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

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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. To explain these differences we develop a theory, whereby contractual frictions limit firms' acquisition of managerial time. If managerial effort provision is non-contractible, entrepreneurs will benefit little from delegating 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 thereby increase the degree of creative destruction. 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 efficacy of managerial delegation can explain a sizable fraction of the difference between plants' life-cycle in the US and India.

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

JEL classification: O31, O38, O40

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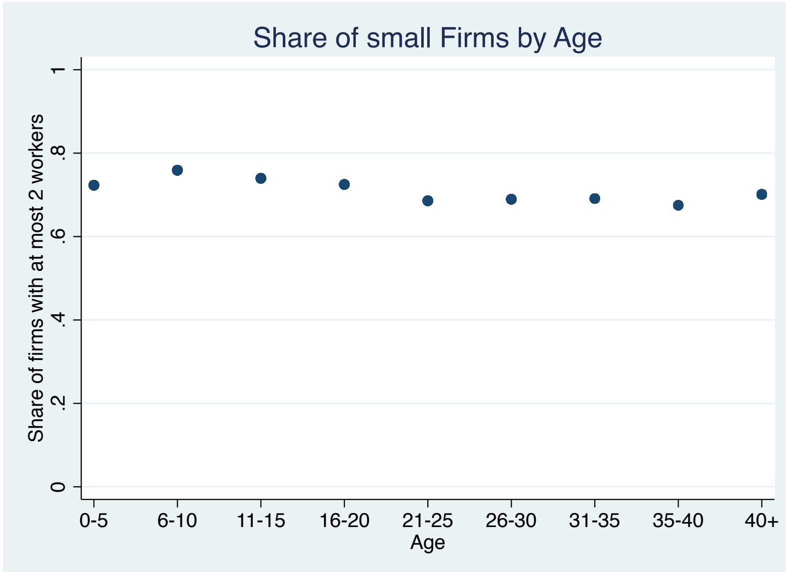
1 Introduction

Recent literature has documented striking differences in firm dynamics across countries. While firms in rich countries experience rapid growth conditional on survival, firms in poor countries remain small and do not grow as they age. Hsieh and Klenow (2014) for example show that the average firm in the US has grown by a factor of five by the time it is 30 years old. In contrast, firms in India see very little growth during their life-cycle, making 30 year old firms barely bigger than new entrants. To explain this pattern, we build on a growing micro-empirical literature, which argues that lack of managerial delegation might be important to understand such differences of performance of firms in poor countries. Bloom, Eifert, McKenzie, Mahajan, and Roberts (2013) for example argue that textile firms in India are severely constrained in their managerial resources, which prevents them from expanding. In particular, they show that the delegation of decision-rights hardly extends to managers outside the family as the imperfect contractual environment makes it difficult for firms to incentivize external managers. In fact, they show that the number of male family members is the dominant predictor of firm size. They also show empirically that the lack of expansion of firms allowed "bad" firms to survive in the market. In this paper we embed these distinct branches of the literature in a macroeconomic model and ask whether such limits to delegation are quantitatively important to explain the observed differences in plants' life-cycle growth across countries.

In a recent work, Hurst and Pugsley (2012) show that there are heterogenous types of entrepreneurs in the US economy, a big majority of which intentionally choose to remain small. However many of these small businesses are forced to exit through competition by firms that expand rapidly and therefore the share of small firms in a cohort declines dramatically as they age. This process creates a massive reallocation of factors across firms - a process which is the major driver of the US productivity growth (Foster, Haltiwanger, and Krizan, 2001, 2006). To the contrary, in developing countries the aggregate importance of small firms does not vanish with age and remains stubbornly high. To see this lack of reallocation, consider Figure 1, which reports the share of Indian manufacturing plants with at most two workers by age. The striking result is that this share is almost constant, i.e. there is no weeding out of small-scale producers as they age. Therefore a first-order problem in India seems to be the high fraction of small firms that manage to survive for very long time due to the lack of competition.

To analyze the effect of managerial delegation on the process of firm dynamics and reallocation, we construct a novel theory of endogenous growth building on the work of Klette and Kortum (2004). In the model, firm dynamics are determined through creative destruction à la Aghion and Howitt (1992), whereby successful firms expand by replacing other producers. To focus on the entrepreneurial heterogeneity, we explicitly allow for firm types that makes firms differ in their growth potential as in Acemoglu, Akcigit, Bloom, and Kerr (2013). While high-type firms have the potential to grow by investing in technological improvements, low-type firms are lacking that potential and remain small. Hence, life-cycle growth generates *selection*, whereby growth of "good" firms eliminates "bad" firms that would have otherwise remained in the economy.

FIGURE 1: SHARE OF FIRMS WITH ≤ 2 WORKERS



Notes: The data comes from Indian Manufacturing Plants (ASI and NSS). The figure plots the share of establishments with less than or equal to 2 workers within the corresponding age bin. See Section 4 for further details on the data.

The reason why innovation incentives are low for firms with growth potential is directly linked to the supply of managerial time, a firm can acquire. Firms can be run by their owners. As the firm owner's time endowment is limited, growing firms will have increasing profitability at a decreasing rate as the owner's attention has to be spread over a larger workforce. Hence, owner-run firms run into span of control problems in the spirit of Lucas (1978), which ultimately reduce the returns of growing large. To overcome such decreasing returns, the firms can augment the owner's time endowment by delegating managerial decisions to outside managers. As stressed by the empirical literature described above however, this interaction is subject to contractual frictions. If managerial effort provision is non-contractible, outside managers have to be monitored by the owner, which itself requires valuable time. The net return to delegation therefore depends both on the countries legal environment and the human capital of the outside manager.

The model predicts a threshold firm size, below which firms are only run by their owners. Furthermore, this threshold depends on the country-specific institutional and technological parameters. As long as firms do not delegate decision rights, firm profits have decreasing returns as the entrepreneur's time is a fixed factor in production. This dictates that growth incentives are declining. Once, the marginal value of delegation is sufficiently high, firms start to hire outside managers to overcome the decreasing returns. In fact, the model predicts that the firm's value function becomes linear, the slope of which is determined by the net benefit of delegation and shapes the dynamic incentives to firm growth. In particular, improvements in the contractual environment will increase firms' incentives to grow by raising the net benefit of delegation. Intuitively, functioning court systems can substitute for owners' monitoring requirements. Outside managers will therefore bring more net managerial resources into firms. This will make the problems of span of control less severe, hence increase the returns to innovation for firms with innovation potential and finally strengthen the degree of selection in the aggregate economy. In the micro data, this increase in aggregate creative destruction will manifest itself in a steep life-cycle profile as profitable firms can expand quickly at the expense of their less innovative competitors.

