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Managerial Delegation, Law Enforcement, and Aggregate Productivity

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Abstract

I propose a novel general equilibrium framework to quantify the impact of law enforcement on the internal organization of firms and thereby on aggregate outcomes. The model features an agency problem between the firm and its middle managers. Imperfect law enforcement allows middle managers to divert revenue from firms, which reduces delegation and constrains firm size. I use French matched employer-employee data for evidence of the model's pattern of managerial wages. Relative to the French benchmark economy, reducing law enforcement to its minimum value decreases GDP (equivalently, TFP) by 23 percent and triples the self-employment rate. Consistent with the model, I document cross-country empirical evidence of a positive correlation between law enforcement indicators and the aggregate share of managerial workers. Mapped across the world, the model explains 3 to 6 percent of the ratio in GDP per worker between the poorest and richest quintile of countries, and 6 to 11 percent of their TFP ratio.

Keywords: Growth and Development, TFP, Productivity, Firm Size, Misallocation, Management, Delegation, Law Enforcement.

JEL codes: O10, O40, O43, O47.

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1. Introduction

Compared to their peers in the rich world, firms in developing countries are on average badly managed. This follows from a series of papers building on the pioneering empirical work on managerial practices by Bloom and Van Reenen (2007). They find that firms could boost productivity via minor and seemingly cheap changes to daily management. In particular, one major source of managerial inefficiency in less developed countries is inadequate delegation of decision-making. Many productivity-enhancing measures are left on the table as the workers who are best informed about specific problems are not endowed with sufficient authority to solve them. Why? Empirically, Bloom, Sadun and Van Reenen (2012) argue that social capital in the form of trust as well as the rule of law are important drivers of firm decentralization across countries. This squares neatly with the empirical investigation on Indian firms in Bloom, Eifert, Mahajan, McKenzie and Roberts (2013) where the lack of trust in non-family members is found to be the main obstacle to the delegation of managerial tasks.[1]

The novelty of the present paper is the joint formalization of these concepts and their quantification through the lens of an equilibrium model. Weak law enforcement is assumed to allow middle managers – i.e., workers with some degree of autonomy – to divert firm revenue. This makes firms reluctant to delegate, resulting in a distorted division of employment within the firm that may be interpreted as poor management. My main interest is to measure the corresponding aggregate productivity loss. In addition, I also quantify the extent to which the mechanism replicates other stylized facts about poor countries such as high self-employment, a small average size of firms, and low dispersion in firm size.

The model features two key elements. One is the firm's production function that captures in a simple manner the endogenous choice of delegation. It is a generalization of the Lucas (1978) model where the span of control is endogenous. The degree of delegation is the number of managerial layers overseeing production workers. Adding managerial layers allows entrepreneurs to increase their span of control, which is traded off against the extra overhead cost per layer. Productive firms choose to delegate more in order to direct a larger workforce.

The second theoretical novelty is the institutional environment. The central hypothesis is that in each layer, imperfect law enforcement allows managerial employees to divert some of the firm's revenue. Those in higher echelons of the hierarchy handle more revenue and can therefore expropriate

[1] See also Bloom and Van Reenen (2010) and Bloom, Mahajan, McKenzie and Roberts (2010) for a review of these findings and how they relate to cross-country productivity differences.

more. Firms offer their middle managers long-term wage contracts that are juicy enough to prevent expropriation, which generates managerial premia relative to the wage of production workers. Because managers in higher echelons require a larger premium, entertaining a long chain-of-command is costly and disproportionately affects the most productive and largest firms. Apart from affecting the organizational structure of firms, the friction impacts employment decisions and the choice of entry.

For empirical evidence, I turn to French matched employer-employee data. First, I test a number of model predictions regarding managerial wages. I confirm that managerial occupations earn a wage premium over and above non-managerial occupations, worth on average 11 percent. Consistent with the model, the wage premium is increasing in the manager's own layer position, her firm's size, and her firm's degree of delegation (total number of layers). In a second step, I use the estimated average premium as a key ingredient in the calibration of the model. The inferred law enforcement parameter is near its maximum level, implying that the French benchmark economy operates close to efficiency.

Next, I lower the institutional parameter to quantify equilibrium changes. The following numbers summarize the move from the French benchmark economy to its counterfactual where law enforcement ceases completely. The most important finding is the large loss in GDP, 23 percent. Absent any form of endogenous capital accumulation, it is entirely a product of labor misallocation and therefore a pure loss in labor efficiency. This paper thus provides a novel theory of total factor productivity (TFP). The magnitude is comparable to that found in the established literature on firm borrowing constraints. For example, the maximum TFP loss due to credit frictions is 36 percent in Buera, Kaboski and Shin (2011), 23 percent in Greenwood, Sanchez and Wang (2013), and roughly 20 percent in Midrigan and Xu (2014).[2]

While in the benchmark economy a typical employee works for a firm with an average of 5.3 layers, in the weakest law enforcement economy that number is 1.1. The mom-and-pop shop replaces *Carrefour* as the most common workplace, both because firms shun delegation and because labor demand becomes more concentrated in small firms with no middle managers, consistent with the empirical evidence in Bloom et al. (2012). Also, lower labor demand drags down the value of entering the labor market. Individuals therefore massively switch into self-employment, which rises from 12 to 40 percent. The

[2] Larger productivity losses are found in papers focusing on the agricultural sector (Adamopoulos and Restuccia, 2014) or on human capital accumulation (Gennaioli, La Porta, Lopez-de Silanes and Shleifer, 2013; Manuelli and Seshadri, 2014), but these are not aimed at uncovering particular institutional failures. The literature finds sizable TFP losses associated with misallocation due to generic tax wedges (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Bento and Restuccia, 2017). The misallocation due to concrete policy variations, however, typically generates relatively minor TFP effects (Restuccia and Rogerson, 2013).

average size of firms shrinks substantially, from almost 8.6 to 2.5 workers. Law enforcement, through the channel of delegation, thus offers an important explanation for the high self-employment rate and the small average size of firms in developing countries (Tybout, 2000; Gollin, 2008; Bento and Restuccia, 2017; Poschke, 2018), consistent with empirical evidence whereby the rule of law positively impacts firm size (Kumar, Rajan and Zingales, 1999; Laeven and Woodruff, 2007). In addition, because weak law enforcement encourages employment in small firms, it rationalizes the low dispersion in the firm size distribution found in poorer countries (Poschke, 2018).

The final part of the paper is a cross-country analysis. Empirically, I find a robust positive cross-country correlation between the aggregate share of managerial workers and law enforcement, as measured by two alternative indicators: the World Bank's Doing Business series on the cost of contract enforcement (henceforth CCE) and the Rule of Law component of the World Governance Indicators (henceforth RL). Apart from validating a key prediction of the quantitative model, these estimates allow to map countries from the data to the model. That is, a country's institutional indicator translates into a particular model parameter of law enforcement via the predicted managerial share. I find that both CCE and RL yield a span of the model parameter that ranges from perfect to no enforcement. The numbers presented above, comparing France to an economy with zero enforcement, are hence plausible extremes.

Grouping countries by their empirical GDP per worker obtains the following summary statistics. Using CCE for the mapping, model output in the poorest quintile of countries is on average 10 percent lower than in the richest quintile. Using RL for the mapping, that number is 19 percent. These results can be compared to the empirical gap in GDP per worker or, alternatively, in TFP. Depending on the institutional indicator used for the mapping, the model accounts for roughly 3 to 6 percent of the empirical ratio in GDP per worker between poor and rich countries. It accounts for 6 to 11 percent of their empirical ratio in TFP. Moreover, the model predicts the group of poorest countries to have a self-employment rate that is 1.8 to 2.5 times higher than that of the richest countries, and an average firm size that is 42 to 64 percent lower.

1.1. Related literature

This paper relates to the literature on delegation in firms. The endogenous choice underlying the number of firm layers resembles the mechanism in the knowledge-based hierarchy model of Garicano (2000), especially the heterogeneous firm version developed by Caliendo and Rossi-Hansberg (2012) and evaluated empirically in Caliendo, Monte and Rossi-Hansberg (2015) and Caliendo, Mion, Opromolla and Rossi-Hansberg (2019). There, the number of workers that a firm can hire is bounded by the time that the entrepreneur spends communicating unresolved problems. The decreasing span of control stems from the fact that paying workers to learn infrequent problems is costly. Adding problem-solving managerial layers between the workers and the entrepreneur allows to ease the span of control constraint at the overhead cost of employing additional managers. More productive firms, having a stronger incentive to scale up production, employ more layers. The simple production function proposed in the present paper captures the gist of that trade-off in a less structural but highly tractable manner.[3] In addition, I introduce an agency problem arising from delegation that is modeled along the lines of optimal dynamic debt contracts with one-sided limited commitment.[4] The resulting prediction that efficiency wages are increasing in the hierarchical managerial position is closely related to that in Calvo and Wellisz (1978) and Calvo and Wellisz (1979), and the more recent contribution by Chen (2017). The main difference is the interpretation. There, higher layers are disproportionately incentivized to provide effort so as to maximize effort supervision of subordinate workers. Here, higher managerial layers are assumed to handle more revenue per manager, which gives them more bargaining power to extract rents. Finally, the trade-off underlying delegation differs from other classic issues such as incentives for initiatives (Aghion and Tirole, 1997), risk of spin-offs (Rajan and Zingales, 1998), and noisy communication (Dessein, 2002).[5]

Methodologically, I follow in the footsteps of contributions measuring misallocation due to institutional frictions. Much of the literature has concentrated on credit frictions. Prime examples are Erosa and Hildago Cabrillana (2008), Greenwood, Sanchez and Wang (2010), Amaral and Quintin (2010), Buera et al. (2011), Caselli and Gennaioli (2013), Midrigan and Xu (2014), and Moll (2014). These papers have in common a game between the capital provider and the entrepreneur, with poor contract enforcement draining the flow of credit.[6] Here, in contrast, the game is set inside the firm between the entrepreneur and her middle managers. The two mechanisms are indeed complementary. Chen, Habib

[3] In contrast to those papers, I abstract from skill acquisition so that wage inequality only results from efficiency wages. Also, there exists no notion of assignment and matching between heterogeneous firms and workers as in some variants of the Garicano (2000) framework (Garicano and Rossi-Hansberg, 2004, 2006; Antràs, Garicano and Rossi-Hansberg, 2006; Caicedo, Lucas and Rossi-Hansberg, 2019).

[4] See for instance Kehoe and Levine (1993) and Alvarez and Jermann (2000).

[5] See Aghion, Bloom and Van Reenen (2014) for a synthesis of the literature on the decentralization of firms.

[6] Other frictions studied in the literature include size-dependent policies (Guner, Ventura and Xu, 2008; García-Santana and Pijoan-Mas, 2014), informational frictions (Cole, Greenwood and Sanchez, 2016; David, Hopenhayn and Venkateswaran, 2016), matching frictions (Alder, 2016), and market power (Peters, 2019). See the reviews of Hopenhayn (2014) and Restuccia and Rogerson (2017).

and Zhu (2019) extend the framework introduced in the present paper to include capital and a standard collateral credit friction. They quantify that the managerial friction depresses GDP by roughly the same amount as the credit friction. Importantly, the two frictions interact by constraining different types of firms. The credit friction binds disproportionately for firms relying on outside finance while the managerial friction dominates in firms that have outgrown the credit constraint through self-finance.[7]

This paper is part of a nascent literature on the effect of institutions and technology on firm organization and aggregate outcomes. The closest contribution is Akcigit, Alp and Peters (2019). They study a model of firm dynamics through endogenous innovation where firms hire outside managers to increase their span of control. They calibrate the model separately to the U.S. and India, interpreting the efficiency of managers as a technological delegation parameter. Interestingly, they find that the delegation parameter exerts a stronger impact on GDP in the U.S. than in India because India has a higher share of subsistence firms that are not looking to innovate and expand, independently of the delegation friction. The present paper differs methodologically in its treatment of distinct managerial layers and efficiency wages, and empirically in tying the cost of delegation more directly to an institutional failure of enforcing contracts. Boehm (2018) and Boehm and Oberfield (2018) examine the effect of contract enforcement on the vertical integration of firms. These papers are complementary to mine as weak contract enforcement hinders the delegation of activities to intermediate input providers.[8] Roys and Seshadri (2014) consider an environment of assortative matching between entrepreneurs and workers where the delegation of tasks is inversely related to human capital accumulation. Firm decentralization is driven by exogenous TFP that affects human capital accumulation. Bhattacharya, Guner and Ventura (2013) and Guner, Parkhomenko and Ventura (2018) study the negative impact of distortionary policies on the human capital accumulation of managerial *entrepreneurs* and thereby on average firm size and TFP.[9] The present paper is different as it focuses on delegation to managerial *employees*. Also, my framework provides an example of a concrete distortionary policy that disproportionately harms the best entrepreneurs, which could be extended to the choice of skill investment.

Section 2 describes the model environment and theoretical results. Section 3 documents empirical

[7] They also point out that the layer technology is another candidate explanation for the large cross-firm dispersion of the average product of capital (Asker, Collard-Wexler and De Locker, 2014; David and Venkateswaran, 2019).

[8] Alfaro, Bloom, Conconi, Fadinger, Legros, Newman, Sadun and Van Reenen (2019) provide a theoretical and empirical investigation of the joint decision of delegation and integration, arguing that both are increasing in firm productivity.

[9] Bloom, Sadun and Van Reenen (2016) focus on a related idea, the investment of firms into their managerial technology. Their partial equilibrium estimations suggest large cross-country TFP differences due to factors that endogenously determine management practices.

evidence on managerial wage premia. Section 4 covers the calibration and the quantitative results. Section 5 present a cross-country analysis. Section 6 concludes.

2. Theory

2.1. Model environment

The economy is populated by a unit measure of infinitely lived individuals. They are heterogeneous in entrepreneurial skill, z, which is permanent and drawn from the cumulative distribution function $F(z)$ with continuous support $(0, \overline{z}]$. Their period utility is linear in earnings and they discount time at the factor $\beta \in (0,1)$.

