Small Scale Reservation Laws and the Missallocation of Talent*

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Abstract

In this paper we quantify the effects of the Small Scale Reservation Laws in India on the aggregate productivity, aggregate output and welfare of the Indian economy. To this end, we extend the span-of-control model by Lucas (1978) into a multi-sector setting and embed it into the neo-classical growth model. Our main theoretical contribution is to model the occupational choice within this framework. We fully calibrate our model to data from India for the early 2000's. We find that lifting the Small Scale Reservation Laws would increase output per worker by 3.2 percent, capital per worker by 7.1 percent and aggregate TFP by 0.8 percent. Within manufacturing, output per worker would increase by 9.8 percent, capital per worker by 12.5 percent and TFP by 3.6 percent. Average firm size in manufacturing would raise from 19 to 69 employees. These are large numbers given that the size of the restricted sector is only 12 percent of manufacturing value added and 3 percent of total GDP. However, this conspicuous type of size-dependent policy cannot account for the large gap in manufacturing TFP existing between the US and India.

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1 Introduction

There are large differences in gdp per capita between countries, and according to many authors a big part of them can be attributed to differences in Total Factor Productivity (TFP).[1] While research has traditionally focused on understanding the determinants of knowledge production and diffusion in a context of a representative firm, a recent strand of literature has started to emphasize resource misallocation between sectors, or between firms, as a source of differences in aggregate TFP.

In particular, the focus has been to show how goverment policies that impose barriers on the size of large firms or promote small ones result in misallocation of capital, labor and managerial talent, and hence lower measured TFP. Often quoted examples of size-dependent policies are labor market regulations like in Italy, privileged access to capital markets in Spain, or the policies that regulate the size of establishments in the retailing sector in countries as France, Japan, Germany or UK. Recent work by Guner, Ventura, and Yi (2008), Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) attempt to measure the aggregate productivity cost of these distortions. Their quantitative results show the potentially large impact of size-dependent policies, accounting for up to 50 percent of the productivity gap between some developing economies and the US.

However, there has been little attention to study the quantitative impact of any specific size-dependent government policy.[2] A conspicuous case of restriction on size has been present in the Indian economy since the end of the 60's. Several products in the manufacturing sector were reserved for small scale industries. A small scale industry is defined as a firm producing with a government-set upper bound in its capital stock. This implies that these goods can not be produced by large firms. These laws receive the name of Small Scale Reservation Laws. Several authors have attributed the poor economic performance of the manufacturing sector in India to the presence of these laws, but no quantitative study has been attempted.[3]

In this paper we want to quantify the effects of the Small Scale Reservation Laws on the aggregate productivity, aggregate output and welfare of the Indian economy. To this end, we extend the span-of-control model by Lucas (1978) into a multi-sector setting and embed it into the neo-classical growth model.[4] The span-of-control model is a

[1]See for instance Hall and Jones (1999), Banerjee and Duflo (2005) or Caselli (2005) among others.

[2]Gallipoli and Goyette (2009) is the only exception. These authors study the effects of the size-dependent probability of tax inspections by the Ugandian government on the size distribution of firms, and on aggregate productivity.

[3]See among others Lewis (2005), Mohan (2002), Morris, Basant, Das, Ramachandran, and Koshy (2001) and Unel (2003).

[4]In this sense we follow Erosa (2001), which is the first article to embed the span-of-control model

very tractable framework that generates an endogenous distribution of firms, and hence, it is a useful tool to think about distortions in firm size. In the Lucas (1978) model a representative household has to choose which individuals are workers and which individuals are entrepreneurs. The Small Scale Reservation Laws distort this allocation by limiting the scale of production of the best entrepreneurs, and by diminishing the overall demand for labor, which in equilibrium gives rise to a larger mass of smaller and less efficient entrepreneurs. We generalize the model such that it contains three sectors: a first manufacturing sub-sector where the Small Scale Reservation Laws apply, a second manufacturing sub-sector with no distortions, and a third sector for the rest of the economy (agriculture and services) where for simplicity there is no firm size problem.