The second part of our paper paper compares the basic predictions of our model to some simple correlations in the data. Even though the main focus of this paper is quantitative and the empirical findings are not necessarily causal, the simple correlations in Indian data lends some support to the theoretical predictions. For instance, we find empirically that the correlation between firm size and family size gets weaker as the state-level trust on other individuals in the society becomes stronger. Likewise, we find that the average firm size is bigger and firm growth declines more slowly in firm size in Indian regions where the trust is higher. Our theory produces similar predictions which directly stem from the delegation frictions between owners and managers.

We then analyze the quantitative importance of this mechanism. As a first step, we calibrate the parameters of the model to micro data from Indian manufacturing plants. A particularly tractable feature of the theoretical model is that the net benefit of delegation is summarized by a single parameter, which we can directly calibrate to the data. Hence, for the calibration exercise, we do not have to take stand on a particular microfoundation of the contractual game between firm owners and managers. Next, keeping all other parameters at the Indian levels, we recalibrate this benefit of delegation parameter to match the share of managers in the US economy. This exercise shows us that if Indian firms were able to obtain the US-level benefits of delegation, the gap in lifecycle growth between India and the US would have been reduced by 30% to 50% depending on the firm age. This quantitatively large impact stems from the fact that when return to expansion increases thanks to more effective managerial delegation possibility, firms try to grow in size which then increases the competition and selection in the economy. Firms start to exit much more frequently but those that survive (mainly high-types) grow faster generating a steeper life-cycle profile.

We then dig deeper into the fundamental determinants of the delegation benefits. Using cross-country data on the quality of legal institutions and on human capital, we show that while 46% to 70% of the higher delegation benefits in the US stem from a more efficient court system, human capital differences between US and Indian managers account for relatively lower portion of these explained 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." Bloom, Eifert, Heller, Jensen, and Mahajan (2009) argues that if an Indian firm owner caught an outside manager stealing or shirking, she would have very little formal recourse as court cases take very long and often require additional bribes. Managerial decision rights therefore largely remain within the family, so that managerial resources are akin to a "fixed" factor for many firms. Relatedly, Bloom, Sadun, and Van Reenen (2012) also find that in countries with better legal institutions, firms are larger and more decentralized in that more managerial tasks are delegated to outsiders.

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 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, encom-

[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).

passing 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. In Section 2 we describe the theoretical model, where we explicitly derive the link between firms' delegation decisions under contractual frictions and their innovation incentives. In Section 4 we take the model to the data. We first calibrate the model to the Indian micro data and then use the cross-country data on the aggregate importance of managerial employees, their human capital and quality of legal institutions to assess the quantitative importance of our mechanism. Section 5 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.

[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.

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 a fixed amount of managerial time and owners can choose to delegate managerial tasks to outside managers. This interaction, however, is subject to contractual frictions.

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

$$y_{jf} = q_{jf} \mu(e_{jf}) l_{jf}, \tag{1}$$

where q_{jf} is the firm-product specific production technology, $\mu(e_{jf})$ is the 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 product line j is a concave function of the managerial effort e_j

$$\pi_{jt} = e_j^{\sigma} Y_t \tag{2}$$

i.e. profits are a simple power-function of managerial effort parametrized by the elasticity σ (which is a property of the function μ in (1)). Section 6.1 in the Appendix provides the necessary details that endogenously leads to the exact expression of (2).

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

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

Definition of a Firm In this model, a firm is a collection of product lines (as in Klette and Kortum (2004)). Figure 2 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 $\tilde{V}^{self}(n) = n\tilde{\pi}_j$:

$$\tilde{V}^{self}(n) = T^{\sigma} n^{1-\sigma} \tag{3}$$

Figure 3 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).

FIGURE 2: DEFINITION OF FIRMS

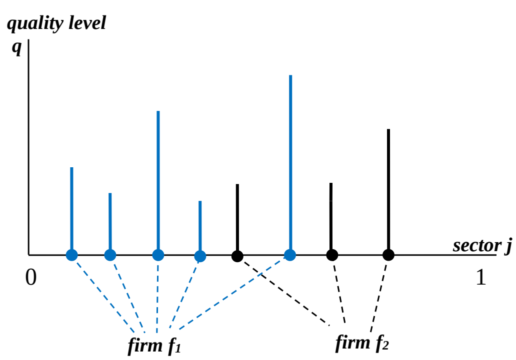
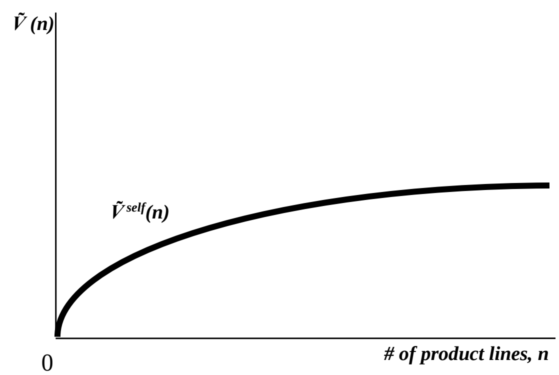


FIGURE 3: VALUE OF AN OWNER-RUN FIRM



2.2 Delegation

An owner can also 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. The benefit is that outside managers will add to the firm's endowment of available managerial time and hence generate managerial effort e. Contractual imperfections however require the owner to spend some of her time to monitor the manager. 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 which 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. Recall that ξ is *net* of the time the owner needs to spend to ensure that the manager adheres to the arrangements. In return, the owner has to pay $m_j w$.

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. Readers, who are not interested in the particular micro-foundation can take ξ as given and skip to Section 2.2.2, where we solve for firms' optimal delegation strategies.

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 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 managers who do not deliver on their promises. Therefore, the owners themselves need to invest time to monitor their outside managers. 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 of η to be the *human capital* of 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 owner 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. 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 κ 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

[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.

despite 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

$$s = \frac{b}{\kappa\phi} \tag{4}$$

units of time monitoring the manager. Note that the expression (4) has two major implications:

1. Improvements in the contractual system will reduce the time necessary to monitor as $\frac{\partial s}{\partial \kappa} < 0$. Hence, monitoring and the strength of the legal system are substitutes.

