turn out to be a useful exercise to see which ingredients are quantitatively important for the model's implications.

Entry We first start with the entry intensity z, which could presumably vary across countries. Figure 20 plots the employment share of firms 31-35 years old against various values of the entry rate, keeping all other parameters at their Indian values. A seen in Figure 20 more entry implies more competition and hence lowers firm size. This is because incumbent firms are losing their product lines at a faster rate to new entrants. Hence, for the entry rate to explain the differences in life cycle growth between Indian and US firms, it had to be the case that entry in the US was markedly. Not only do we not know of any evidence for this to be true, but Figure 20 also shows that the quantitative effect of a higher entry rate is relative minor. Differences in the rate of entry are therefore unlikely to play a major role - at least within a model like ours.

Entrepreneurial Talent We next turn to α, the probability of being a high type entrepreneur. Maybe the low life-cycle growth profile among Indian plants stems simply from the fact that there are too few entrepreneurs with high innovation potential. In Figure 21 we keep all other parameters at their Indian values and vary only α. Initially, this indeed contributes to a higher employment share of older firms. However, this positive effect fades away quickly, so that the life-cycle growth is essentially non-responsive to changes in the share of innovative firms. In fact, for large values of α, the average employment of large firms even start to decrease. This is due to the general equilibrium nature of the model. In our model growth is driven by selection, whereby successful firms managed to innovate and thereby steal market share from their less fortunate competitors. A higher share of innovative types therefore implies more competition among high type incumbents, so that firms also lose products quickly. To generate a steeply increasing life-cycle profile there cannot be too many innovative firms - there have to be sufficiently many marginal firms in the economy, which can be replaced easily. While this margin is likely to be more

FIGURE 21: TYPE DISTRIBUTION α VS EMPLOYMENT PROFILE OF 26-30 YEAR-OLD FIRMS



important then the entry rate analyzed above, average employment does not increase sufficiently to make it the sole candidate for explaining the differences between Indian and US firms. Simply having more talented entrepreneurs does not contribute much to the dynamism of economy unless the managerial environment allows for seamless delegation and thereby sustained incentives to grow large.

4 Conclusion

This paper studies the reasons behind the stark differences in firm dynamics across countries, as documented in Hsieh and Klenow (2014). We focus on manufacturing firms in India and analyze the stagnant firm behavior. We show that the poor life-cycle behavior in India could be explained by the lack of firm selection, wherein firms with little growth potential survive because innovative firms do not expand sufficiently quickly to replace them. Our theory stresses the role of of imperfect managerial contracts as the main cause for the insufficient expansion by the high type firms. We show that if the provision of managerial effort is non-contractible, the benefits of delegation are low and firms will run quickly into decreasing returns. This in turn will reduce the returns to innovation. Improvements in the degree of contract enforcement will therefore raise the returns to growth and increase the degree of creative destruction. This argument is in line with the empirical findings of Bloom and Van Reenen (2007, 2010). Quantitatively, such limits to delegation can explain up to 50% of the difference in life-cycle growth between the US and India. While the cross-country variation in legal system can account for 70% of this explained part, variation in managerial human capital is unlikely to have a large impact.

References

ACEMOGLU, D., U. AKCIGIT, N. BLOOM, AND W. KERR (2013): "Innovation, Reallocation and Growth," NBER Working Paper 18993.

AGHION, P., AND P. HOWITT (1992): "A Model of Growth through Creative Destruction," *Econometrica*, 60(2), 323–351.

AKCIGIT, U., AND W. KERR (2010): "Growth through Heterogeneous Innovations," NBER Working Paper 16443.

Bloom, N., B. Eifert, T. Heller, E. Jensen, and A. Mahajan (2009): "Contract Enforcement and Firm Organization: Evidence from the Indian Textile Industry," Center on Democracy, Development, and The Rule of Law Working Paper 104.

Bloom, N., B. Eifert, D. McKenzie, A. Mahajan, and J. Roberts (2013): "Does Management Matter: Evidence from India," *Quarterly Journal of Economics*, 128(1), 1–51.

Bloom, N., R. Sadun, and J. Van Reenen (2012): "The Organization of Firms Across Countries," *Quarterly Journal of Economics*, 127(4), 1663–1705.

Bloom, N., and J. Van Reenen (2007): "Measuring and Explaining Management Practices Across Firms and Countries," *Quarterly Journal of Economics*.

——— (2010): "Why Do Management Practices Differ across Firms and Countries?," *Journal of Economic Perspectives*, 24(1), 203–224.