I focus on the stationary equilibrium where all prices and probability distributions are constant. The individual makes a permanent choice between entrepreneurship and supplying labor as an employee. Entrepreneurship procures the discounted present value $\frac{\pi(z)}{1-\beta}$ where $\pi(z)$ represents period profits. Alternatively, the individual enters the labor market to find a job. The value of labor market entry is V, which is independent of z because the entrepreneurial skill does not affect the individual's efficiency as an employed worker. The labor market will be described in detail below. For now, note that it is frictionless so that all searchers are matched to jobs, albeit of different types. Let $\mathbb{I}(z)$ be the occupational indicator function for entrepreneurship such that

$$\mathbb{I}(z) = \begin{cases} 1 & \text{if } \frac{\pi(z)}{1-\beta} \geq V, \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

Each entrepreneur produces quantity $y(j)$ of a distinct variety $j \in [0,1]$. These varieties are purchased at price $p(j)$ by a competitive stand-in firm producing aggregate output (GDP) via

$$Y = \left(\int_0^1 y(j)^{\phi} \mathrm{d}j \right)^{\frac{1}{\phi}} = \left(\int \mathbb{I}(z) y(z)^{\phi} \mathrm{d}F(z) \right)^{\frac{1}{\phi}}, \tag{2}$$

with $\phi \in (0,1]$. The corresponding inverse demand function is

$$p(z) = \left(\frac{Y}{y(z)} \right)^{1-\phi}. \tag{3}$$

2.1.1. Organizational structure and output

An entrepreneur can choose between two distinct organizational structures. The first type is the own-account firm, or zero-layer firm ($L = 0$). Here, the entrepreneur is the only worker, and more precisely a *production* worker of mass $n = 1$. Output is given by

$$y(z, 0) = z\mu. \tag{4}$$

Parameter $\mu > 0$ can be interpreted as the own-account worker's amount of efficiency labor.

The other organizational structure is the employer firm, organized in up to $L = \{1, 2, 3, ...\}$ layers. Here, the entrepreneur is a *managerial* worker and occupies the highest hierarchical position (mass $m_L = 1$). He provides $\alpha > 0$ units of efficiency labor.[10] The employer firm hires n production employees. In addition, it may hire middle managers, depending on its organizational choice. A *single-layer* firm, $L = 1$, does not hire any middle managers. In contrast, a *multi-layer* firm, $L \geq 2$, can hire a mass of managerial employees in the layers beneath the entrepreneur: m_1, m_2, ..., m_{L-1}. Output is given by

$$y(z, L) = z\alpha^{\theta^L} n^{1-\theta} \prod_{l=1}^{L-1} m_l^{(1-\theta)\theta^l}. \tag{5}$$

The proposed technology has the following interpretation. Consider first the single-layer firm, $L = 1$. Production workers provide n units of input at efficiency e_n, which depends on the entrepreneur's span of control according to $e_n = (\frac{m_1 e_1}{n})^\theta$. Since labor input and efficiency of the top layer are fixed, $m_1 = 1$ and $e_1 = \alpha$, effective output is simply

$$y(z, 1) = zne_n = zn\left(\frac{m_1 e_1}{n}\right)^\theta = zn\left(\frac{\alpha}{n}\right)^\theta = z\alpha^\theta n^{1-\theta}.$$

This is the standard Lucas (1978) formulation where $1 - \theta \in (0, 1)$ is the span of control parameter.

Now, suppose that the entrepreneur delegates supervision and knowledge acquisition to m_1 managerial employees in layer 1. Production employees again supply n units of labor at efficiency $e_n = (\frac{m_1 e_1}{n})^\theta$. The managerial employees are themselves supervised by the entrepreneur who now occupies layer 2. They contribute m_1 units of labor at efficiency $e_1 = \left(\frac{m_2 e_2}{m_1}\right)^\theta = \left(\frac{\alpha}{m_1}\right)^\theta$ since the entrepreneur's input

[10] Parameters α and μ only matter for the quantification. Setting $\alpha = \mu = 1$ preserves the main qualitative features.

is fixed, $m_2 = 1$ and $e_2 = \alpha$. Effective output in this $L = 2$ firm is therefore

$$y(z,2) = zne_n = zn\left(\frac{m_1 e_1}{n}\right)^\theta = zn\left(\frac{\left(\frac{m_2 e_2}{m_1}\right)^\theta m_1}{n}\right)^\theta = zn\left(\frac{\left(\frac{\alpha}{m_1}\right)^\theta m_1}{n}\right)^\theta = z\alpha^{\theta^2} n^{1-\theta} m_1^{(1-\theta)\theta}. \quad (6)$$

Analogously, delegation through two layers of middle management, $L = 3$, yields effective output

$$y(z,3) = z\alpha^{\theta^3} n^{1-\theta} m_1^{(1-\theta)\theta} m_2^{(1-\theta)\theta^2}. \quad (7)$$

The technology is therefore a generalization of the Lucas (1978) model. It retains its simplicity while endogenizing the supervision technology. Adding managerial layers permits the firm to increase its span of control yet comes at an implicit fixed cost.[11] Note that in the limit, $L \to \infty$, the technology becomes a Cobb-Douglas constant returns to scale production function in employees.

Before proceeding, it is worth stressing that this particular technology of layers is chosen purely for tractability. It abstracts from the rich micro foundation in knowledge-hierarchy models, especially the notion that firms require workers in distinct types of layers to differ in skill (Garicano, 2000). It does, however, mechanically incorporate the main trade-off: in return for a higher overhead cost, delegation allows the entrepreneur to span more workers.

2.1.2. Compensation of workers and profit

The output market is monopolistically competitive as each firm produces a distinct variety. Firms choose the organizational structure that maximizes profits:

$$\pi(z) = \max_L \{\pi(z,L)\}_{L=0}^{\infty}. \quad (8)$$

The zero-layer firm ($L = 0$) does not make any input decisions. Its profits are simply

$$\pi(z,0) = p(z)y(z,0) = Y^{1-\phi} y(z,0)^\phi = Y^{1-\phi}(z\mu)^\phi \quad (9)$$

after substituting in the price (3) and output (4).

[11] This is easily seen by comparing the examples (6) and (7). Setting $y(z,2) = y(z,3)$ with an equal amount of workers n and m_1 implies that $m_2 = \alpha$. Thus, at given choices of n and m_1, a firm with 3 layers must employ (and pay) an extra $m_2 = \alpha$ middle managers to produce as much as the firm with 2 layers.

The single-layer firm ($L = 1$) only hires production employees who earn a competitive wage, w. Its profit function is standard:

$$\pi(z,1) = p(z)y(z,1) - wn = Y^{1-\phi}y(z,1)^{\phi} - wn = \max_n \left\{ Y^{1-\phi}z^{\phi}\alpha^{\phi\theta}n^{\phi(1-\theta)} - wn \right\}$$

after substituting in output (5) and price (3).

The core of the model lies in the compensation of middle managers by multi-layer firms ($L \geq 2$). Managerial and production employees are *ex ante* identical. However, I assume that the nature of their work differs in that managerial employees can abuse their autonomy (e.g. in knowledge transmission or supervision) to divert resources from the firm. Concretely, I postulate that the firm's total revenue $r(z) = p(z)y(z)$ flows up the managerial hierarchy and that in every layer l each managerial employee handles a proportional part of it, namely $\frac{r(z)}{m_l(z)}$. Any such middle manager can divert up to a fraction $1 - \lambda$ of that value without facing charges. The parameter $\lambda \in [0, 1]$ measures the quality of law enforcement or property protection in the economy. It could for instance capture the cost of legal procedures, affecting the threshold at which the firm is willing to take its employees to court.

Consider a supermarket chain for visualization. The cashiers collect revenue, but cannot divert anything because their task is fully automated and perfectly monitored. The cashiers pass revenue on to the store managers. These, in contrast, have sufficient autonomy to divert part of the proceeds, for example by fudging reports. Further up, the revenue of a set of stores is channeled to the regional headquarters where middle managers (including accountants, lawyers, sales directors) can again appropriate a portion. And so forth up to (but excluding) the residual claimant, the owner/entrepreneur.

I assume that firms must take action to prevent stealing so that in equilibrium it will not occur.[12] The timing is as follows. At the beginning of each period, firm z offers its managerial employees in layer l a contract that stipulates three elements. First, a spot wage, $w_l(z)$, to which the firm can commit. Second, the threat of firing the manager if diversion is detected. Third, the promise to retain the manager when there is no diversion. This promise can only be kept imperfectly as separations occur exogenously.[13] The manager may accept or decline the contract. Upon acceptance, the manager decides whether to divert revenue within the period. At the end of the period, the firm pays out wages and perfectly detects any potential expropriation.

[12]This is an assumption and not necessarily an optimal choice.

[13]Both the promise and the threat are credible because firms are indifferent as to which worker they employ.

The offer of firm z to a middle manager in position $l \in \{1, 2, ..., L(z) - 1\}$ is

$$V_l(z) = w_l(z) + \beta\Big(\delta[\gamma V + (1-\gamma)\max\{V_l(z), V\}] + (1-\delta)\max\{V_l(z), V\}\Big). \tag{10}$$

The middle manager earns a period wage $w_l(z)$. In the following period, the match breaks exogenously with probability $\delta \in (0, 1)$. In this case, I assume that with exogenous probability $\gamma \in (0, 1]$ the middle manager definitely enters the labor market in search of another job, which procures value V. Alternatively, with probability $1 - \gamma$, the middle manager is instantly offered a job with identical characteristics in some other firm.[14] He then has the choice between accepting that job and returning to the labor market. If there is no exogenous separation, with probability $1 - \delta$, the manager similarly chooses between the option of remaining in the current job and entering the labor market.

If the middle manager accepts the job, he can expropriate revenue. The corresponding value is

$$V_l^{exp}(z) = w_l(z) + (1-\lambda)\frac{r(z)}{m_l(z)} + \beta\left[\gamma V + (1-\gamma)\max\{V_l(z), V\}\right]. \tag{11}$$

Under this scenario, the middle manager pockets the contractual wage as well as the diverted revenue. In the subsequent period he is fired. With probability γ he is forced to enter the labor market. Alternatively, he is instantly offered a job with identical characteristics at another firm, which he can accept or decline. Since the firm must prevent stealing, its contract has to be incentive-compatible:

$$V_l(z) \geq V_l^{exp}(z). \tag{12}$$

In addition, the value of the contract must be sufficiently high for the middle manager to accept the job in the first place. The minimum outside option is represented by the production job, which yields $w + \beta V$. Production workers earn a spot wage w and re-enter the labor market in the following period. The participation constraint for middle managers is therefore

$$V_l(z) \geq w + \beta V. \tag{13}$$

[14] The role of γ is to improve the model's quantitative fit. In the absence of worker heterogeneity, it captures parsimoniously the empirical fact that workers persist in particular occupations because they possess the required skill. The lower is γ, the higher is a managerial employee's persistence in his occupation. Setting $\gamma = 1$ does not undermine the main qualitative features of the model.

Table 1: Sequence of event stages within a period

1) Demand for workers	Firms demand $n(z)$ production employees at wage w and $m_l(z)$ managerial employees at contract $V_l(z)$ with wage $w_l(z)$.
2) Incumbent manager decision	Incumbent managers decide whether to accept offer, $\mathbb{M}_l(z)$ (in equilibrium, everyone accepts).
3) Matching	Searchers: all workers, except incumbent managers accepting offer in stage 2. Vacancies: all jobs, except of incumbent managers accepting offer in stage 2.
4) Production & compensation	Production takes place and workers are compensated.
5) Expropriation decision	Managerial employees decide whether to expropriate revenue $(1-\lambda)\frac{r(z)}{m_l(z)}$ (in equilibrium, no expropriation takes place).
6) Separation	Endogenous: all expropriating managers (in equilibrium, none). Exogenous separation: fraction δ of non-expropriating managers.
7) New incumbent managers	Non-separated managers and a fraction $1-\gamma$ of separated managers who are rematched with equivalent jobs.

Combining (3) and (5), the profit function of the managerial firm $L \geq 2$ is

$$\pi(z,L) = p(z)y(z,L) - wn - \sum_{l=1}^{L-1} w_l(z)m_l = Y^{1-\phi}y(z,L)^{\phi} - wn - \sum_{l=1}^{L-1} w_l(z)m_l$$
$$= \max_{n,\{m_l,w_l(z)\}_{l=1}^{L-1}} \left\{ Y^{1-\phi}z^{\phi}\alpha^{\phi\theta^L}n^{\phi(1-\theta)}\prod_{l=1}^{L-1} m_l^{\phi(1-\theta)\theta^l} - wn - \sum_{l=1}^{L-1} w_l(z)m_l \right\} \quad (14)$$

subject to $V_l(z) \geq V_l^{exp}(z)$ and $V_l(z) \geq w + \beta V$, $\forall l \in \{1, 2, ..., L-1\}$.

2.1.3. Labor market

The sequence of events in any given period is summarized in Table 1. In stage 1, firms determine their demand for production employees, $n(z)$, and managerial employees, $m_l(z)$. A fraction of the managerial jobs are offered to managers that the firm inherits from the previous period (stage 2). These *incumbent* managers decide whether to accept the offer, $V_l(z)$, or whether to enter the labor market at value V. The incumbent manager's choice, defined as $\mathbb{M}_l(z)$, is hence such that

$$\mathbb{M}_l(z) = \begin{cases} 1 & \text{if } V_l(z) \geq V, \\ 0 & \text{otherwise.} \end{cases} \quad (15)$$

Subsequently, the labor market opens and job searchers are matched with unfilled jobs (stage 3). The pool of job searchers comprises all workers except the incumbent managerial employees choosing $\mathbb{M}_l(z) = 1$ in the previous stage. Likewise, the pool of vacancies consists of all production jobs and managerial jobs except those pre-filled by incumbents. Searchers meet unfilled jobs randomly according to a set of endogenous probabilities. Let q be the probability of finding a production job. Let $q_l(z)$ denote the probability density of landing an unfilled managerial job at firm z in layer $l \in \{1, 2, ..., L(z) - 1\}$. Search is frictionless, so job finding is guaranteed:

$$q + \int \sum_{l=1}^{L(z)-1} q_l(z) \mathrm{d}z = 1. \tag{16}$$

The expected value of labor market entry is therefore

$$V = q(w + \beta V) + \int \sum_{l=1}^{L(z)-1} q_l(z) V_l(z) \mathrm{d}z \tag{17}$$

where $w + \beta V$ is the value of a production job and $V_l(z)$ is defined in (10). Labor market clearing requires that

$$\int \mathbb{I}(z) \left(n(z) + \sum_{l=1}^{L(z)} m_l(z) \right) \mathrm{d}F(z) = 1. \tag{18}$$

Following production and worker compensation (stage 4), managerial employees have the option to divert revenue (stage 5). Finally, the separation and partial rematching of managerial employees (stages 6 and 7) determines the identity of incumbent managers proceeding to the next period.