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 (4) such that the overall managerial effort in a line j is

$$e_j = \frac{T}{n} - m_j \frac{b}{\phi\kappa} + m_j \eta. \tag{5}$$

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

$$\xi\left(\kappa, \eta, \phi\right) \equiv \eta - \frac{b}{\phi\kappa} \tag{6}$$

Note that the benefit of delegation is increasing in rule of law κ, human capital η, and the monitoring technology ϕ. As the whole purpose of delegation is to increase the firms' managerial resources, firms will never hire a manager if $\xi\left(\kappa, \eta, \phi\right) < 0$. Hence, whenever the quality of legal system is sufficiently low (in particular $\kappa < \frac{b}{\phi\eta}$), there will not be any managerial demand as the net benefits of delegation are negative: Owners need to spend more of their human capital to prevent opportunistic behavior of managers than they gain in return. For the following we will assume that $\xi > 0$ to make the analysis interesting.

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 (2), the owner maximizes the total profits of the firm by choosing the optimal number of outside managers

$$V(n) = \sum_{j \in \mathcal{J}_f} \max_{m_j \geq 0} \left\{ \left(\frac{T}{n} + \xi m_j \right)^{\sigma} Y_t - w_t m_j \right\} \tag{7}$$

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.

Proposition 1 *Consider the maximization problem in (7) 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*

$$m_j = 0 \text{ if } n < n^* \equiv \left\lceil T\left(\frac{\omega}{\sigma\xi}\right)^{\frac{1}{1-\sigma}}\right\rceil. \tag{8}$$

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

$$m_j = \left[\frac{\sigma}{\omega}\right]^{\frac{1}{1-\sigma}} \xi^{\frac{\sigma}{1-\sigma}} - \frac{T}{\xi n} \qquad \text{if } n \geq n^*. \tag{9}$$

Proof. This follows trivially from the first order condition of (7). ■

The intuition for these results are provided in Figures 4 and 5.

FIGURE 4: DELEGATION IN DIFFERENT-SIZED FIRMS

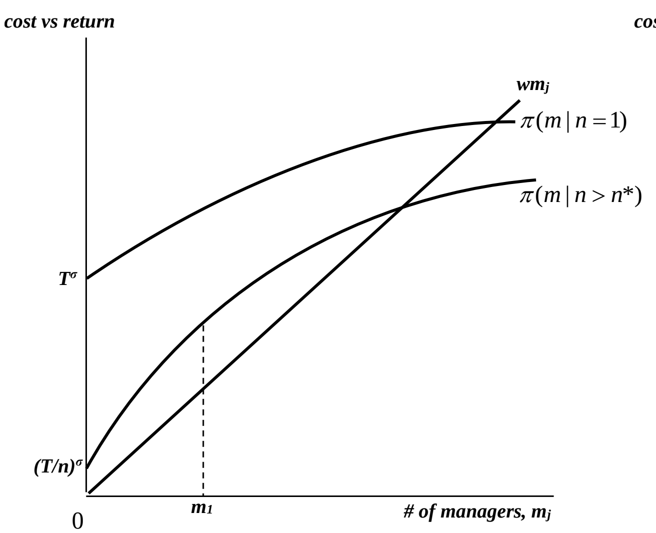
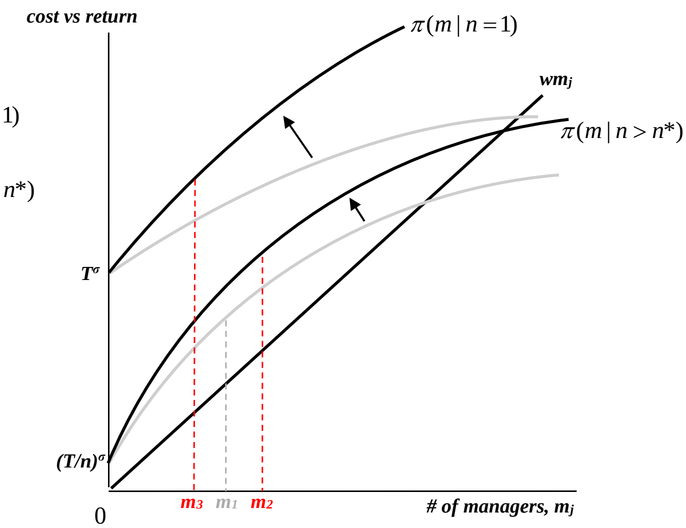


FIGURE 5: IMPACT OF AN INCREASE IN NET BENEFIT ξ



If the owner runs a small firm ($n = 1$ in Figure 4), 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.

[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).

The result in (8) 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 *Everything else equal, probability of hiring an outside manager and, conditional on hiring, the number of outside managers (i) increase in firm size n, (ii) decrease in owner's time T, and (iii) increase in the rule of law κ.*

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 (8) and (9), the equilibrium normalized value $\tilde{V} = \frac{V}{Y}$ 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,

$$\tilde{V}_t^{manager}(n) = \frac{\omega T}{\xi} + n(1-\sigma)\left(\frac{\xi\sigma}{\omega}\right)^{\frac{\sigma}{1-\sigma}}. \tag{10}$$

Proof. Directly follows from substituing (8) and (9) into (7). ■

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 6 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 7. 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.

FIGURE 6: VALUE FUNCTION UPON DELEGATION

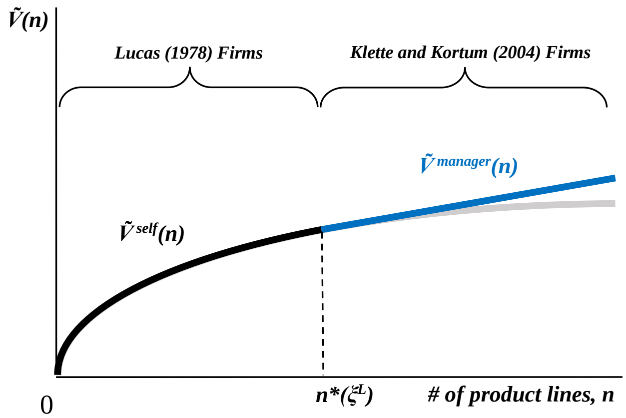
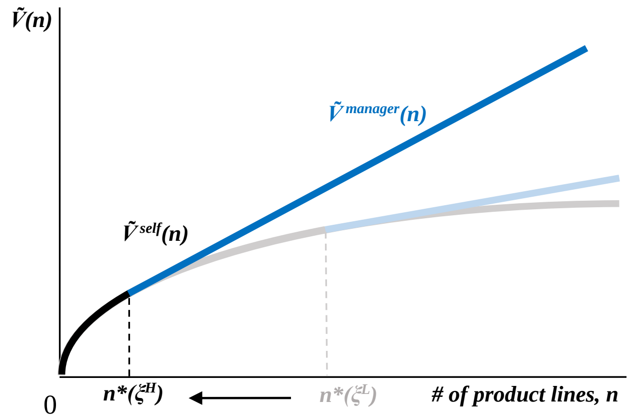