Buera, F., J. Kaboski, and Y. Shin (2011): "Finance and Development: A Tale of Two Sectors," *American Economic Review*, 101(5), 1964–2002.

Caselli, F., and N. Gennaioli (2012): "Dynastic Management," *Economic Inquiry*.

Cole, H. L., J. Greenwood, and J. M. Sanchez (2012): "Why Doesnt Technology Flow from Rich to Poor Countries?," Federal Reserve Bank of St. Louis Working Paper Series 2012-040.

Collard-Wexler, A., J. Asker, and J. De Loecker (2011): "Productivity Volatility and the Misallocation of Resources in Developing Economies," *NBER Working Paper*, 17175.

Foster, L., J. Haltiwanger, and C. J. Krizan (2006): "Market Selection, Reallocation, and Restructuring in the US Retail Trade Sector in the 1990s," *Review of Economics and Statistics*, 88(4), 748–758.

Foster, L., J. C. Haltiwanger, and C. J. Krizan (2001): "Aggregate Productivity Growth: Lessons from Microeconomic Evidence," *New Developments in Productivity Analysis*, pp. 303–372, University of Chicago Press.

Grossman, G., and E. Helpman (1991): "Quality Ladders in the Theory of Growth," *Review of Economic Studies*, 58(1), 43–61.

Guner, N., G. Ventura, and Y. Xu (2008): "Macroeconomic implications of size-dependent policies," *Review of Economic Dynamics*, 11(4), 721–744.

Hopenhayn, H. (2012): "On the Measure of Distortions," *Working Paper*.

Hsieh, C.-T., and P. Klenow (2009): "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 124(2), 771–807.

——— (2014): "The Life-Cycle of Plants in India and Mexico," *Quarterly Journal of Economics*, forthcoming.

Hsieh, C.-T., and B. A. Olken (2014): "The Missing "Missing Middle"," *Journal of Economic Perspectives*, forthcoming.

Hurst, E., and B. Pugsley (2012): "What Do Small Businesses Do," *Brookings Papers on Economic Activity*.

Jones, C. (2013): "Misallocation, Economic Growth and Input-Output Economics," in *Advances in Econometrics: 10th World Congress*, ed. by D. Acemoglu, M. Arrelano, and E. Dekel, vol. 2. Cambridge University Press.

Klette, T. J., and S. Kortum (2004): "Innovating Firms and Aggregate Innovation," *Journal of Political Economy*, 112(5), 986–1018.

Lentz, R., and D. T. Mortensen (2005): "Productivity Growth and Worker Reallocation," *International Economic Review*, 46(3), 731–751.

——— (2008): "An Empirical Model of Growth through Product Innovation," *Econometrica*, 76(6), 1317–1373.

Lucas, R. E. (1978): "On the Size Distribution of Business Firms," *The Bell Journal of Economics*, 9(2), 508–523.

Midrigan, V., and D. Y. Xu (2010): "Finance and Misallocation: Evidence From Plant-Level Data," NBER Working Paper 15647.

Moll, B. (2010): "Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation?," Working Paper.

Penrose, E. T. (1959): *Theory of the Growth of Firms*. J. Wiley & Sons, New York.

Peters, M. (2013): "Heterogeneous Mark-Ups, Growth and Endogenous Misallocation," Working Paper.

Powell, M. (2012): "Productivity and Credibility in Industry Equilibrium," Discussion paper, Working Paper.

Restuccia, D., and R. Rogerson (2008): "Policy Distortions and Aggregate Productivity with Heterogenous Establishments," *Review of Economic Dynamics*, 11(4), 707–720.

Romer, P. M. (1990): "Endogenous Technological Change," *Journal of Political Economy*, 98(5), 71–102.

5 Appendix

5.1 Proofs and Derivations

Derivation of Profit π_j

On the demand side, we have a representative household with standard preferences

$$U_0 = \int_0^\infty \exp(-\rho t) \ln C_t dt, \tag{18}$$

where $\rho > 0$ is the discount factor. Given the unitary intertemporal elasticity of substitution, the Euler equation along the balanced growth path is simply given by $g = r - \rho$, where g is the growth rate of the economy and r is the interest rate.