Our main theoretical contribution is to model the occupational choice within this framework: in a multi-sector model the representative household has to choose into which sector to send its entrepreneurs, as well as who becomes entrepreneur and who becomes worker. The multi-sector model is important for two reasons. First, when size-dependent distortions are not too severe and apply to only one sector of the economy, reassignment of managers between sectors may leave the aggregate allocations of the economy unchanged. The smaller the sector where the restrictions apply, the more likely this outcome. Hence, since many size-dependent policies in different countries affect only a fraction of the economy, quantifying the productivity loss of such distortions with a one-sector model may give very misleading answers. Second, as emphasized by Schmitz (2001), when economic distortions are present in a sector producing investment goods, then the whole economy is affected through a decrease in capital accumulation. Since investment goods are more intensive in manufactures than consumption goods, the Small Scale Reservation Laws have the potential to have economy-wide effects despite applying to a relatively small subset of goods.

We fully calibrate our model to data from India for the early 2000's. Hence, in our model economy: (a) we measure directly the severity of the distortion; (b) the distorted sector has the actual size in the Indian economy: 12 percent of manufacturing and 3 percent of total gdp; and (c) the distribution of managerial talent and the degree of diminishing returns to scale are backed out from the data on firm size in India. We think this empirical strategy is important.[5] Previous papers that analyze the size distribution of firms rely on the size distribution in the US economy to back out the distribution of

of occupational choice into a well defined intertemporal consumption and saving problem, and Guner, Ventura, and Yi (2008), which embed the span-of-control model in a single sector neo-classical growth model.

[5] Schmitz (2001) is an early example of focusing on particular distortionary government policies and measuring them directly with data of the affected countries.

talent and the technology parameters. Then, they measure the distortions to the optimal firm size distribution as a residual.[6] Therefore, by imputing all the difference in the size distribution of firms between the US and other countries to size-dependent policies, this previous body of literature magnifies the importance of such distortions. While there is no reason to think that the distribution of innate IQ is different in different countries, the distribution of managerial talent may depend on many other things than just innate IQ, like the distribution of education quality in the population or the type of available business opportunities.

Despite the small size of the restricted sector in the actual economy, the effects on overall productivity are large. We find that lifting the Small Scale Reservation Laws would increase output per worker by 3.2 percent in real terms. Within the manufacturing sector, the overall increase in output per worker would be of 9.8 percent and within the list of reserved goods it would be of 148 percent. The causes of these productivity gains are multiple. First, there is the direct effect of smaller capital ratios in the production of reserved goods. Second, under the Small Scale Reservation Laws there are too many small firms: lifting the constraint would imply a fall in the number of establishments in manufacturing sector of 72 percent, with average establishment size increasing from 19 to 69 employees. Third, managerial talent is misallocated between the restricted and unrestricted sector. Top managers operate in the unrestricted sector where they do not see their scale of production reduced, and worse managers operate in the restricted sector to benefit from higher prices. Lifting the constraint would more than double the amount of managerial talent in the production of the reserved goods. And fourth, under the Small Scale Reservation Laws there is too little capital in all sectors of the economy. This is because the capital goods of the economy are intensive in manufactured goods and the price of the manufactured goods is relatively too high in the restricted economy. In particular, lifting the constrain would increase the steady state capital to labor ratio by 7.1 percent for the whole economy, a figure that comes from a 12.5 percent increase in manufactures and a 6 percent increase in agriculture and services.

The productivity gains of lifting the Small Scale Reservation Laws are partly due to the better allocation of production factors and partly due to the capital deepening that arises as a response. To quantify the importance of each, we measure TFP as it is typically done in development accounting exercises. We find that lifting the Small Scale Reservation Laws would increase the TFP for the overall economy by 0.85 percent and the TFP for manufactures by 3.6 percent. Hsieh and Klenow (2009) argue that, were capital

[6] See for instance Guner, Ventura, and Yi (2008), Restuccia and Rogerson (2008) or Hsieh and Klenow (2009).

and labor reallocated efficiently, the TFP gains in India would be around 50 percent. Hence, we conclude that, while the Small Scale Reservation Laws are an important drag for growth in India, other distortions need to be identified to account for the small TFP in India.