FIGURE 7: VALUE FUNCTION WITH INCREASED ξ



2.3 Dynamics

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

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

$$X(R;\theta,n) = \theta\left[\frac{R}{Q}\right]^{\zeta} n^{1-\zeta}. \tag{11}$$

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, the value of an incumbent of type i with n products prior to the innovation stage is given by

$$X_n^* = \arg\max_{X_n} \left\{ V_i(n,t) + X_n \left[V_i(n+1,t) - V_i(n,t)\right] - Q\left[\frac{X_n}{\theta n^{1-\zeta}}\right]^{\frac{1}{\zeta}} \right\}, \tag{12}$$

where the last term is simply the cost function of innovation that is implied directly by the production function in (11). Hence the profit-maximizing innovation rate per peroduct line, $x_n = X_n/n$ is given by

$$x_n^* = \Delta_n^{\frac{\zeta}{1-\zeta}} \theta^{\frac{1}{1-\zeta}} \zeta^{\frac{\zeta}{1-\zeta}}, \tag{13}$$

where Δ_n denotes the marginal return to innovation as

$$\Delta_n \equiv \frac{V(n+1) - V(n)}{Q}. \tag{14}$$

Equations(13) and (14) are crucial equations in that they link firms' innovation incentives to the *slope* of the value function V_n in Figures 6 and 7. 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 2 *Average firm size n (i) increases in owner's time T, (ii) increases in the rule of law κ, and (iii) the positive relationship between firm size n and the owner's time T becomes weaker as the rule of law κ improves.*

Prediction 3 *Firm growth decreases in firm size, more so when the rule of law κ is weaker.*

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

$$\Psi^L + \sum_{n=1}^{\infty} \Psi_n^H = 1. \tag{15}$$

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,

$$\tau \equiv \sum_{n=1}^{\infty} x_n \Psi_n^H + N. \tag{16}$$

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:

$$\begin{array}{rrcl}
\underline{\text{STATE}}: & \underline{\quad\text{OUTFLOW}\quad} & = & \underline{\text{INFLOW}} \\
\Psi^L: & \Psi^L \tau & = & (1-\alpha) N \\
\Psi_1^H: & \Psi_1^H \tau & = & \alpha N \\
\Psi_{n\geq 1}^H: & \Psi_n^H n \left[\tau + x_n\right] & = & \Psi_{n-1}^H \left[n-1\right] + \Psi_{n+1}^H \tau \left[n+1\right]
\end{array} \tag{17}$$

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, (15)-(17) fully characterize the stationary distribution of the economy. As x_n is only dependent on Δ_n (see (13)), (15)-(17) 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 Theoretical Predictions and Empirical Correlations

The theoretical model generated a number of predictions about the delegation decision, various firm moments and the rule of law. Before we move on to the quantitative analysis, which is the main focus of this paper, we first would like to see if the theoretical predictions are in accordance with the basic correlations in the data. Establishing empirical causal links is beyond the scope of this paper, nevertheless analysing the cross-country and Indian firm level data correlations through the lens of the model's predictions could shed light on the mechanisms behind those empirical facts. In what follows, we first describe our data sources and then turn to the reduced form analysis.

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. As there is no data on family size for firms in the ASI, we will have to limit our attention to the NSS sample, when exploiting this information. 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 both at the country level and by narrowly defined occupational groups (within countries). For our empirical exercise, we are going to use two measures of human capital across countries. As a benchmark, we are going to use the human capital by managerial workers as the empirical counterpart of the theories parameter η. While this measure is attractive in that it provides us with information about human capital conditional on working as a manager, the interpretation of counterfactual exercises is less straight-forward, as these require us to take a stand on the human capital of the marginal *non*-manager. We will therefore also show the results of simply using the average human capital stock within countries. 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.

Data Across Indian States We augment our cross-country exercise with some cross-state variation across India. As we are particularly interested in the link between the prevailing legal system and firms' subsequent delegation decisions. Both the Indian microdata on firms and the Indian version of the census contain information about the state, where the respective firm or individual is located in. Additionally, we extract information on the general level of trust between people at the state-level from the World Value Surveys. While this variable is not directly aimed at eliciting the (perceived) quality of the prevailing legal environment, it fits well into our theoretical framework as long as trust reduced the required time, the owner needs to spend to incentivize outside managers. See also Bloom, Sadun, and Van Reenen (2012), who also use this variable.

[8] See Appendix for details.

Table 1: Cross-country Correlations

VARIABLES	(1) manager share	(2) manager share	(3) manager share	(4) manager share
rule of law	0.061***			0.042**
	(0.021)			(0.019)
human capital		0.017	0.058***	0.012
		(0.013)	(0.008)	(0.012)
log GDP per capita	0.018***	0.018***		0.014***
	(0.004)	(0.005)		(0.005)
Constant	yes	yes	yes	yes
Observations	48	46	46	46
R-squared	0.71	0.67	0.55	0.71

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

3.2 Stylized Facts

In this section, we first summarize the predictions of the theoretical model and then provide the empirical results.

Prediction 1 *Everything else equal, the probability of hiring an outside manager and, conditional on hiring, the number of outside managers is (i) increasing in firm size n, (ii) decreasing in the owner's time T, and (iii) increasing in the rule of law κ.*

Prediction 2 *Average firm size n (i) increases in the owner's time T, (ii) increases in the rule of law κ*, and *(iii) the positive relationship between firm size n and the owner's time T becomes weaker as the rule of law κ improves.*

Prediction 3 *Firm growth decreases in firm size, more so when the rule of law κ is weaker.*

Cross-country Correlations Our model predicts that as the benefit of delegation increases in a country, firms will demand more managers both at the extensive and intensive margins as in Prediction 1 and therefore we should observe a bigger fraction of workforce working as managers. To this end, Table 1 regresses the fraction of managers in a country on the rule of law and the average human capital in the population. Column 1 includes rule of law, Column 2 human capital and Column 3 includes both at the main independent variables. All regressions control for the GDP per capita, to absorb the most basic form of heterogeneity across countries.

In all the regressions, the rule of law measure appears to be highly significant and positive as the theory predicts. This relationship is not simply driven by the general level of economic development of the countries or the fact that human capital, i.e. the average years of schooling, is higher in richer countries. Our theory also predicts that the level of managerial human capital should increase the demand for managers. As seen in columns 2 and 3, this impact does not come out significantly once we control for a countries' GDP per capita even though the sign of the variable is as expected.