2.2. Definition of the stationary equilibrium

The stationary equilibrium is composed of entrepreneurship decisions $\mathbb{I}(z)$ and managerial decisions $\{\mathbb{M}_l(z)\}_{l=1}^{L(z)-1}$, $\forall z$; firm policy functions $L(z)$, $n(z)$, $\{m_l(z)\}_{l=1}^{L(z)}$, and $\{w_l(z)\}_{l=1}^{L(z)-1}$ for all active firms z; outcomes $y(z)$, $\pi(z)$, $p(z)$, $r(z)$, and $\{V_l(z), V_l^{exp}(z), q_l(z)\}_{l=1}^{L(z)-1}$ for all active firms z; and aggregate equilibrium objects w, V, Y, and q, such that:

(i) Individuals of type z decide their occupation, $\mathbb{I}(z)$, according to (1), $\forall z$;

(ii) Managerial employees decide whether to keep their incumbent job, $\mathbb{M}_l(z)$, following (15), $\forall z, l$;

(iii) Given w, V, Y, and given constraints (10) and (11), all active firms z solve (8) by maximizing over (9) and (14), with policy functions $L(z)$, $n(z)$, $\{m_l(z)\}_{l=1}^{L(z)}$, and $\{w_l(z)\}_{l=1}^{L(z)-1}$;

(iv) The price $p(z)$ for all active firms z is given by (3) with output $y(z)$ defined by (4) and (5);

(v) Aggregate output Y is given by (2);

(vi) The value of labor market entry V is given by (17);

(vii) The labor market clears according to (18);

(viii) The probabilities q and $\{q_l(z)\}_{l=1}^{L(z)-1}$ for all active firms z are consistent with vacancies.

2.3. Characterization of the equilibrium

Lemma 1. *The value of a managerial job at firm z in position l weakly exceeds the value of the labor market: $V_l(z) \geq V$, $\forall z, l$.*

Proof. See Appendix A.2.

Central to this result is the assumption that firms must prevent expropriation. Since the firm commits to a wage in advance (i.e., before expropriation can be detected), it is only the promise of retaining the manager that prevents defection. For this, the continuation value associated with staying in the firm must be more attractive than the expected value of the labor market.

The immediate consequence is that all *incumbent* managers accept to remain in their job, $\mathbb{M}_l(z) = 1$, $\forall z, l$. A second consequence is that during the matching phase of the labor market (stage 3 in Table 1), all searchers accept the job to which they are randomly matched, including those matched to production jobs. The intuition is as follows. Every searcher offered a managerial job accepts it as it is more lucrative than the expected value of search. Thus, all managerial jobs are instantly filled, which in turn leads the remaining (unlucky) searchers to accept production jobs.[15]

Lemma 2. *The incentive-compatible wage of managers at firm z in position l is*

$$w_l(z) = B(1-\lambda)\frac{r(z)}{m_l(z)} + (1-\beta)V, \tag{19}$$

[15]Note that a firm cannot exploit the gap between searchers' outcomes because its offer $V_l(z)$ is the minimum that is incentive-compatible. In essence, this resembles the efficiency wage argument of Shapiro and Stiglitz (1984) except that the reservation floor of unemployment is replaced by production employment.

where $B \equiv \frac{1-\beta(1-\gamma\delta)}{\beta\gamma(1-\delta)}$ *and where the flow value of the labor market is*

$$(1-\beta)V = w + \frac{1}{N_e}\frac{\delta(1-\lambda)}{\beta(1-\delta)}\int \mathbb{I}(z)\max\{[L(z)-1],0\}r(z)\mathrm{d}F(z) \geq w, \tag{20}$$

with N_e *denoting the aggregate mass of production employees.*

Proof. See Appendix A.3.

The managerial wage is decreasing in λ and increasing in the amount of revenue handled by the manager, $\frac{r(z)}{m_l(z)}$. Besides, equations (19) and (20) capture the entire role of *dynamics* in the model. Forward-looking behavior affects the managerial wage through two channels, one direct and one indirect. The direct impact occurs through B. First, B is increasing in the separation rate δ. A higher likelihood of laying off managers forces firms to front-load the compensation through higher present efficiency wages. Second, B is decreasing in γ. A low value of γ indicates that upon losing his job, a managerial worker is likely to transit back to another job with identical characteristics. The threat of firing the worker is weak, giving him strong bargaining power. Third, B is decreasing in β. The more patient the worker is, the more value he attaches to keeping his job. Finally, notice that β and δ implicitly measure the quality of detection. The economic meaning of time is nothing more than the period that it takes to detect expropriation. If detection were instantaneous, the time period would be infinitesimal, implying $\beta \to 1$ and $\delta \to 0$, and hence $B \to 0$. The contractual friction would disappear, independently of λ.[16]

The indirect equilibrium impact on $w_l(z)$ is through the term $(1-\beta)V$ in (20). It is at least as large as the production wage, w, due to the possibility of finding higher paying managerial jobs. With perfect law enforcement, $\lambda = 1$, the two coincide: $(1-\beta)V = w$. This also occurs when there are no middle manager jobs in the economy, $L(z) \leq 1$, $\forall z$, or if there are no managerial vacancies in the labor market as incumbent managers never get displaced, $\delta \to 0$.

Lemma 3. *The incentive-compatible profit function of employer firms,* $L \geq 1$*, can be expressed as*

$$\pi(z,L) = \max_{n,\{m_l\}_{l=1}^{L-1}} \left\{ [1 - B(1-\lambda)(L-1)] \underbrace{r(z)}_{p(z)y(z)=Y^{1-\phi}z^{\phi}\alpha^{\phi\theta^L}n^{\phi(1-\theta)}\prod_{l=1}^{L-1}m_l^{\phi(1-\theta)\theta^l}} - wn - (1-\beta)V\sum_{l=1}^{L-1} m_l \right\}. \tag{21}$$

Proof. Directly from replacing the incentive-compatible wage $w_l(z)$ from (19) into (14).

[16] The calibration further down implies $B = 0.24$. The dynamic game therefore helps firms lower the efficiency wage significantly relative to compensating the total amount that managers can run away with.

The incentive-compatible profit function reduces to a simple expression. Notice that the friction λ effectively acts as a tax wedge on revenue, and that the wedge is increasing in L. In particular, the demand for production and managerial workers is

$$n(z, L) = \phi(1-\theta)[1 - B(1-\lambda)(L-1)]\frac{r(z)}{w}, \tag{22}$$

and

$$m_l(z, L) = \phi(1-\theta)\theta^l[1 - B(1-\lambda)(L-1)]\frac{r(z)}{(1-\beta)V}. \tag{23}$$

Due to the friction, firms with longer hierarchies L are more reluctant to hire workers per unit of revenue. In addition, notice that for a given choice of L, imperfect law enforcement distorts the relative employment of managers to production employees as it leads to $(1-\beta)V > w$.

Proposition 1. *Selection and profit-maximizing choices depend as follows on z:*

(i) There exists a productivity threshold $\underline{z}$ such that individuals are entrepreneurs (i.e., self-employed) if and only if their $z \geq \underline{z}$;

(ii) The degree of delegation $L(z)$ is finite and weakly increasing in z;

(iii) Firm size is strongly increasing in z, both in terms of employment, $x(z) \equiv n(z) + \sum_{l=1}^{L(z)-1} m_l(z)$, and revenue, $r(z)$.

Proof. See Appendix A.4.

Point (i) is a standard outcome. Regarding point (ii), note that there are two sources of decreasing returns in the model: downward-sloping demand ($\phi < 1$) and span of control ($\theta < 1$). Firms have the possibility to dampen the second source of decreasing returns through delegation. That, however, is costly: each layer represents an implicit fixed cost for technological reasons and due to contractual frictions ($\lambda < 1$). Consequently, $L(z)$ is increasing in z, because more productive firms have a greater incentive to flatten the gradient of decreasing returns. Finally, point (iii) is a standard outcome on the intensive margin. It is reinforced by discrete upward jumps in employment and revenue around productivity thresholds at which firms add an extra layer.

Proposition 2. *The equilibrium wage of middle managers at firm z in position l is*

$$w_l(z) = (1-\beta)V\left(1 + \frac{B(1-\lambda)}{\theta^l(1 - B(1-\lambda)[L(z)-1])}\right). \tag{24}$$

It is increasing in the hierarchical position l and increasing in the firm's hierarchy length $L(z)$, and therefore positively correlated with firm size.

Proof. Directly from combining (19) and (23).

This provides a testable implication for the equilibrium wage across firms and layers. In any given firm, managerial employees in higher layers are paid a higher efficiency wage because of they handle more revenue per person. In addition, for any given level of seniority, middle managers earn more in firms that delegate through a longer chain-of-command $L(z)$. This happens because firms with longer hierarchies are more reluctant to hire workers relative to their revenue size. As a result, middle managers in such firms handle more revenue per person.

Finally, notice from (22) and (23) that in employer firms, $L(z) \geq 1$, the occupational ratio between managerial and production employees is

$$\frac{\sum_{l=1}^{L(z)-1} m_l(z)}{n(z)} = \frac{w}{(1-\beta)V}\frac{\theta - \theta^{L(z)}}{1-\theta}. \tag{25}$$

It is increasing in the firm's hierarchy length, $L(z)$, and thus positively correlated with firm size. Moreover, in the cross-section of firms, the occupational ratio is a proxy measure for delegation, $L(z)$.

2.4. Law enforcement and the equilibrium

Next, I examine the comparative statics of varying the law enforcement parameter. A differential increase in λ reduces the revenue wedge faced by firms practicing managerial delegation, which generates two partial equilibrium effects. On the intensive margin, managerial firms increase their demand for workers and hence output. On the extensive margin, marginal firms are encouraged to add an extra managerial layer, further raising their employment and output. These changes lead to a feedback response through three general equilibrium objects: w, V, and Y.[17] To make headway in understanding the full equilibrium variation, I use the following simplifying assumptions.

[17] In equilibrium, these are determined by the premium (20), labor feasibility (18), and aggregate output (2).

Assumption 1. *The parameters are such that in equilibrium, there exist own-account firms ($L = 0$), single-layer firms ($L = 1$), and multi-layer firms ($L \geq 2$) with up to $\overline{L}$ layers.*

Assumption 2. *There is no exogenous managerial separation, $\delta \to 0$.*

Assumption 1 simply establishes the empirically relevant case.[18] Assumption 2, by contrast, leads to a specific and substantially simplified equilibrium. In that case, the value (20) reduces to $(1-\beta)V = w$. One consequence is that the enforcement friction only distorts the firm's organizational structure, but not the relative employment of managerial versus production workers for a given choice of L, as can be seen from (25).

Proposition 3. *Under Assumptions 1 and 2, a differential increase in λ leads to:*

(i) An increase in the value of labor market entry and production wages, $\frac{\mathrm{d}\ln V(\lambda)}{\mathrm{d}\lambda} = \frac{\mathrm{d}\ln w(\lambda)}{\mathrm{d}\lambda} > 0$*;*

(ii) An increase in GDP, $\frac{\mathrm{d}\ln Y(\lambda)}{\mathrm{d}\lambda} > 0$ *for* $\lambda < 1$*.*

(iii) A decrease in self-employment and thus an increase in the average firm size in terms of employment, $\frac{\mathrm{d}\ln \underline{z}(\lambda)}{\mathrm{d}\lambda} = \frac{1}{\phi}\left[\frac{\mathrm{d}\ln V(\lambda)}{\mathrm{d}\lambda} - (1-\phi)\frac{\mathrm{d}\ln Y(\lambda)}{\mathrm{d}\lambda}\right] \equiv \varepsilon(\lambda) > 0$*.*

Proof. See Online Appendix A.2.

The first point is straightforward. Stronger demand for workers leads to a higher production wage, w, and hence a larger V. The second point shows unambiguously that more rigorous law enforcement increases GDP.[19] The third point clarifies that the net effect on V and Y induces marginal entrepreneurs to switch into employment. The model thus offers an institutional explanation for low GDP and the widespread occurrence of self-employment in economies with weak law enforcement.

Next, consider the firms that change their organizational structure due to the variation in λ. Let z_L denote the threshold productivity such that firms $z = z_L$ are indifferent between employing L and

[18] Some parameter constellations may produce different equilibria. Namely, such that there are no multi-layer firms at all (only own-account and/or single-layer firms), or such that there exist multi-layer firms, but no own-account and/or single-layer firms. See Appendix A.4 for details.

[19] Also, in the absence of contractual frictions, $\lambda = 1$, GDP is first-best. While competition in the output market is monopolistic, it is not distortionary because all costs are expressed in terms of labor and the wage simply adjusts in proportion to the mark-up.

$L-1$ layers, $\pi(z_L, L) = \pi(z_L, L-1)$, $\forall L \in \{2, 3, ...\}$. Under Assumptions 1 and 2:

$$\frac{\mathrm{d}\ln z_L(\lambda)}{\mathrm{d}\lambda} = \begin{cases} \varepsilon(\lambda) > 0 & \text{if } L = 1, \\ \varepsilon(\lambda) - g(L;\lambda) & \text{if } L \in \{2, 3, ..., \overline{L}\}, \end{cases} \tag{26}$$

where the function $g(L;\lambda) > 0$ captures the direct impact of λ and is increasing in L, $\frac{\partial g(L;\lambda)}{\partial L} > 0$ (see Online Appendix A.3). The productivity threshold between own-account work and single-layer firms, z_1, moves unambiguously to the right. This is because single-layer firms see their effective cost of production increase without directly benefiting from the increase in λ. For multi-layer firms, $L \geq 2$, on the other hand, the increase in λ induces a direct positive impact on profitability through g. That effect is larger for firms employing more layers.