5.2 Static Equilibrium

Now consider the equilibrium in the product market. At each point in time, each product line j is populated by a set of firms that can produce this good with productivity $\left[q_{jt}^f\right]_f$, where f identifies the firm. We will make sufficient assumptions on $m(.)$, that the most productive firm (which we will sometimes refer to as the (quality) leader) will be the sole producer of product j. Intuitively, while managerial slack can and will be a drag on efficiency, it can never reverse comparative advantage based on physical efficiency q. This assumption will make the structure of the optimal contract between entrepreneurs and managers slightly easier but it is not essential for our results. As the demand functions stemming from (2.1) will have unitary elasticity, the optimal mark-up was infitiny if there was no entry threat. Hence, we assume that there is a competitive fringe of firms, which can produce the product with efficiency $\frac{q_{jt}}{\gamma}$ for some $\gamma > 1$. For simplicity, we assume that fringe firms do not provide any managerial effort.

Hence, the leader will always be forced to engage in limit pricing. Given this assumption, the equilibrium price for product j is given by

$$p_{ij} = \frac{\gamma w_t}{q_{jt}}, \tag{19}$$

as $\frac{\gamma w_t}{q_{jt}}$ are exactly the competitive fringe's marginal costs of producing product j. Equation (2.1) then implies that the demand for product j is given by

$$y_{jt} = \frac{Y_t}{p_{ij}} = \frac{q_{jt} Y_t}{\gamma w_t}, \tag{20}$$

so that total sales are simply $S_{jt} = p_{jt} y_{jt} = Y_t$, i.e., equalized per product. This, of course, does not imply that the distribution of sales is also equalized across firms; as some firms will (endogenously) have more products than other firms, the distribution of sales is fully driven by the distribution of products. This tight link between firm-level sales and firms' product portfolios is not only analytically attractive but also conceptually useful in that it clarifies that our model attributes firm dynamics to a single mechanism: why countries differ in the speed at which firms accumulate (and lose) products along their life-cycle.

Similarly, the allocation of labor demand is simply

$$l_{jft} = \frac{y_{jft}}{q_{jft} m(e_{ft})} = \frac{Y_t}{m(e_{jft}) \gamma w_t}, \tag{21}$$

i.e., the allocation of labor across products depends on firms' managerial choices. In particular, managerial efficiency is *labor-saving*. Intuitively, an increase in managerial effort *increases* profitability as it increases the firms' sustainable mark-up. To see this, note that equilibrium mark-ups are given by

$$\zeta_{jft} = \frac{p_{jft}}{MC_{jft}} = \frac{\frac{\gamma w_t}{q_{jt}}}{\frac{w_t}{q_{jt}m\left(e_{jft}\right)}} = \gamma m\left(e_{jft}\right), \tag{22}$$

i.e., well-managed firms can keep their competitors at bay, sustain high prices and hence move up on their product demand curve. The resulting profit (before paying the managers) for producer f of variety j is then simply

$$\tilde{\pi}_{jft} = \left[\frac{\gamma w_t}{q_{jt}} - \frac{w_t}{q_{jt}m\left(e_{ft}\right)}\right]\frac{q_{jt}Y_t}{\gamma w_t} = \frac{\gamma m\left(e_{jft}\right) - 1}{m\left(e_{jft}\right)\gamma}Y_t, \tag{23}$$

i.e., profits depend *only* on how well the respective firm can incentivize their managers. In particular, $\tilde{\pi}_{jft}$ is increasing in e_{jft}: better managerial practices increase mark-ups and hence profits per product. Equation (23) contains the main intuition about the interaction between contractual frictions and innovation incentives: As contractual frictions will be detrimental to the provision of managerial effort, firms will be unable to sustain high mark-ups as they grow. The marginal product will therefore be less profitable than the average product and incentives to break into new products will be low.

Substituting (20) into (2.1) we get that equilibrium wages are given by

$$w_t = \frac{1}{\gamma}Q_t, \tag{24}$$

where Q_t is the Cobb-Douglas composite of individual efficiencies

$$\ln Q_t \equiv \int_0^1 \ln q_{jt} dj.$$

Using (21), we get that $l_{jft} = \frac{1}{Q(t)m\left(e_{jft}\right)}Y_t$, so that total output is given by

$$Y_t = Q_t M_t L_t^P, \tag{25}$$

where

$$M_t = \left[\int_0^1 m\left(e_{jft}\right)^{-1} dj\right]^{-1}. \tag{26}$$

Here, M_t is the endogenous TFP term based on managerial effort. In particular, increases in x-efficiency, i.e., managerial effort, will increase aggregate TFP.[15]

[15]In this paper, we will mostly be concerned with the process of firm-dynamics and less with the stationary properties of managerial effort determining the distribution of mark-ups and hence M_t. See Peters (2013) for a related model that focuses explicitly on the heterogeneity of mark-ups as source of misallocation across firms.