Empirical support for Prediction 2, especially on the positive link between the rule of law and average firm size, has already been provided by several papers and while we test this prediction using the cross-state variation in legal system within India, we lack the firm-level micro-data in different countries to test this prediction in the international context. Bloom, Sadun, and Van Reenen (2012), for instance, document that trust on legal system in the cross-country data correlates very significantly with average firm size. Likewise Kumar, Rajan, and Zingales (1999) find similar positive link between average firm size and the strength of the legal system among European countries. Laeven and Woodruff (2007) establishes a causal link between the quality of legal institutions and average firm size using Mexican firms. La Porta et al. (1997) show that the sales of the largest 20 publicly traded companies as a share of GDP highly correlates with the level of trust prevailing in a country.

Cross-state Correlations in India There are a number of predictions that are easier to study in micro-level establishment data. Especially predictions related to owner's time can be tested in the Indian establishment level data. The NSS data contains information on the size of the family of the owner of the firm. In the theory, T referred to the owner's time endowment, which had a comparative advantage *within* the establishment - it could neither be sold nor on the market, nor was there any need to monitor. As long as family members require less monitoring time than outside managers, we can think of family size as inducing variation in the time endowment T. Additionally, we use our state level measures of trust, which - through the lens of the model - we interpret as inducing variation in the legal environment κ. Table 2 reports the correlations regarding Prediction 1 using Indian micro data.

Column 1 regresses the manager hiring decision on size of the firm proxied by log employment, size of the household and state dummies to absorb state-specific heterogeneities. When we introduce state dummies, we are not able to measure the effect of trust since it varies at the state level. As pedicured by the theory, bigger firms are more likely to employ managers, but firms with larger families abstain from hiring outside managerial personnel (holding firm-size constant). In column 2 we explicitly introduce the state-level trust variable and exclude the state dummies. This leaves the coefficients from Column 1 unchanged but shows that trust is indeed correlated with an increase in managerial demand at the firm-level. In columns 3 to 6, we then turn to Predictions 2 and 3. Both of these predictions refer to firms who actually delegate. Hence, columns 3 to 6 consider only firms, who report to hire outside managers. In columns 3 we consider all firms (both in the ASI and in the NSS) and show that there is a robust positive correlation between firm-size and regional trust. Columns 4 and 5 look more detailed into the mechanism, by again considering the variation in family size (which forces us to focus on firms in the NSS). Bloom, Eifert, McKenzie, Mahajan, and Roberts (2013) show that the number of male family members is one of the best predictors of firm size in India. Motivated by this observation, Column 4 correlates firm size with household size which is also interacted with regional trust measure. The interesting result here is that the positive

Table 2: Cross-state Correlations

VARIABLES	(1) (Manager>0)	(2) (Manager>0)	(3) Log Employment	(4) Log Employment	(5) Log Employment	(6) Growth of Employment
Log employment	0.037***	0.036***				-0.436***
	(0.003)	(0.003)				(0.078)
Log household size	-0.005***	-0.004***		0.242***	0.130**	
	(0.001)	(0.001)		(0.074)	(0.062)	
Trust		0.013**	0.295**			
		(0.007)	(0.150)			
Log employment × Trust						0.131*
						(0.078)
Log household size × Trust				-0.353**	-0.196*	
				(0.139)	(0.115)	
Log assets					0.131***	
					(0.010)	
State Dummies	yes	no	no	yes	yes	no
Firm dummy	no	no	no	no	no	yes
Observations	170,404	170,404	20,700	2,284	2,232	152,808
R-squared	0.09	0.09	0.53	0.74	0.79	0.23

Notes: Data comes from ASI and NSS. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. All regressions include a constant term which is not reported. Additional controls are as follows. Columns (1) and (3): 4-digit sector dummies, rural/urban dummy, the age of the establishment, and state dummies. Columns (2) and (4): 4-digit sector dummies, rural/urban dummy, the age of the establishment, and state-level GDP per capita.

correlation between firm size and family size becomes weaker when the regional trust gets stronger. This is consistent with the view that family ties do in fact provide a comparative advantage in regions, where interactions with outside managers are hampered by low quality legal institutions and little trust. One potential concern could be that family wealth might generate a spurious correlation between family size and firm size. Hence column 5 introduces log assets to proxy for family wealth. Even though the point estimates decrease in absolute value, the main message of column 4 remains the same. Note that both columns 4 and 5 explicitly introduce state fixed effect, so that we cannot identify the main effect of the regional trust but only the interaction with the size of the household. Column 6 finally turns to Prediction 3 and shows that firm growth decreases in firm size but that this negative relationship becomes weaker in high trust regions. To calculate the growth rate, we focus on the panel dimension of the ASI. As we have 8 years of the data, we calculate the annual growth rate and include firm fixed effects in the regression. This again precludes us from identifying the main effect of regional trust.

Overall, the empirical correlations in the data provides some suggestive evidence on the predictions of the theoretical model. In the next section we study the quantitative implications of the theoretical framework.

4 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.

4.1 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

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

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 3 and 4.

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 3: Moments Targeted for Indian Firms

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 4: Parameter Calibration for Indian Firms

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

As seen in Table 3, 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 3 shows that the model replicates our moments of interest relatively well. This is also seen in Figure 8, 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 3.

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 8 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 9, which shows both the average life-cycle profile from Figure 8 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 8: LIFE CYCLE OF INDIAN FIRMS

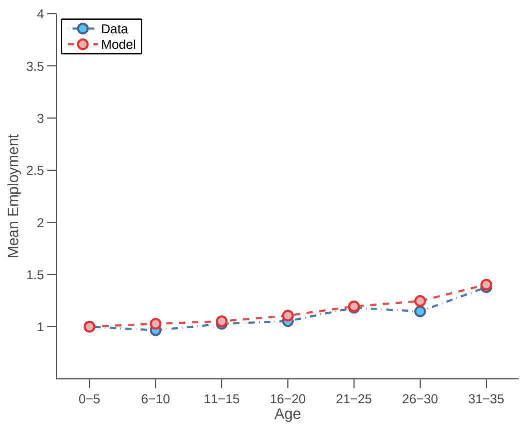
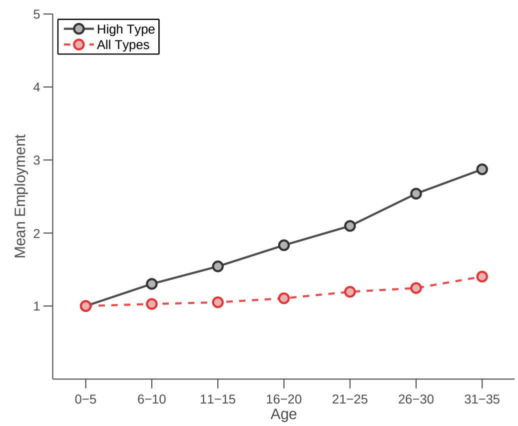