Proposition 4. *Under Assumptions 1 and 2, a marginal increase in λ expands the mass of firms organized in $\overline{L}$ layers, $\frac{\mathrm{d}\ln z_{\overline{L}}(\lambda)}{\mathrm{d}\lambda} < 0$.*

Proof. See Online Appendix A.4.

This Proposition states that – at the very least – the highest threshold, $z_{\overline{L}}$, moves to the left. Conversely, the Proposition also implies that a sufficiently large *decline* in λ may increase the threshold $z_{\overline{L}}$ to such an extent that no firm is productive enough to organize in $\overline{L}$ layers. In other words, the theory offers an explanation for why the most productive (and hence the largest) firms tend to delegate more in countries with strong law enforcement.

How does a change in λ affect firms' employment choice, $x(z)$, on the intensive margin? Under Assumptions 1 and 2, the semi-elasticity is

$$\frac{\mathrm{d}\ln x(z)}{\mathrm{d}\lambda} = \begin{cases} \frac{-\phi\varepsilon(\lambda)}{1-\phi(1-\theta^{L(z)})} < 0 & \text{if } L(z) = 1, \\ \frac{h(L(z);\lambda)-\phi\varepsilon(\lambda)}{1-\phi(1-\theta^{L(z)})} & \text{if } L(z) \in \{2, 3, ..., \overline{L}\}, \end{cases} \tag{27}$$

where the function $h(L;\lambda) > 0$ captures the direct impact of λ and is increasing in L, $\frac{\partial h(L;\lambda)}{\partial L} > 0$ (see Online Appendix A.3). As law enforcement improves, singe-layer firms only experience a rise in their effective cost and hence reduce employment. Managerial firms, in contrast, benefit directly through h. The longer is their chain-of-command, L, the more they benefit from the drop in frictions, and the more likely it is that they grow, i.e., that $h(L(z);\lambda) - \phi\varepsilon(\lambda) > 0$. Also, note the role of the denominator $1 - \phi(1 - \theta^L)$ in the semi-elasticity (27). It is smaller for firms that delegate more, so that delegation effectively acts as a lever. For a given net benefit $h(L; \lambda) - \phi\varepsilon(\lambda)$, firms with more layers react more strongly. The theory helps explain why in countries with strong property protection, the most efficient firms can grow exceptionally large. The framework differs markedly from models of capital frictions and collateral constraints. There, the friction does not disproportionately harm the best entrepreneurs, but those with the lowest wealth. The possibility to retain earnings and self-finance allows many of the most skilled entrepreneurs to grow out of the constraint (Buera et al., 2011; Moll, 2014). The institutional friction here cannot be circumvented through self-finance and represents an obstacle that is biased against the most productive firms. This is also consistent with the notion that in poorer countries, there is a stronger positive correlation between firm size and generic tax wedges as hypothesized in Restuccia and Rogerson (2008) and inferred empirically by Hsieh and Klenow (2009), Bartelsman, Haltiwanger and Scarpetta (2013), and Bento and Restuccia (2017).

Finally, remember that the clear qualitative results above rely on Assumption 2, namely $\delta \to 1$. In general, for $\delta < 1$, there exists an additional feedback loop as V and w do not move in tandem. The analytic equilibrium variation becomes considerably more complex.

3. Empirical evidence of managerial wage premia

A key outcome of the model is that managerial workers are paid a wage premium relative to production workers, and that the premium depends on the manager's hierarchical position. Before proceeding to the quantitative model, this Section tests the model's predictions by estimating wage premia on French matched employer-employee data. Moreover, the results provide an important empirical moment for the later quantification of the model.

I use three data sources. The first is the *Déclaration annuelle des données sociales, fichier salariés* (DADS). It encompasses nearly all formal employees in France, building on compulsory employer fillings of the earnings and other characteristics of their salaried employees. Each annual dataset provides information both for the current and the previous year, giving rise to year-by-year panels. Also, it provides the employee's firm identification number, which allows to construct the firm's characteristics regarding employment patterns and payroll. The second data source is the *DADS, fichier panel apparié à l'Échantillon démographique permanent* (henceforth EDP) which is a representative sample of the

DADS in panel format that, moreover, contains further information such as educational attainment and job tenure. Finally, I match the DADS and EDP with the *Fichier approché des résultats d'Esane* (FARE) which contains balance sheet information for all non-financial firms in France. Please refer to Online Appendix C.1 for the construction of all variables.

The French occupational code PCS classifies workers into categories that can be interpreted as hierarchical layers (Caliendo et al., 2015). Class 2 is composed of firm owners (*Artisans, commerçants et chefs d'entreprise*), of which only those that are paid a wage show up in the DADS data.[20] Class 3 is composed of senior staff or top management positions (*Cadres et professions supérieures*). Class 4 is composed of employees at the supervisor level (*Professions intermédiaires*). Class 5 is composed of qualified and nonqualified clerical employees (*Employés*). Class 6 is composed of blue-collar qualified and unqualified workers (*Ouvriers*).

Following Caliendo et al. (2015), I define managers as workers belonging to classes 2, 3 and 4, and production workers as those in classes 5 and 6. I first look at the wage premium associated with being any type of manager, i.e. class 2, 3 or 4, as opposed to class 5 or 6. Subsequently, I consider the wage premia for the three classes of managers separately. What is important to note is that the three managerial classes need *not* necessarily correspond one-for-one to the layers in the model. Instead, the assumption is the three classes are representative of the hierarchical order. For example, if a firm employs workers of classes 3 and 4, then class 4 workers are likely to be encountered in lower layers than those of class 3.

Consider the following hourly wage regression of individual i in year t:

$$\begin{aligned} \ln w_{i,t} =& \mu_i + \phi_t + \sum_{l=1}^{L} \left[\beta_l \cdot M_{l,i,t} + \theta_l \cdot M_{l,i,t} \cdot s_{i,t}\right] \\ &+ \sum_{n=1}^{N} \gamma_n \cdot X_{n,i,t} + \psi \cdot a_{i,t} + \eta \cdot a_{i,t}^2 + \sum_{j=1}^{J} \left(\nu_j + \zeta_j \cdot a_{i,t}\right) \cdot Z_{j,i} + \varepsilon_{i,t} \end{aligned}$$

where μ and ϕ denote individual and time fixed effects, respectively. The main coefficient of interest is β_l. It measures the wage impact associated with employment in managerial position l, denoted by the indicator $M_l = 1$. The other coefficient of interest is θ_l, measuring the wage impact associated with the interaction term between the managerial position l and some firm characteristic s such as e.g. firm size. The vector of controls, X, consists of: the department of residence; the employer's

[20] Class 1 is composed of farmers (*Agriculteurs exploitants*), which are excluded from the analysis.

two-digit sector; the employment type (including full-time work and part-time work); the employment contract (including permanent, fixed-term and internship); and job tenure (in years, logged). The final dependent variables are the individual's age a (in years) and a vector Z of time-invariant individual characteristics whose impact may depend on age: sex as well as educational attainment (8 indicators).

The analyzed panel is the latest available one, 2012-2013. To avoid estimating a large number of individual fixed effects, I run an OLS regression on year-on-year differences:

$$\Delta \ln w_i = \tilde{\phi} + \sum_{l=1}^{L} \left[\beta_l \cdot \Delta M_{l,i} + \theta_l \cdot \Delta \left(M_{l,i} \cdot s_i \right) \right] + \sum_{n=1}^{N} \gamma_n \cdot \Delta X_{n,i} + \tilde{\psi} \cdot a_i + \sum_{j=1}^{J} \zeta_j \cdot Z_{j,i} + \tilde{\varepsilon}_i. \qquad (28)$$

I only consider the sub-sample of employees who, between 2012 and 2013, switched their main employer. The purpose of that restriction is to discard wage changes associated with internal promotions and demotions resulting from firms learning the ability of their workers. The sample is further restricted to workers whose current and previous employer operates in the private non-agricultural sector, and to employment spells that lasted at least 180 days.

In the first two columns of Table 2, the only explanatory variable of interest is ΔM, an indicator of switching into or out of any managerial occupation.[21] In the initial regression, I discard all workers who in 2012 or 2013 held managerial occupations of class 2 (i.e., firm owners receiving a wage) in order to focus exclusively on pure employees. The resulting managerial wage premium is 10.8%.[22] In Column (2), occupations of class 2 are included, yielding a similar premium of 11.4%.

Next, column (3) separates the indicator into the three different classes of managers, where M_1 indicates the lowest managerial layer, M_2 the intermediate level, and M_3 the highest level. As predicted by Proposition 2 of the model, the managerial premium is larger in higher hierarchical positions: 7.3% in the first layer, 24.3% in the second, and 29.3% in the third.

In the remaining regressions, I analyze how firm characteristics impact each of the three managerial premia. By Proposition 2, the managerial premium is predicted to increase in the firm's size. Two measures of firm size are used to test that prediction: the firm's log of employment (EMP) and its log of value added (VA). The interaction terms in columns (4) and (5) show that, indeed, each of the

[21] That is, $\Delta M = 1$ if the individual switches into any managerial occupation, $\Delta M = -1$ if she switches out, and $\Delta M = 0$ if she either remains a managerial worker or remains a non-managerial worker.

[22] The regression specification implicitly assumes that the managerial wage premium is identical for workers switching *into* and *out* of managerial jobs. An alternative is to index all coefficients β by time, e.g. $\beta_l M_{l,i} + \beta_{l,-1}(-M_{l,i,-1})$ in equation (28). The managerial premia corresponding to Column (1) of Table 2 would be very much alike: $\beta = 0.1032$ for individuals switching into managerial posts and $\beta_{-1} = 0.1083$ for those switching out of them. Similar results, available upon request, obtain for all regressions in Table 2.

Table 2: Managerial premium

	(1)	(2)	(3)	(4)	(5)	(6)
ΔM	0.1078***	0.1124***				
	(0.0039)	(0.0040)				
ΔM_1			0.0733***	0.0332***	0.0232**	0.0374**
			(0.0041)	(0.0075)	(0.0115)	(0.0149)
ΔM_2			0.2425***	0.2179***	0.2145***	0.2064***
			(0.0060)	(0.0093)	(0.0139)	(0.0183)
ΔM_3			0.2926***	0.2663***	0.1616***	0.0537
			(0.0157)	(0.0219)	(0.0417)	(0.0494)
$\Delta (M_1 \times \ln \text{EMP})$				0.0074***		
				(0.0014)		
$\Delta (M_2 \times \ln \text{EMP})$				0.0042***		
				(0.0015)		
$\Delta (M_3 \times \ln \text{EMP})$				0.0131**		
				(0.0059)		
$\Delta (M_1 \times \ln \text{VA})$					0.0049***	
					(0.0012)	
$\Delta (M_2 \times \ln \text{VA})$					0.0029**	
					(0.0014)	
$\Delta (M_3 \times \ln \text{VA})$					0.0203***	
					(0.0057)	
$\Delta (M_1 \times \ln \text{MPROD1})$						0.0043**
						(0.0021)
$\Delta (M_2 \times \ln \text{MPROD2})$						0.0048**
						(0.0025)
$\Delta (M_3 \times \ln \text{MPROD3})$						0.0337***
						(0.0064)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,620	26,917	26,917	24,498	24,135	24,387
R^2	0.1662	0.1640	0.1911	0.1984	0.1991	0.1988

OLS regression.
Dependent variable: log wage difference.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

managerial wage premia is increasing in firm size. Finally, following Lemma 2, the model predicts the managerial wage in each layer to be increasing in the firm's measured productivity per managerial layer, $\frac{r}{m_l}$. This result finds empirical support in column (6) of Table 2 where the indicator of each managerial layer is interacted with the firm's log productivity in that layer (MPROD).[23]

All the regressions in Table 2 are based on EDP data that allows to control for educational attainment and job tenure. Appendix B.1 presents analogous and quantitatively similar results for the entire

[23] Productivity in layer l is computed as the firm's revenue divided by the firm's total number of workers in layer l.

universe of French workers from the DADS. There, I also show that the wage premium for managerial workers in layer 1 is increasing in the total number of managerial layers of the employing firm, which represents further direct evidence for the prediction in Proposition 2.

4. Quantitative model

4.1. Calibration

The model is calibrated to France in 2013. The parameters and target moments are summarized in Table 3. A more detailed description of the computed moments is relegated to Appendix **??**. All relevant employment numbers exclude the public and agricultural sectors.

The model time period is a year under the assumption that firms require a year to detect expropriation. This is reasonable given that many evaluations occur annually (e.g. staff performance, accounting audits, corporate reports). The time discount factor, β, is therefore set to the standard value of 0.97. Parameter ϕ is set to 0.9, implying an elasticity of substitution between varieties of 10 (Basu and Fernald, 1995; Basu, 1996).[24] The parameter governing the exogenous separation of managers, $\delta = 0.1080$, is computed directly from the DADS based on managerial turnover.

The remaining seven parameters are jointly calibrated to match seven target moments exactly. The crucial parameter is that of law enforcement, λ. It is calibrated to match the average wage premium of managers over production employees computed in column (1) of Table 2, namely $\exp(0.1078) - 1 = 0.114$. This requires $\lambda = 0.9736$, implying that managers can divert 2.6 percent of the revenue that they handle. A second key moment of interest is the aggregate share of managerial workers, 0.371. Its main determinant is the span of control parameter, $\theta = 0.4157$.

I assume that entrepreneurial skill follows a truncated log-normal distribution centered around mean zero: $\log z \sim \mathcal{N}(0,\sigma^2)$ over the support $(0, \overline{z}]$. Absent the possibility of adding managerial layers, firm employment would be log-linear in z, giving rise to a log-normal firm size distribution. By adding layers, firms increase their span of control, which convexifies the relationship between firm employment and z. It thickens the tail of the distribution and allows to mimic an empirical firm

[24] I follow Atkeson and Kehoe (2005) who also target an elasticity of substitution of 10 and whose model similarly features two types of decreasing returns, downward-sloping demand and limited span of control. They find that organization capital in U.S. business firms is worth between 10 to 15 percent of value added. Here, the analogous concept of the aggregate profit share of employer firms is 15.4 percent.