FIGURE 9: LIFE CYCLE OF INDIAN FIRMS

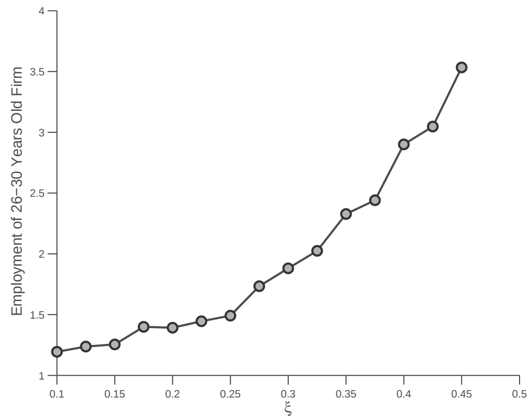


The main argument of this paper is that it is this slope, which is too low in that these firms are hampered by an unfavorable managerial environment as captured by low managerial benefits ξ. As seen in Figures 6 and 7, improvements in the efficiency of delegation will keep innovation incentives high 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 10, where we show the relative size of firms at age 30 as a function of the delegation benefits ξ.

Qualitatively, the model predicts that plants' life-cycle in the US should be much steeper since the US firms are associated with better delegation benefits. Whether this mechanism is also pow-

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

Figure 10: Delegation Benefits and the Life-Cycle of Plants

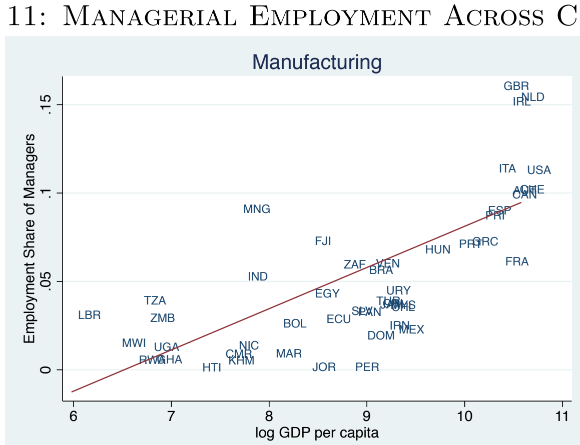


erful quantitatively depends of course on the discipline we impose on the variation in ξ. This is the subject of the next section.

4.2 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, how would the life-cycle of Indian firms have looked 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 11 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.

Figure 11: Managerial Employment Across Countries



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 11.[13] For the particular case of the US, the result of this exercise is contained in Table 5.

	Share of Managers	ξ
US	0.113	0.31
India	0.033	0.17

Table 5: 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 5).

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 12 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 12: Life Cycle of US Firms

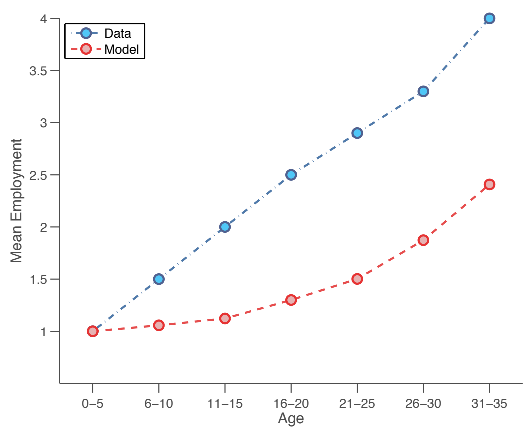
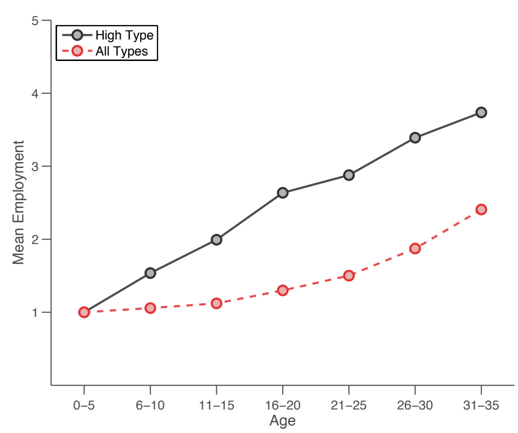


Figure 13: Life Cycle of US Firms



Two important channels through which higher benefit of delegation in US result in a steeper

[12] We will come back to this assumption in Section 4.4 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.

life cycle profile for the overall economy are worth emphasizing. First, by comparing Figure 9 and 13, 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 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 14 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 14: Selection Mechanism in India and the US

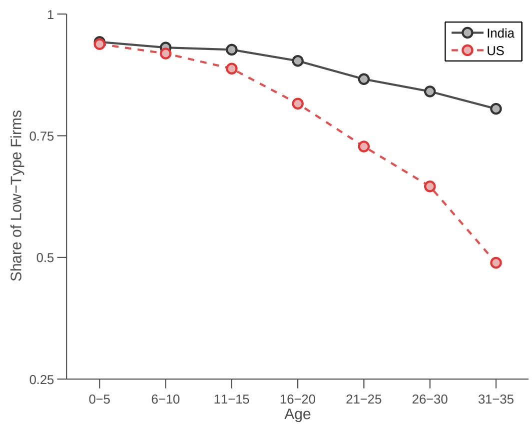
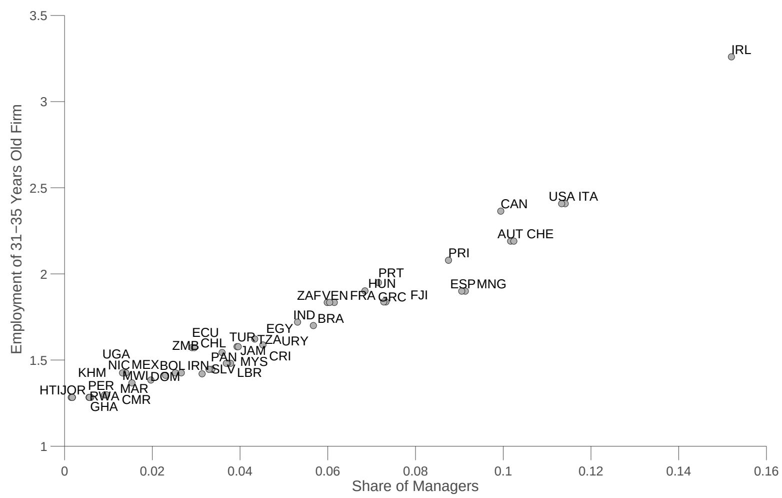


Figure 15 extends this analysis to the entire world. In particular, we show the model's implication for cross-country relationship between the managerial employment share and implied "steepness" of the life-cycle profile, i.e. the size of 30 year old firms relative to new entrants. Recall that the slope 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.

4.3 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

FIGURE 15: MANAGEMENT AND LIFE-CYCLE GROWTH



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

$$\xi_c = \alpha + \varphi \times HC_c^M + \beta \times ROL_c + \chi ln(y_c) + u_c. \tag{18}$$

where ROL_c proxies the legal system by the World Banks rule of law measure, HC_c^M denotes the measured managerial human capital and $ln(y_c)$ is country c's log GDP per capita, which we include in the regression to control for the general stage of development.

In order to implement the decomposition contained in (18), we have to decide on an appropriate measure of human capital. We present the results using two different measures. As a benchmark we consider the *average* level of human capital, which we construct from the educational attainment of the entire population in the respective country (taken from the Census data). As an alternative we consider the human capital of managerial workers. The results are contained in Table 6 below.

These results show that the cross-sectional variation in delegation benefits across countries is robustly correlated with the quality in legal institutions, even after the level of development and human capital is controlled for. Column 2 shows, that the average level of human capital is positively correlated with delegation benefits, but that this positive correlation is no longer statistically significant, once we control for the country's GDP. Columns 3 and 5 show that the variation in managerial human capital is essentially orthogonal to the inferred delegation benefits.

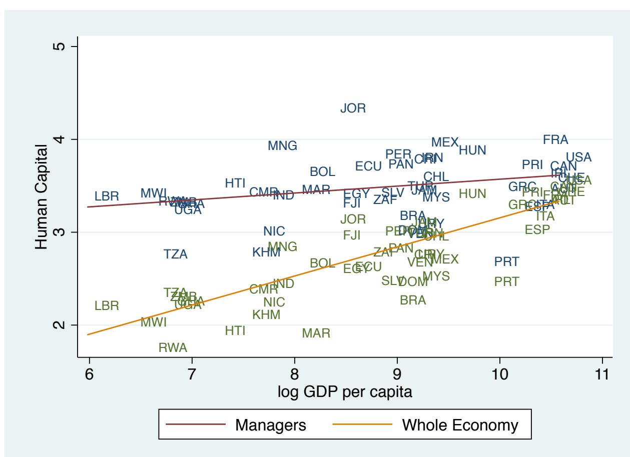
The stark differences between the average level of human capital and the one of managerial workers might be surprising. The reason for this discrepancy is that while the average level of human capital is indeed correlated with both income per capita and a country's legal system, the

Dep. Variable	Delegation Benefits ξ				
Rule of Law	0.086**			0.075**	0.090***
	(0.035)			(0.036)	(0.032)
Overall Human Capital		0.056*		0.045	
		(0.030)		(0.030)	
Managerial Human Capital			-0.026		-0.030
			(0.026)		(0.026)
log GDP per capita	0.026***	0.021*	0.041***	0.013	0.027***
	(0.008)	(0.012)	(0.007)	(0.012)	(0.008)
N	46	46	46	46	46
R^2	0.57	0.56	0.53	0.60	0.59

Table 6: Decomposition of Delegation Benefits

human capital within managerial occupations is not. This is clearly seen in Figure 16 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 (conditional on working as a manager) 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 11).

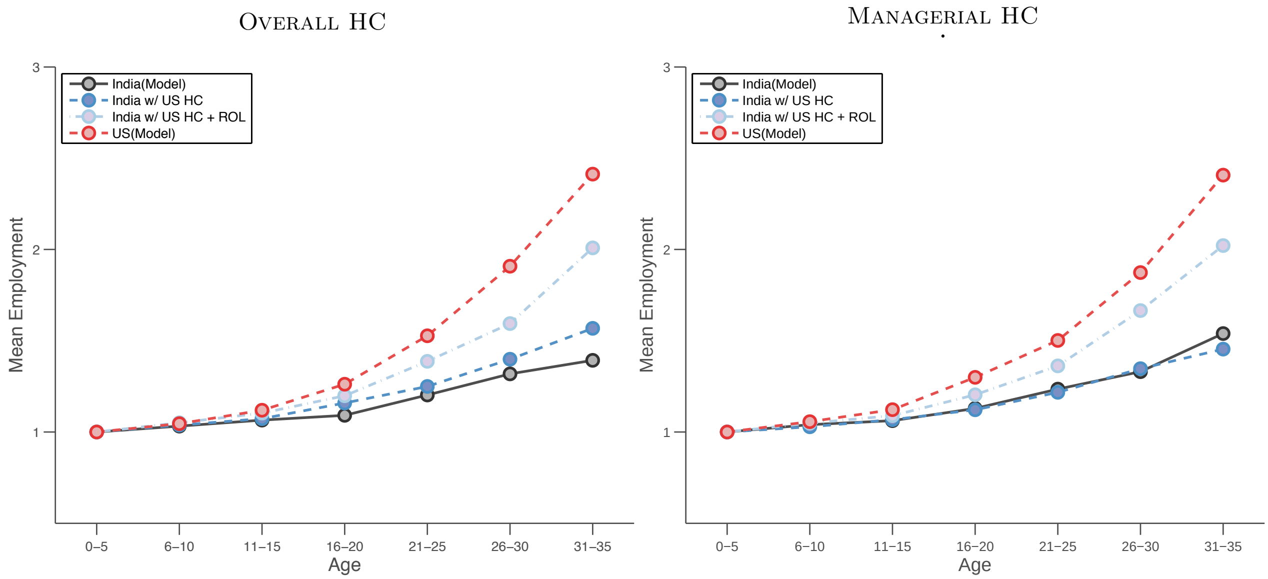
Figure 16: Human Capital Across the World: Managers vs the whole economy



Given the estimated parameters $\hat{\varphi}$ and $\hat{\beta}$ we can use (18) to decompose the variation in inferred delegation benefits ξ_c into its different components. For concreteness we focus on the US versus India comparison and we report these decompositions in Figure 17. The left panel displays the decomposition based on the average human capital, the right panel the one based on the managerial human capital.