Table 3: Calibration parameters

Jointly calibrated parameters	Value	Target	Data	Model
Expropriation, λ	0.9736	Managerial wage premium	0.114	0.114
Span of control, θ	0.4157	Empl. share managers	0.371	0.371
Skill dispersion, σ	0.4402	Pareto dist. of firm size	−1.092	−1.092
Maximum skill, $\overline{z}$	9.499	Empl. share large firms	0.265	0.265
Time own-account workers, μ	0.3827	Empl. share own-account	0.0715	0.0715
Time employers, α	0.4589	Mean employer firm size	20.8	20.8
Cond. labor market entry, γ	0.2852	Transition rate manag. jobs	0.720	0.720
Set parameters				
Time discount factor, β	0.97			
Goods substitutability, ϕ	0.9			
Separation rate, δ	0.1080			

size distribution that in many countries – including France (Geerolf, 2017) – closely follows a Pareto distribution. I compute from the DADS that, on average, the proportion of employer firms with more than q workers equals $q^{-1.092}$, providing an additional target moment. To discipline the firm size distribution further, I also target the employment share of large firms (exceeding 5,000 employees), 26.5 percent. The corresponding calibrated parameters are $\sigma = 0.4402$ and $\overline{z} = 9.499$. The resulting firm size distribution is depicted in Panel (a) of Figure 1.

Other relevant empirical features to match are the self-employment rates of own-account and managerial (employer) entrepreneurs. The former is the French employment share of own-account entrepreneurs, 0.0715. The latter is obtained indirectly by targeting the average size of employer firms in France, 20.8.[25] The closest corresponding parameters are the relative time endowments of own-account and managerial entrepreneurs, $\mu = 0.3827$ and $\alpha = 0.4589$, respectively. The remaining parameter is γ. Recall that $1 - \gamma$ governs the probability, conditional on separation, of transiting between two identical managerial jobs. One relevant empirical counterpart is the transition rate at which separated managerial workers switch into managerial (as opposed to production) jobs. Using the sub-sample of job switchers in the DADS, that probability equals 0.720. The corresponding value is $\gamma = 0.2852$.

4.2. Cross-sectional outcomes

Next, I turn to several non-targeted outcomes. The purpose is to provide an insight into the working of the quantitative model and, whenever possible, to compare the results to the data. Panel (a) of

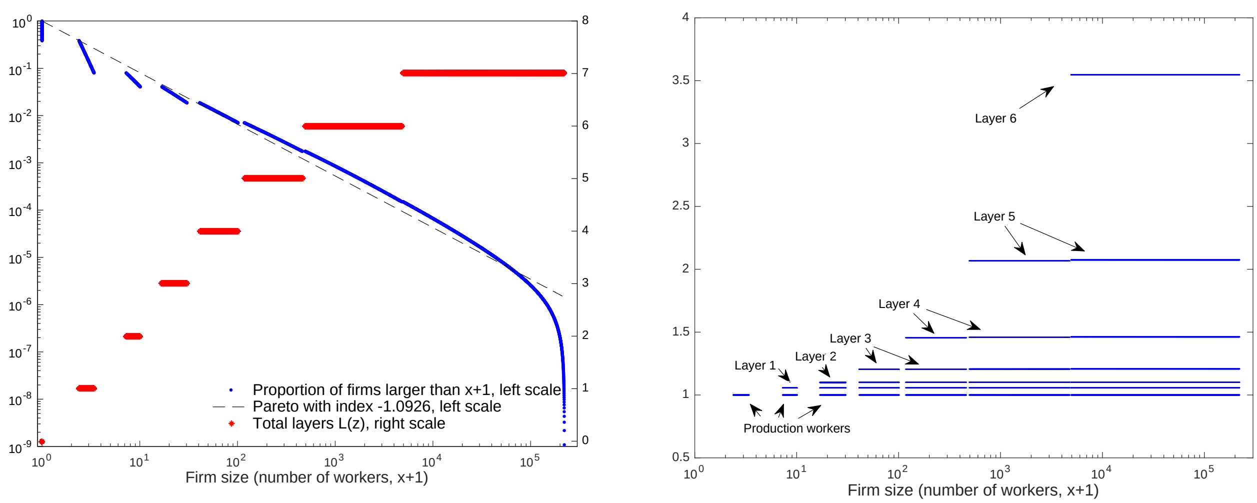
[25] The calibration thus matches the four main occupational category shares of interest: production employees, N_e; managerial employees, M_e; own-account entrepreneurs, N_s; and managerial entrepreneurs, M_s.

Figure 1 depicts the relationship between firm size and the choice of layers. The smallest employer firm consists of 2.4 workers, i.e. one managerial entrepreneur and 1.4 employees ($L = 1$). At 7.3 workers, firms start employing one layer of middle management ($L = 2$). Subsequent size thresholds are 17 ($L = 3$), 41 ($L = 4$), 118 ($L = 5$), 494 ($L = 6$), and 4,919 ($L = 7$). Delegation quickly rises as firms grow, then flattens off. Clearly, the implied hierarchy is finer than the French one-digit PCS occupational code that allows for a maximum of three layers (Caliendo et al., 2015). A more suitable empirical counterpart is the hierarchical classification that businesses themselves use. Baker, Gibbs and Holmstrom (1994), for instance, study an undisclosed large U.S. firm that is organized in eight layers. A hierarchy of seven layers in the largest firms is therefore reasonable.

Figure 1

(a) Firm size distribution and layers

(b) Wage by layer and firm size

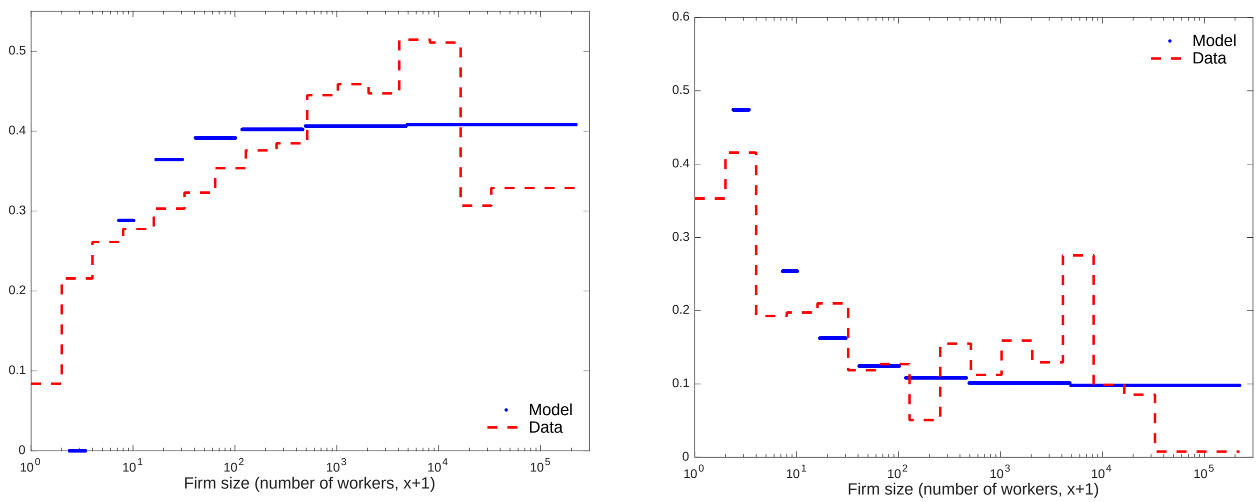


Panel (b) of Figure 1 depicts wages by firm size and layer relative to the production wage. Consider the largest firms employing six layers of middle management ($L = 7$). The managerial premia in these firms are as follows: 5.7% in layer $l = 1$; 10.1% in $l = 2$; 20.6% in $l = 3$; 45.9% in $l = 4$; 107.4% in $l = 5$; and 254.7% for top managerial employees in $l = 6$. Note from the plot that for a given position l, the wage is only slightly increasing in the employer's size. For instance, managerial employees in position $l = 5$ at firms of length $L = 6$ are predicted to earn a premium of 106.7%, which is only marginally less than their peers in that same managerial position at firms of length $L = 7$. It is not straightforward to compare these results to the data without an exact empirical counterpart of the model's layers. One useful statistic is the firm's average wage across layers. The model's elasticity of the average wage to firm size is 0.010. One of the most careful studies estimating the firm-size wage premium is Troske (1999) who finds an elasticity of 0.026 on U.S. employer-employee matched data. The model's outcome is plausible given that the empirical firm-size wage premium is likely to result from a number of compensating differentials over and above the efficiency wage theory proposed here.

Figure 2

(a) Share of managerial employees by firm size

(b) Profit share by firm size



Next, Figure 2 portrays two cross-sectional relationships that can be directly compared to the data. Panel (a) shows that the model correctly predicts a positive relationship between the share of managerial employees and firm size.[26] Panel (b) reveals that the model's prediction of a negative relationship between the profit share and firm size is, by and large, reflected in the data. In particular, the results imply that the model's assumed production function is consistent with the empirical evidence.

4.3. Quantitative results

This Section measures the quantitative impact of the law enforcement parameter $\lambda \in [0, 1]$. For France, the calibrated parameter $\lambda = 0.9736$ is close to its upper limit. The focus rests therefore on changes associated with reducing λ.

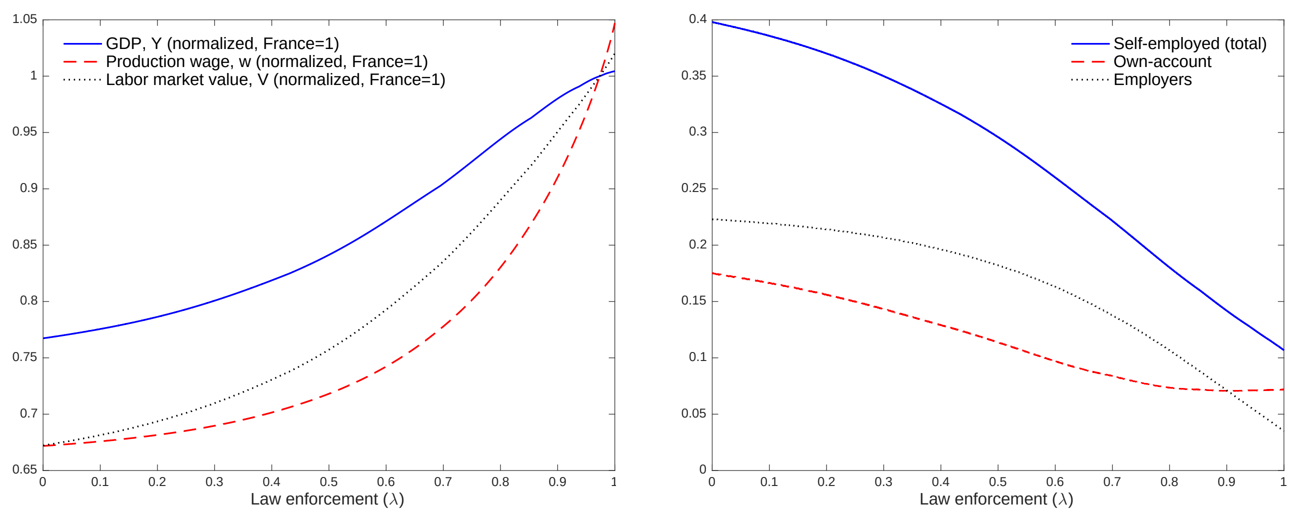
The main outcome of interest, GDP, is portrayed in Panel (a) of Figure 3, along with the other general equilibrium variables w and V. The benchmark economy, France, is close to first-best. Imple-

[26] The model misses the empirical fact that managerial employment drops for the largest firms. This is a compositional effect as those firms are disproportionately drawn from manufacturing where the managerial share is relatively low.

menting perfect enforcement, $\lambda = 1$, leads to a GDP increase of merely 0.4 percent. On the other hand, moving from the benchmark economy to $\lambda = 0$, output drops by 23.3 percent. In Section 5, I propose a method to map λ into its empirical counterpart, suggesting that countries lie along the entire domain of λ. The upshot is that the model explains a sizable portion of the cross-country variation in GDP per worker via a concrete institutional failure. Also, in the absence of any form of capital, GDP here is proportional to TFP. Adding endogenous factors of production such as human and physical capital has the potential to lever the misallocation through a capital multiplier and accentuate the GDP loss.

Figure 3

(a) GDP, prod. wage and labor market value (b) Self-employment share



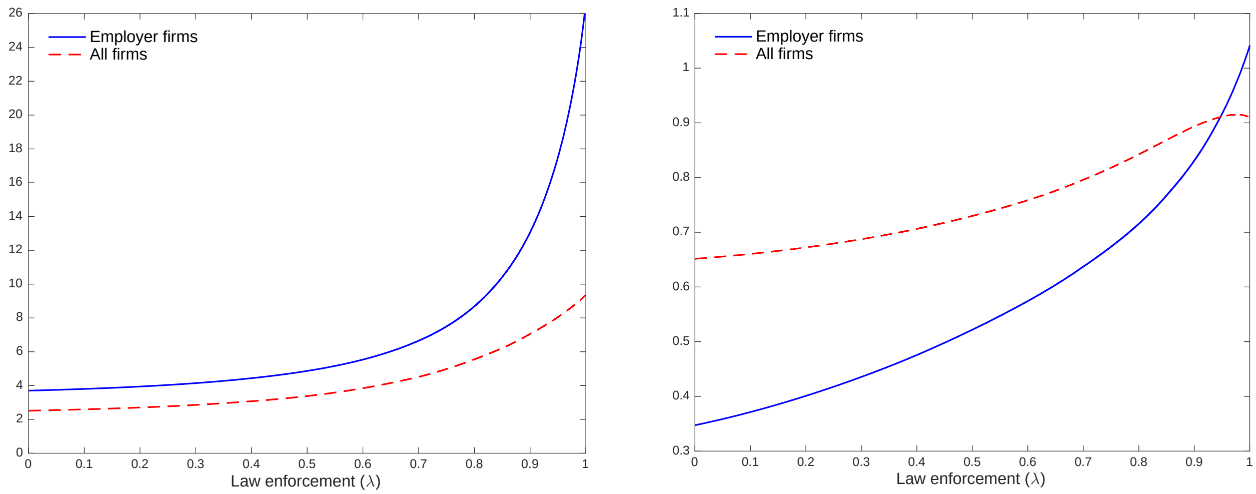
Panel (b) of Figure 3 depicts the other key quantitative outcome of the model, self-employment. At $\lambda = 0$, the total rate of self-employment stands at almost 40 percent as opposed to 11.6 percent in France. Weak law enforcement depresses the demand for labor and hence the attractiveness of entering the labor market, V. The differential in the self-employment rate is driven both by own-account workers, and, to an even larger extent, by employers. The bulk of these are single-layer employers who face no frictions yet benefit from low production wages in economies with weak law enforcement. Overall, law enforcement rationalizes the well-known negative correlation between aggregate productivity and self-employment (Gollin, 2008).

An alternative way to express the evolution of self-employment is by comparing the average size of firms across economies, portrayed in Panel (a) of Figure 4. The average size of the employer firm (solid line) is particularly elastic to law enforcement. It drops from 20.8 in the benchmark economy to 3.7 at the bottom end of the spectrum. As for the average size of all firms, including own-account firms, it drops from 8.6 in France to just over 2.5 at economies with $\lambda = 0$.

Figure 4

(a) Mean firm size in workers

(b) Std. dev. of log firm size in workers



Another variable of interest is the dispersion in firm size, plotted in Panel (b) of Figure 4. The distribution is more compressed in weak institutional environments where high-productive firms are discouraged from employing as they shun delegation. This is consistent with the newly highlighted stylized fact in Poschke (2018). Using internationally comparable firm data that do not suffer from sample selection, he shows that the dispersion in firm size is systematically increasing in GDP per worker. In summary, the model provides a powerful mechanism explaining the high entrepreneurship rate, the low average firm size, and the compression of the firm size distribution in developing countries.[27]

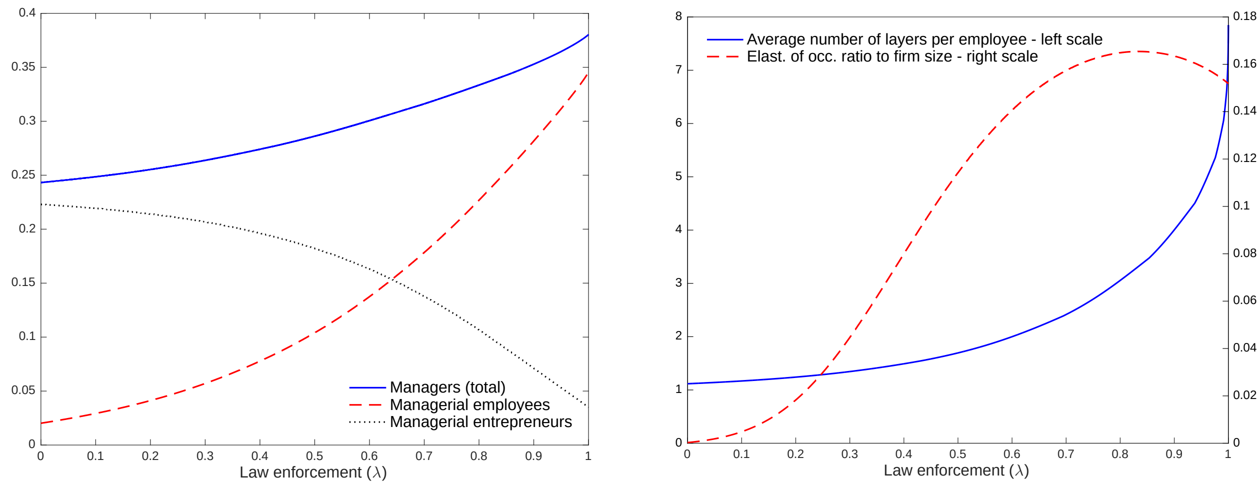
This paper argues that the law enforcement friction manifests itself in limited managerial delegation. Figure 5 proposes various measures of delegation. Of these, the aggregate share of managers is arguably the most interesting. Panel (a) shows that it is clearly increasing in λ. Moreover, the relationship is a net result of two counteracting forces. The dominant force is the aggregate share of managerial employees (dashed line), which is highly reactive to law enforcement. In contrast, the share

[27] Papers finding a positive cross-country correlation between the average firm size and GDP per worker (Alfaro, Charlton and Kanczuk, 2009; Bollard, Klenow and Li, 2016) typically use data that exclude the vast majority of very small firms in developing countries (Bento and Restuccia, 2017). Also, Hsieh and Olken (2014) show that with a proper adjustment of the data there is no perceptible "missing middle" (Tybout, 2000): rather, the whole firm size distribution is shifted to the left in developing relative to developed countries.

of managerial entrepreneurs (dotted line) is higher in economies with weak law enforcement. Albeit an imperfect proxy for delegation, the aggregate managerial share is useful in that it can be directly compared across numerous countries. Section 5 presents empirical evidence in line with the model.

Figure 5

(a) Managerial share (b) Alternative measures of delegation



Panel (b) of Figure 5 proposes two additional measures of delegation. The solid line traces the economy-wide average number of layers per employee.[28] In the benchmark French economy, an average employee works in a firm of length $L = 5.3$. In an economy at $\lambda = 0$, that value is 1.1. This massive drop has two sources. One is that weaker law enforcement shortens delegation in individual firms.[29] The second is a composition effect: weaker law enforcement shifts employment from firms that delegate to those that do not. Both outcomes are consistent with the empirical findings in Bloom et al. (2012) who argue that in countries with weak rule of law, firms are less decentralized and – because of that – employ fewer workers. As for the dashed line, it shows the economy-wide elasticity of the occupational ratio of managerial to production employees with respect to firm size. It is increasing in λ over most of the support. Appendix B.2 provides qualitative empirical evidence for such a relationship using the World Bank's Enterprise Survey firm micro data. Thus, the model helps explain why in economies with weak rule of law, *growing* firms are reluctant to step up their degree of delegation.

[28] Concretely, the measure is $\frac{\int L(z)x(z)\mathrm{d}H(z)}{\int x(z)\mathrm{d}H(z)}$ where $H(z)$ is the cumulative distribution function of employer firms.

[29] In the benchmark economy, the average number of layers per employer firm is 1.38, and the most productive firm is organized in 7 layers. At $\lambda = 0$, these numbers drop to 1.01 and 3, respectively.

5. Cross-country analysis

The quantitative results indicate that aggregate managerial employment – a proxy measure for managerial delegation – is increasing in the degree of law enforcement. The aim of this Section is twofold. First, it provides empirical evidence for a positive cross-country relationship between managerial employment and institutional indices of law enforcement. Second, it uses that evidence to translate the institutional indices into the model parameter λ in order to create a map between countries in the data and model economies.

5.1. Empirical evidence

Managerial shares by country, year and sector are computed from ILO data on employment by occupation. Managers are defined as belonging to the first three single-digit ISCO groups classified as high skilled white collar occupations: (1) *Legislators, senior officials and managers*; (2) *Professionals*; and (3) *Technicians and associate professionals*.[30] Online Appendix B provides robustness results using a narrower definition of managers that excludes *Technicians and associate professionals*. The dataset covers 97 countries over the period 1997 to 2014. I exclude the agricultural sector and sectors that are largely non-private such as public administration, health and education. Please see Online Appendix C.3 for the construction of all variables.

I use two alternative economy-wide indicators for law enforcement. One is the World Bank's Doing Business indicator that measures the average cost for resolving a commercial dispute as percent of the claim value, labeled cost of contract enforcement, CCE (in log). The second indicator is the widely used Rule of Law component of the Worldwide Governance Indicators, RL (in level), that scores countries on the support -2.5 to 2.5. It encompasses a broader set of law enforcement data assembled from numerous data sources (Kaufmann, Kraay and Mastruzzi, 2006).[31] The advantage of CCE is that it closely matches the definition of the model parameter λ. The advantage of RL is a more comprehensive coverage of concepts relating to property protection that capture the gist of λ. Consequently, I assign equal importance to the two indicators.

Consider the following least squares regression on the log of the managerial share, m, in sector s

[30] The numerator of the managerial share consists of managerial occupations plus *Clerks*; *Service workers and shop and market sales workers*; *Craft and related trades workers*; *Plant and machine operators and assemblers*; and *Elementary occupations*. I exclude non-classifiable workers as well as *Skilled agricultural and fishery workers* and *Armed forces*.

[31] It is defined as *the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.*

Table 4: Regression of managerial shares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln CCE	-0.464***	-0.199*	-0.210**	-0.227***				
	(0.118)	(0.110)	(0.0868)	(0.0595)				
RL					0.307***	0.166***	0.269***	0.161***
					(0.0371)	(0.0513)	(0.0319)	(0.0301)
ln HC		2.257***		1.942***		1.607**		1.411**
		(0.348)		(0.334)		(0.615)		(0.580)
FE Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	780	487	4,800	3,271	817	493	5,799	3,910
R^2	0.485	0.612	0.445	0.566	0.561	0.626	0.526	0.571
Clusters	88	55	543	370	93	56	658	443

Columns 1-2 and 5-6: OLS regression on latest country-year observations.
Columns 3-4 and 7-8: weighted LS regression on all available country-year observations.
Dependent variable: log employment share of managers.
Clustered standard errors in brackets.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

and country or country-year c:

$$\ln m_{s,c} = \beta_0 + \beta_1 \cdot \ln \text{CCE}_c + \beta_2 \cdot \ln \text{HC}_c + \text{FE}_s + \varepsilon_{s,c}. \tag{29}$$

The explanatory variable of interest is CCE or, alternatively, RL. Since occupational employment relates strongly to the sectoral composition and skills, I include sectoral fixed effects, FE, and aggregate human capital, HC. The reported standard errors are clustered around country-years.

Columns (1)-(2) of Table 4 report OLS regression results based exclusively on the most recent (typically 2014) sectoral shares of each country. On its own, the cost of contract enforcement in column (1) is strongly negatively correlated with the managerial share. When human capital is added to the regression in column (2), the economic and statistical significance of CCE, albeit diminished, is preserved. Columns (3)-(4) repeat the regressions, with the difference that all available country-year observations over the period 1997-2014 are included.[32] The relevant coefficients on CCE are similar. In columns (5)-(8) the institutional variable is replaced by the RL index. The finding is confirmed: the stronger is the rule of law, the higher is the managerial share. In summary, countries with more costly contract enforcement on average tend to have relatively fewer managerial workers in any given sector.

[32] I apply observation weights to country-years so that all countries carry equal weight.

5.2. Map of the model across countries

In the remainder, I return to the quantitative model and map the law enforcement parameter, λ, across countries. Specifically, I infer λ from the aggregate managerial share. This resembles the methodology in Buera et al. (2011) who use external credit over GDP as the observable to infer their model parameter of financial frictions. In contrast to that paper, however, it is not plausible to assign all the cross-country variation to institutional frictions. The raw managerial share is, after all, driven by other prominent factors such as human capital and the sectoral employment composition.[33] Instead, I build on the empirical estimates from Section 5.1 to create a bridge between the model parameter λ and the institutional indicators CCE and RL.

Using the institutional indicator CCE, let the predicted share of managers be $\ln \tilde{m}_{\text{CCE}} = \alpha + \hat{\beta} \cdot \ln \text{CCE}$. I set $\hat{\beta} = -0.199$ using the estimated coefficient in column (2) of Table 4. To make the level of $\tilde{m}_{\text{CCE}}$ comparable to the model, α is normalized so that the French value of CCE, 17.4, exactly predicts the French managerial share used in the calibration, 0.371. The quantitative model then maps $\tilde{m}_{\text{CCE}}$ into the model parameter λ_{CCE}. I use an analogous procedure for RL. That is, the predicted share of managers is $\ln \tilde{m}_{\text{RL}} = \alpha + \hat{\beta} \cdot \text{RL}$, where $\hat{\beta} = 0.166$ from column (6) of Table 4 and where α is again normalized to predict the French managerial share exactly.

Panel (a) of Figure 6 plots the model's implied relationship between CCE and output, overlaid by the empirical pairs of CCE and GDP per worker.[34] As visualized, the quantitative model is able to span almost the entire support of CCE. That is, countries with the lowest (highest) CCE scores correspond to model economies close to $\lambda = 1$ ($\lambda = 0$), which on average also the richest (poorest) countries. Similarly, the model spans most of the domain of RL in Panel (b). I conclude that the extremes of $\lambda = 0$ and $\lambda = 1$ are largely consistent with the cross-country span of the institutional indices. The magnitude of the quantitative results in Section 4.3 is therefore reasonable.

Next, I use the above map to translate each country's particular CCE (RL) score into its model parameter λ.[35] To summarize the findings, Table 5 reports average outcomes over quintiles of countries

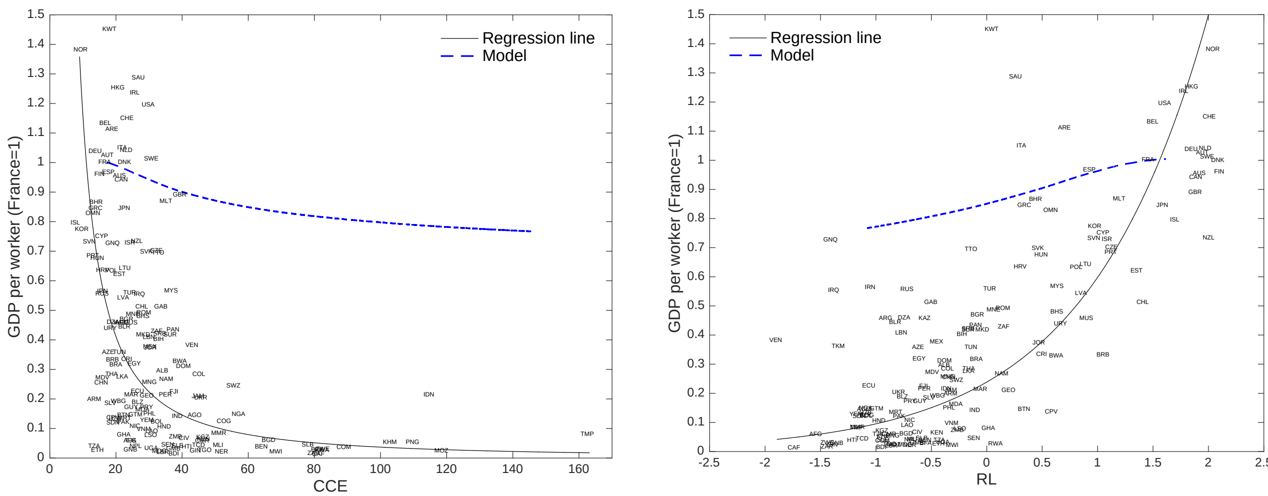
[33] For the 56 countries for which the non-agricultural private sector managerial share can be computed from ILO data, the first decile averages 7 percent, the median 23 percent, and the tenth decile 48 percent.