The grey and red line show the model's predictions for India and the US respectively - more precisely, it shows a plants' lifecycle given the inferred delegation benefits $\hat{\xi}(ROL_{IND}, HC_{IND})$

Figure 17: Decomposing the Life Cycle Profile Difference between US and India



and $\hat{\xi}(ROL_{US}, HC_{US})$ while keeping all other remaining parameters at their Indian levels reported in Table 4. While this matches the life-cycle perfectly for India, it explains roughly half of the actual life-cycle pattern in the US (see Figure 12 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 $\hat{\xi}(ROL_{US}, HC_{US})$, 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 (18) was orthogonal to the regressors, these counterfactual life-cycle profiles had a structural interpretation. The light blue line was the life-cycle profile of Indian firms 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 of human capital, holding legal systems the same, i.e., $\hat{\xi}(ROL_{IND}, HC_{US})$. According to Figures 12 and 17, we conclude that the delegation margin as such can explain 50% of the life-cycle difference between the US and India (by age 30), 70% of which can be explained by the empirical variation in legal systems and human capital. How this explained share is attributed to the variation in the legal environment and the human capital depends on the human capital measure we use. In case we focus on the average human capital (left panel), the human capital margin explains roughly one third, with the remaining two thirds being attributed to the legal system. However, if we take managerial skills as our human capital measure (right panel), the human capital margin is not important and the entirety of the 70% is explained by the quality of the rule of law, precisely because in the data managerial human capital is uncorrelated with managerial employment shares and hence the inferred delegation benefits.

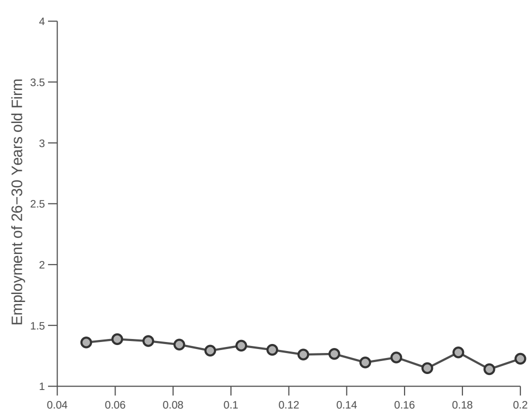
Which of these decompositions is preferable depends on the assumed quality of *marginal non-manager*. If one where the think that the marginal non-managerial worker is of a similar skill level than the average manager, the decomposition in the right panel would be appropriate. We know that this cannot be the case "globally", as we know that the average level of human capital is lower in poor countries. Hence, such interpretation implicitly presumes that there are some non-managerial workers with a similar skill level, which could be hired as managers if there was sufficient demand. The polar opposite interpretation would say that the marginal non-manager had the same human capital as the average individual in the respective country. In that case, it might be more appropriate to base the decomposition of delegation benefits in (18) on the left panel. The reason is that the demand for managers is determined from the marginal worker. If that worker was of much worse quality then the average manager and if such quality differences were correlated with the country's rule of law, the important variation in managerial employment shares across countries might largely be driven by the supply of potential managers and the demand channel induced by variation in the quality of legal institutions has less weight.

4.4 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.

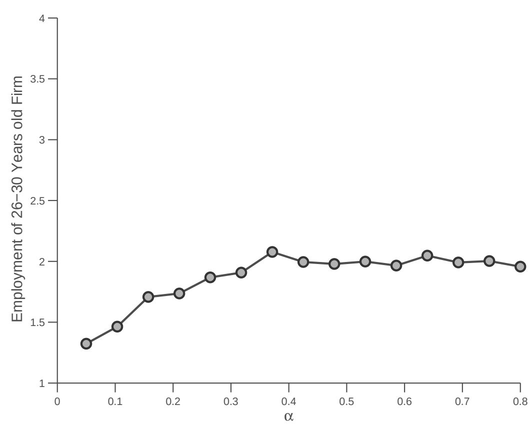
Entry We first start with the entry intensity z, which could presumably vary across countries. Figure 18 plots the employment share of firms 31-35 years old against various values of the entry rate, keeping all other parameters at their Indian values. A seen in Figure 18 more entry implies more competition 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 much lower. Not only do we not know of any evidence for this to be true, but Figure 18 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.

FIGURE 18: ENTRY RATE z VS EMPLOYMENT PROFILE OF 26-30 YEAR-OLD FIRMS



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 19 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 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.

Figure 19: Type Distribution α vs Employment Profile of 26-30 Year-old Firms



5 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 delegation as the main cause for the insufficient expansion by the firms with growth potentials. 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 46%-70% of this explained part, variation in managerial human capital has relatively lower impact.

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6 Appendix

6.1 Proofs and Derivations

Derivation of Profit π_j

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

$$U_0 = \int_0^\infty \exp(-\rho t) \ln C_t dt, \tag{19}$$

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.

6.2 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

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

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

$$y_{jt} = \frac{Y_t}{p_{ij}} = \frac{q_{jt} Y_t}{\gamma w_t}, \tag{21}$$

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

$$l_{jft} = \frac{y_{jft}}{q_{jft} m\left(e_{ft}\right)} = \frac{Y_t}{m\left(e_{jft}\right)\gamma w_t}, \tag{22}$$

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

$$\zeta_{jft} = \frac{p_{jft}}{MC_{jft}} = \frac{\frac{\gamma w_t}{q_{jt}}}{\frac{w_t}{q_{jt} m\left(e_{jft}\right)}} = \gamma m\left(e_{jft}\right), \tag{23}$$

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

$$\tilde{\pi}_{jft} \quad = \quad \left[\frac{\gamma w_t}{q_{jt}} - \frac{w_t}{q_{jt} m\left(e_{ft}\right)}\right]\frac{q_{jt} Y_t}{\gamma w_t} = \frac{\gamma m\left(e_{jft}\right) - 1}{m\left(e_{jft}\right)\gamma} Y_t, \tag{24}$$

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 (24) 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 (21) into (2.1) we get that equilibrium wages are given by

$$w_t = \frac{1}{\gamma} Q_t, \tag{25}$$

where Q_t is the Cobb-Douglas composite of individual efficiencies

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

Using (22), we get that $l_{jft} = \frac{1}{Q(t)m\left(e_{jft}\right)} Y_t$, so that total output is given by

$$Y_t = Q_t M_t L_t^P, \tag{26}$$

where

$$M_t = \left[\int_0^1 m\left(e_{jft}\right)^{-1} dj\right]^{-1}. \tag{27}$$

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.[14]

[14] 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.