[34] All empirical series correspond to 2014, with CCE (RL) available for 165 (167) countries. GDP per worker is from the World Bank Development Indicators (GDP in constant PPP-adjusted 2011 international dollars).

[35] As can be observed from Panel (a) of Figure 6, 15 countries lie outside of the domain of λ. In these cases, I assign $\lambda = 1$ ($\lambda = 0$) for countries with low (high) CCE scores. I apply an analogous rule the RL-based mapping for the 35 countries outside the model's range in Panel (b) of Figure 6. The magnitude of the following results remains unchanged if those countries are dropped from the analysis.

Figure 6

(a) GDP per worker and CCE (b) GDP per worker and RL



ordered by empirical GDP per worker. The poorest quintile ranges from the Central African Republic to Bangladesh, the richest from Cyprus to Luxembourg. Columns (1)-(4) are means over data moments: GDP per worker, TFP, CCE, and RL. As mentioned before, TFP is arguably the most relevant empirical productivity counterpart of the model's output measure.[36] Columns (5)-(9) report averages over quintiles of corresponding model economies where each country's model parameter λ is inferred via CCE. Columns (10)-(14) do likewise for the RL mapping.

Consider columns (5) and (6). Using CCE, the average predicted managerial share, $\tilde{m}$, is higher in rich than in poor countries. The average implied λ ranges from 0.596 in the poorest quintile of countries to 0.910 in the richest quintile. The main outcome of interest is model output, Y, in column (7). It averages 90 percent in poor vis-à-vis rich countries. Since the interquintile ratio of empirical GDP per worker is 0.03, I conclude that the model accounts for roughly $\frac{\ln 0.90}{\ln 0.03} = 3$ percent of it.[37] Alternatively, the model accounts for $\frac{\ln 0.90}{\ln 0.16} = 6$ percent of the interquintile empirical TFP ratio. This is sizable, especially given that a substantial fraction of the cross-country variation in empirical GDP per worker and TFP is driven by productivity differences in the agricultural sector (Caselli, 2005; Restuccia, Yang and Zhu, 2008; Gottlieb and Grobovšek, 2019).

[36]TFP is constructed for 2014 as the residual A from the GDP per worker decomposition $y = Ak^{\alpha}h^{1-\alpha}$ where k and h are physical and human capital per worker, respectively. The latter are obtained from the Penn World Table Version 8. Parameter α is set to the standard value 1/3.

[37]The explanatory power is defined as the model's fraction of the logarithmic distance: $\frac{\ln(1)-\ln 0.90}{\ln(1)-\ln(0.03)} = \frac{\ln 0.90}{\ln 0.03}$.

Table 5: Country outcomes averaged over quintiles of income distribution

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Data				Model inferred from CCE					Model inferred from RL				
	GDP	TFP	CCE	RL	$\tilde{m}$	λ	Y	Self-emp.	Firm size	$\tilde{m}$	λ	Y	Self-emp.	Firm size
Q1	0.033	0.180	55.4	-0.830	0.304	0.596	0.879	0.254	4.39	0.257	0.195	0.790	0.366	2.76
Q2	0.125	0.382	35.7	-0.631	0.331	0.767	0.934	0.191	5.67	0.263	0.251	0.801	0.351	2.91
Q3	0.302	0.548	34.1	-0.259	0.331	0.773	0.934	0.191	5.65	0.281	0.431	0.833	0.309	3.36
Q4	0.568	0.812	24.6	0.242	0.349	0.871	0.967	0.154	6.79	0.306	0.582	0.884	0.251	4.62
Q5	1.129	1.152	21.1	1.380	0.358	0.910	0.979	0.140	7.52	0.358	0.897	0.972	0.146	7.66
$\frac{Q1}{Q5}$	3%	16%	–	–	85%	–31 pp	90%	181%	58%	72%	–70 pp	81%	251%	36%

Note: GDP per worker, TFP, and model output (Y) are normalized so that France equals 1. The results are averages over quintiles of countries ordered by GDP per worker. The bins are constructed using the 2014 sample of 165 countries with full data on GDP per worker, CCE, and RL. Average TFP is computed on the sub-sample of 139 countries for which the required data are available.

In column (8), the poorest quintile of countries is predicted to have 1.8-fold higher self-employment than the richest quintile. This can be compared to the empirical findings in Poschke (2019) where the difference in the self-employment rate between the poorest and richest countries is a factor of 5.[38] Roughly one-third of that is hence accounted for by the model. A related statistic is the average firm size in terms of workers, reported in column (9). The interquintile ratio between poor and rich countries is 58 percent. The most relevant empirical comparison is Bento and Restuccia (2019).[39] They report that both in manufacturing and services, establishments are roughly one-half the size in the poorest relative to the richest *quartile* of countries. Using the same dataset, Bento and Restuccia (2017) find that the average size of manufacturing establishments is 30 percent in the poorest relative to the richest *decile* of countries. I conclude that the model rationalizes a substantial fraction of the average firm size difference between high and low income countries.

Columns (10)-(14) report analogous outcomes for the RL mapping. The quantitative results are more pronounced. While the highest quintile countries show similar results in the RL and CCE mappings, the RL mapping predicts a larger and more continuous drop in λ across the income spectrum. Model output, Y, averages 81 percent in the lowest relative to the highest quintile. The model hence accounts for a larger share of the empirical interquintile ratio: $\frac{\ln 0.81}{\ln 0.03} = 6$ percent in the case of GDP per worker and $\frac{\ln 0.81}{\ln 0.16} = 11$ percent in the case of TFP. Self-employment is on average 2.5 times higher

[38] Self-employment across the world varies strongly with agricultural employment. To exclude agriculture, Poschke (2019) focuses exclusively on urban employment. He finds that, on average, the self-employment rate (i.e., self-employment over the sum of self-employment and wage employment) is 55 percent in the poorest and 11 percent in the richest country.

[39] They also cover countries along the entire world income distribution and take stock of very small (own-account) producers. What differs is that their unit of analysis consists of establishments, not firms.

in the poorest relative to the richest countries, while their average firm size is almost three times lower (36 percent).

6. Concluding remarks

This paper introduces a novel general equilibrium framework to study the interplay between law enforcement, firm organization, and entrepreneurial selection. It also documents cross-sectional and cross-country evidence that lends support to the mechanism. The quantitative model suggests that the cross-country variation in law enforcement, through the proposed channel of intra-firm delegation, has a substantial impact on a number of aggregate outcomes that distinguish rich from poor countries: self-employment, the firm size distribution, and managerial employment. In particular, it depresses output by as much as 23 percent relative to the French benchmark economy. Mapping the model across the world, weaker law enforcement reduces output by 10 to 19 percent in the poorest relative to the richest quintile of countries. This explains between 3 and 6 percent of the interquintile GDP per worker ratio, and between 6 and 11 percent of the interquintile TFP ratio. It represents a non-trivial new mosaic piece to understanding the wealth of nations.

The simplicity of the main building blocks of the model − the generalized Lucas span of control production function and the structure of the dynamic game − allows for a number of extensions in future work. Examples include interaction effects with physical and human capital, dynamic innovation, and other institutional constraints.[40] What is particularly worth exploring is whether such additional features amplify or attenuate the equilibrium impact of costly delegation due to imperfect law enforcement.

A. Solutions and proofs

A.1. Solution to the employer firm's problem, $L \geq 1$

The first-order conditions with respect to employment in (21) are:

$$n(z, L) = [1 - B(1-\lambda)(L-1)]\phi(1-\theta)\frac{r(z, L)}{w}, \tag{30}$$

[40] Chen et al. (2019) investiges the interaction with physical capital accumulation while an earlier version of this paper, Grobovšek (2014), studies the interaction with human capital accumulation.

$$m_l(z,L) = \theta^l \frac{w}{(1-\beta)V} n(z,L), \quad \forall l \in \{1,2,...,L-1\}, \tag{31}$$

where $r(z,L) = Y^{1-\phi} y(z,L)^{\phi}$. Solving for output (5), the profit function is:

$$\pi(z,L) = [1-\phi(1-\theta^L)]Q(z,L), \tag{32}$$

where

$$Q(z,L) \equiv \Bigg\{ Y^{1-\phi} z^{\phi} \alpha^{\phi\theta^L} [\phi(1-\theta)]^{\phi(1-\theta^L)} [1-B(1-\lambda)(L-1)] \left(\frac{1}{w}\right)^{\phi(1-\theta)} \left(\frac{1}{(1-\beta)V}\right)^{\phi\theta\left(1-\theta^{L-1}\right)} \theta^{\phi(1-\theta)\sum_{l=1}^{L-1} l\theta^l} \Bigg\}^{\frac{1}{1-\phi(1-\theta^L)}}.$$

Revenue and total employment are:

$$r(z,L) = \frac{Q(z,L)}{1-B(1-\lambda)(L-1)}, \tag{33}$$

$$x(z,L) = \phi(1-\theta) \left(\frac{1}{w} + \frac{\sum_{l=1}^{L-1} \theta^l}{(1-\beta)V} \right) Q(z,L). \tag{34}$$

A.2. Proof of Lemma 1

Suppose that $V_l(z) \geq V$, $\forall (z,l)$. Profit maximization implies that the incentive compatibility constraint (12) holds with equality, $V_l^{exp}(z) = V_l(z)$. Using $\max\{V_l(z), V\} = V_l(z)$ in (10) and (11), and substituting for $w_l(z)$, yields

$$V_l(z) = V + \frac{1-\lambda}{\beta\gamma(1-\delta)} \frac{r(z)}{m_l(z)}. \tag{35}$$

What remains to be established is that $V_l(z) \geq V$, $\forall (z,l)$, holds indeed. First, consider the case $\lambda = 1$, which yields $V_l(z) = V$, $\forall (z,l)$. To see this, replace $V_l(z)$ in (17) and use (16) to obtain $V = \frac{w}{1-\beta}$. The participation constraint (13) then holds with equality, and so does the incentive compatibility constraint (12). Now, consider the case $\lambda < 1$ and suppose by contradiction that there exists some pair (z,l) for which $V_l(z) < V$. Then (10) and (11) reduce to $V_l(z) = w_l(z) + \beta V$ and $V_l^{exp}(z) = w_l(z) + \frac{(1-\lambda)r(z)}{m_l(z)} + \beta V$. For the incentive compatibility (12) to hold, it must be that $\frac{r(z)}{m(z)} = 0$. This, however, is not compatible with profit maximization. It follows that $V_l(z) \geq V$, $\forall (z,l)$.

A.3. Proof of Lemma 2

The expression (19) derives directly from combining (35) and (10). Regarding the second part of the Lemma, replacing (35) in (17) and using (16) results in

$$(1-\beta)V = w + \frac{1}{q}\frac{1-\lambda}{\beta\gamma(1-\delta)}\int\sum_{l=1}^{L(z)-1}\frac{r(z)}{m_l(z)}q_l(z)\mathrm{d}z. \tag{36}$$

The mass of all vacant jobs at the beginning of each period is the sum of all production employment jobs, N_e, and the density of vacated managerial posts, $\mathbb{I}(z)\gamma\delta\int\sum_{l=1}^{L(z)-1}m_l(z)f(z)$, where $f(z)=\frac{\partial F(z)}{\partial z}$. The probability density of landing a managerial job (z,l) is therefore

$$q_l(z) = \frac{\mathbb{I}(z)\gamma\delta m_l(z)f(z)}{N_e+\gamma\delta\int\mathbb{I}(z)\sum_{l=1}^{L(z)-1}m_l(z)\mathrm{d}F(z)}.$$

Using this probability and the expression for q from (16), equation (36) yields

$$(1-\beta)V = w + \frac{1}{N_e}\frac{\delta(1-\lambda)}{\beta(1-\delta)}\int\mathbb{I}(z)\max\{[L(z)-1],0\}r(z)\mathrm{d}F(z). \tag{37}$$

A.4. Proof of Proposition 1

Independently of the organizational choice, profits of both own-account and employer firms, (9) and (32), are strictly increasing in z. The labor market value is V, so from (1) it must be that only sufficiently skilled individuals, $z\geq\underline{z}$, become entrepreneurs.

Next, I prove that $L(z)$ is finite and increasing in z. For this, I first show that $L(z)$ is increasing in z for *employer* firms. Let z_L denote the threshold productivity such that firms $z=z_L$ are indifferent between employing L and $L-1$ layers, $\pi(z_L,L)=\pi(z_L,L-1)$, $\forall L\in\{2,3,...\}$. Using (32), $\pi(z,L)\geq\pi(z,L-1)$ implies $z\geq z_L$ where

$$\begin{aligned} z_L = {} & \left(\frac{\alpha^{1-\phi}w^{\phi(1-\theta)}[(1-\beta)V]^{1-\phi(1-\theta)}}{Y^{1-\phi}\phi(1-\theta)}\right)^{\frac{1}{\phi}}\frac{[1-B(1-\lambda)(L-2)]^{\frac{1-\phi(1-\theta^L)}{\phi^2(1-\theta)\theta^{L-1}}}}{[1-B(1-\lambda)(L-1)]^{\frac{1-\phi(1-\theta^{L-1})}{\phi^2(1-\theta)\theta^{L-1}}}} \\ & \times\left(\frac{1-\phi(1-\theta^{L-1})}{1-\phi(1-\theta^L)}\right)^{\frac{[1-\phi(1-\theta^{L-1})][1-\phi(1-\theta^L)]}{\phi^2(1-\theta)\theta^{L-1}}}\theta^{\frac{-\phi\theta(1-\theta^{L-1})-(1-\phi)(1-\theta)(L-1)}{\phi(1-\theta)}}. \end{aligned} \tag{38}$$

This is strictly positive because positive profits require an L such that $[1-B(1-\lambda)(L-1)]>0$. Then, differentiating z_L with respect to L yields $\frac{\partial z_L}{\partial L}=\frac{z_L}{\phi^2(1-\theta)}[J(L)+H(L)]$ where

$$J(L)\equiv\frac{[1-B(1-\lambda)(L-2)][1-\phi(1-\theta^{L-1})]-[1-B(1-\lambda)(L-1)][1-\phi(1-\theta^{L})]}{\theta^{L-1}[B(1-\lambda)]^{-1}[1-B(1-\lambda)(L-1)][1-B(1-\lambda)(L-2)]}$$
$$+\frac{\ln(\theta)(1-\phi)}{\theta^{L-1}}\ln\left(\frac{1-B(1-\lambda)(L-1)}{1-B(1-\lambda)(L-2)}\right)\geq 0,$$

and

$$H(L)\equiv-\ln(\theta)\left[\phi^2\theta^L\ln\left(\frac{1-\phi(1-\theta^L)}{\theta-\phi(\theta-\theta^L)}\right)-\frac{(1-\phi)^2}{\theta^{L-1}}\ln\left(\frac{1-\phi(1-\theta^L)}{1-\phi(1-\theta^{L-1})}\right)\right]>0.$$

Since $J(L)+H(L)>0$, the threshold z_L is strictly increasing in L.[41] This proves that the optimal layer choice of *employer* firms, $L^\star(z)\geq 1$, is (weakly) increasing in z.

What remains to be shown is that $L(z)$ is monotonically increasing when allowing for own-account work as well. Let $\tilde{z}$ denote the threshold productivity such that the firm $z=\tilde{z}$ is indifferent between being an employer firm, organized optimally in $L^\star(z)\geq 1$ layers, and an own-account firm, i.e., $\pi(\tilde{z},L^\star(\tilde{z}))=\pi(\tilde{z},0)$. Combining (9) and (32), it is straightforward to show that $\pi(z,L^\star(z))\geq\pi(z,0)$ implies $z\geq\tilde{z}$. This proofs therefore that $L(z)$ is (weakly) increasing in z.

Furthermore, $L(z)$ is finite. For $\lambda<1$, this is obviously true because positive profits require that $[1-B(1-\lambda)(L-1)]>0$. For $\lambda=1$, $\lim_{L\to\infty}z_L=\infty$, but the support of z is bounded by $\overline{z}$. Thus, the longest organizational hierarchy in the economy is $\overline{L}=L(\overline{z})$.[42]

The final part of the Proposition relates to employment and revenue. It is obvious from (33) and (34) that both are increasing in z for any given L. What remains to be determined is that both jump up discretely at threshold productivities z_L. For this, notice from (32) that $\pi(z,L)=\pi(z,L-1)$,

[41] With perfect law enforcement, $\lambda=1$, $J(L)=0$, while $H(L)>0$. If, in addition to $\lambda=1$, the model allowed for $\phi=1$, then $H(L)=0$. It is hence only the combination of perfect law enforcement and linear utility that would lead to z_L being independent of L.

[42] Note that not all organizational forms $L=\{0,1,...,\overline{L}-1\}$ are necessarily present in the economy. Own-account firms only exist if the threshold for entrepreneurship $\underline{z}$ is sufficiently low, $\underline{z}\leq\tilde{z}$. Employer firms only exist if the largest firm passes the own-account threshold $\overline{z}\geq\tilde{z}$. If there are employer firms and the maximum hierarchy length is $\overline{L}\geq 2$, the intermediate employer hierarchy length L only exists if $z_{L+1}\geq\max\{\underline{z},\tilde{z}\}$. For example, it is possible to have own-account firms ($L=0$) and employer firms of hierarchy length of only $L=3$. It is also possible to have own-account firms $L=0$ and firms with hierarchy lengths $L=2$ and $L=3$ only. What is not possible is to have $L=1$ and $L=3$ firms while missing $L=2$ firms, due to the continuous support of z.

combined with (33) implies

$$\frac{r(z_L, L)}{r(z_L, L-1)} = \frac{1-\phi(1-\theta^{L-1})}{1-\phi(1-\theta^{L})} \frac{1-B(1-\lambda)(L-2)}{1-B(1-\lambda)(L-1)} > 1.$$

Similarly, (34) implies

$$\frac{x(z_L, L)}{x(z_L, L-1)} = \frac{\frac{1}{w} + \frac{\sum_{l=1}^{L-1}\theta^l}{(1-\beta)V}}{\frac{1}{w} + \frac{\sum_{l=1}^{L-2}\theta^l}{(1-\beta)V}} \frac{1-B(1-\lambda)(L-2)}{1-B(1-\lambda)(L-1)} > 1.$$

Both revenue and employment thus increase discretely when layers are added.

B. Additional empirical results

B.1. Managerial wage premia

Here, I provide further empirical evidence on the managerial wage premium estimated in Section 3. First, I repeat the regression (28) on the universe of French employees, i.e., all employees in the DADS as opposed to the sample in the EDP. The only distinction is that the regression does not use any controls for educational attainment and tenure as these variables are not available in the DADS. Table 6 summarizes the regression specifications, analogous to those in Table 2. The coefficients are quantitatively very similar. In particular, the overall managerial premium in column (1) is 0.1175, which is only slightly different from the one used in the calibration, 0.1078.[43]

Next, I run an alternative set of regressions, shown in Table 7. The sample is the entire universe of employees in the DADS sample, except for those who in 2012 or 2013 were classified as firm owners receiving a wage. The indicator for belonging to the first managerial layer, M_1, is interacted with an indicator for whether the worker's firm employs at least one worker in layer 2, L2. The results in column (1) suggest that managers in layer 1 obtain a higher premium in firms with a higher degree of delegation, 0.0809 versus 0.0544. This is the most direct evidence of Proposition 2 and the model's efficiency wage mechanism: the manager's wage does not only depend positively on her own rank, but also on her employer's total number of firm layers. For completeness, columns (2) and (3) interact the three managerial premia with firm size. They are all increasing in firm employment or value added.

[43]The main difference between the two sets of regressions is that the R^2 is markedly higher in Table 6 than in Table 2, suggesting that the EDP sample is more noisy.

Table 6: Managerial premium

	(1)	(2)	(3)	(4)	(5)	(6)
ΔM	0.1175***	0.1215***				
	(0.0006)	(0.0006)				
ΔM_1			0.0759***	0.0441***	0.0278***	0.0372***
			(0.0007)	(0.0013)	(0.0020)	(0.0026)
ΔM_2			0.2379***	0.2013***	0.1699***	0.2172***
			(0.0009)	(0.0016)	(0.0024)	(0.0030)
ΔM_3			0.2908***	0.2432***	0.1923***	0.0980***
			(0.0026)	(0.0040)	(0.0072)	(0.0087)
$\Delta (M_1 \times \ln \text{EMP})$				0.0067***		
				(0.0002)		
$\Delta (M_2 \times \ln \text{EMP})$				0.0086***		
				(0.0002)		
$\Delta (M_3 \times \ln \text{EMP})$				0.0183***		
				(0.0011)		
$\Delta (M_1 \times \ln \text{VA})$					0.0052***	
					(0.0002)	
$\Delta (M_2 \times \ln \text{VA})$					0.0080***	
					(0.0002)	
$\Delta (M_3 \times \ln \text{VA})$					0.0151***	
					(0.0010)	
$\Delta (M_1 \times \ln \text{MPROD1})$						0.0055***
						(0.0004)
$\Delta (M_2 \times \ln \text{MPROD2})$						0.0037***
						(0.0004)
$\Delta (M_3 \times \ln \text{MPROD3})$						0.0270***
						(0.0011)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,399,516	1,412,528	1,412,528	1,300,179	1,282,507	1,296,176
R^2	0.2465	0.2427	0.2597	0.2682	0.2705	0.2680

OLS regression.
Dependent variable: log wage difference.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.2. Managerial employment and establishment size

Here, I examine firm-level evidence of managerial delegation across countries using the World Bank's Enterprise Surveys (ES) of establishments. In particular, I present evidence that stronger law enforcement positively affects the relationship between firm size and managerial employment.

The survey is composed of standardized questions and follows a common methodology across 139 countries over the period 2006-2016. In some countries, the survey is administered only in a single year,

Table 7: Managerial premium

	(1)	(2)	(3)
$\Delta\,(M_1 \times (1-\text{L2}))$	0.0544***	0.0222***	-0.0317***
	(0.0012)	(0.0023)	(0.0054)
$\Delta\,(M_1 \times \text{L2})$	0.0809***	0.0581***	0.0529***
	(0.0007)	(0.0016)	(0.0024)
ΔM_2	0.2377***	0.2008***	0.1716***
	(0.0009)	(0.0016)	(0.0024)
$\Delta\,(M_1 \times (1-\text{L2}) \times \ln \text{EMP})$		0.0110***	
		(0.0010)	
$\Delta\,(M_1 \times \text{L2} \times \ln \text{EMP})$		0.0045***	
		(0.0003)	
$\Delta\,(M_2 \times \ln \text{EMP})$		0.0084***	
		(0.0003)	
$\Delta\,(M_1 \times (1-\text{L2}) \times \ln \text{VA})$			0.0128***
			(0.0009)
$\Delta\,(M_1 \times \text{L2} \times \ln \text{VA})$			0.0029***
			(0.0002)
$\Delta\,(M_2 \times \ln \text{VA})$			0.0077***
			(0.0002)
Controls	Yes	Yes	Yes
Observations	1,399,516	1,288,894	1,272,068
R^2	0.2626	0.2709	0.2729

OLS regression.
Dependent variable: log wage difference.
Significance levels: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

while others are revisited twice. The observations are random draws from strata that are representative of the manufacturing and service sectors in each economy. The sample size ranges from about 150 in small economies to 1,200-1,800 in large ones. The major advantage of the data is its comprehensive coverage of a large number of countries. One drawback is that the sample covers few informal firms (García-Santana and Ramos, 2015). See Online Appendix C.4 for the construction of all variables.

Consider the following regression where i indexes an individual establishment in country c:

$$\begin{aligned}\ln y_{i,s,c} =& \beta_0 + \beta_1 \cdot \ln \text{EMP}_{i,s,c} + \beta_2 \cdot \ln \text{EMP}_{i,s,c} \cdot \ln \text{CCE}_c + \beta_3 \cdot \ln \text{EMP}_{i,s,c} \cdot \ln \text{HC}_c \\ &+ \text{FE}_c + \text{FE}_s + \sum_{n=1}^{N} \gamma_n \cdot X_{n,i,s,c} + \varepsilon_{i,s,c}.\end{aligned}$$

The dependent variable is the ratio of non-production to production workers in each establishment (in

Table 8: Regression of the occupational ratio on establishment size and institutional indices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln EMP	0.203**	0.136	0.190***	0.253	-0.0464**	-0.113	-0.0677***	-0.0784
	(0.0804)	(0.215)	(0.0611)	(0.180)	(0.0222)	(0.158)	(0.0226)	(0.122)
ln EMP × ln CCE	-0.0815***	-0.0717***	-0.0822***	-0.0848***				
	(0.0230)	(0.0260)	(0.0194)	(0.0224)				
ln EMP × RL					0.0388	0.0292	0.0170	0.0134
					(0.0294)	(0.0390)	(0.0286)	(0.0376)
ln EMP × ln HC		0.0447		-0.0543		0.0775		0.0157
		(0.168)		(0.142)		(0.158)		(0.126)
FE Sector & Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	No	No	Yes	Yes	No	No	Yes	Yes
Observations	54,276	37,608	49,572	35,284	54,276	37,608	49,572	35,284
R^2	0.113	0.104	0.139	0.141	0.109	0.100	0.135	0.136
Clusters	189	86	179	82	189	86	179	82

Weighted LS regression.
Dependent variable: log of firm's ratio of non-production to production workers.
Clustered standard errors in brackets.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

log).[44] The size of the establishment is measured by its number of worker, EMP (in log). The first interaction term hence captures the impact of the country-specific cost of contract enforcement, CCE (in log), on the relationship between the occupational ratio and size. This relationship is moreover allowed to depend on country-specific abundance of human capital, HC. Throughout, control variables consist of fixed effects for country-year and 13 sectors. An additional set of potentially relevant controls, vector X, includes a dummy for whether the establishment belongs to another firm, the establishment's age, the establishment's legal status as well as the establishment's fraction of skilled production workers. The reported standard errors are clustered around country-years. Also, to make the sample as representative as possible, all regressions use observation weights provided by ES.

Consider column (1) of Table 8. The coefficient on the interaction term between EMP and CCE implies that countries where contract enforcement is more costly feature relatively fewer managerial workers in large compared to small firms. The result does not change after controlling for a second interaction term with country-specific human capital in column (2). It is also robust to the inclusion of additional control variables, columns (3) and (4). More costly contract enforcement has a negative impact on the occupational ratio-size relationship. Column (5)-(8) present analogous regressions using RL as the measure of law enforcement. Qualitatively, all regression specifications point in a similar direction. Countries with stronger rule of law tend to have a higher correlation between the occupational

[44]The distinction between non-production and production workers in the ES data is the closest to the dichotomy between managerial and non-managerial workers.

ratio and size. These results, however, are not statistically significant at standard thresholds.

I conclude that the rule of law has a positive effect on the relationship between firm size and managerial employment. This is in line with the quantitative results of the model, namely the elasticity presented in Panel (b) of Figure 5. While the evidence is not a direct test of the theory, it is suggestive. In an environment of weak law enforcement, growing firms are reluctant to enhance their degree of delegation.

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