The remaining of the paper is organized as follows. In Section 2 we describe the main characteristics of the Small Scale Reservation Laws. In Sections 3 and 4 we present the model economy without and with the size restrictions, and we discuss the different equilibria that may arise. Then, in Section 5 we calibrate our model economy and in Section 6 we present our main quantitative results. Finally, Section 7 concludes.

2 The Small Scale Reservation Laws

The Small Scale Reservation Laws is one of the most striking cases of size-dependent policies in the World.[7] From 1960, the government of India has been "reserving" a large number of manufacturing goods for exclusive production by Small Scale Industries. The number of reserved goods was 177 products in 1974, 504 in 1978, 847 in 1989, and 823 in 2002. Since then, the scenario has changed dramatically. In the next eight years, around 800 items have been liberalized: 51 items were de-reserved in 2002, 75 in 2003, 85 in 2004, 108 in 2005, 180 in 2006, 212 in 200, 93 in 2008 and 1 in July 2010. In June 2010 only 20 products were reserved, which means that today reservation has become almost extinct.

Small Scale Industries The Indian government defines a Small Scale Industry (SSI) according to the cumulative amount of investment in plant and machinery. This means that all the firms with a level of capital below a limit set by the government are considered "small" and therefore they are allowed to produce reserved goods. Such limit has changed over time. It started at Rs.0.5 million in 1960 and has been periodically adjusted upward using inflation. However, in 1999 the limit was revised downward due to political pressure from the smaller SSI firms, making the real value of the limit lower than it was in 1991. This limit, which remains today, is very low. According to Lewis (2005), a minimum efficient scale shirt manufacturing plant requires five hundred sewing machines. Countries as China and Sri Lanka have a lot of plants like this. In contrast, plants manufacturing for the domestic market in India have an average of twenty sewing machines.

[7] According to Morris, Basant, Das, Ramachandran, and Koshy (2001), India is the only country that attempts to protect the space for small firms through this kind of policy.

Why was reservation born? It was argued that small establishments producing labor-intensive goods would make efficient use of capital and would absorb the abundant labor supply present in an underdeveloped country. However, in official documents there is not any clear criterion for the selection of goods to be reserved (this is not surprising given the difficulty in determining the optimal capital-labor ratio for the production of each type of goods). For example, in clothing, cotton and woolen socks, scarfs, cloths and vests were reserved. Instead, no linen, jute or hemp textiles products were reserved, which implies that there was a considerable degree of substituatbility between reserved and not reserved clothing items. The list of reserved goods also included food and food-related goods, sanitary goods and investment goods. There is also evidence to think that non reserved investment goods were possible substitutes of reserved ones. For instance, hand and animal drawn carriages were reserved but mechanical drawn ones were not, steel tables were reserved but wood and plastic tables were not.

Other policies that support Small Scale Industries Reservation is not the only policy that has been set up to support SSI. First, SSI have important fiscal advantages. For instance, they are totally or partially exempt from paying excise duties, which are indirect taxes charged on manufacturing goods produced in India and sold in the Indian market.[8] Second, until the 90's, the credit system in India was constructed in order to give preferential treatment to the SSI. In this system, SSI had access to artificially low interest rates and 15 percent of all bank credit was to be allocated to SSI. With reforms in the 90's, interest rate subsidies have been partially eliminated, but most of the credit support is still in place.[9] Third, the central government directly operates a large system for assisting SSI in several aspects: tool rooms, product-cum-process development centers, small industry service institutes, etc. Finally, most Indian states also have complex programs for providing different kinds of subsidies for SSI. These include subsidies on power consumption, capital subsidies, exemption from sales tax, subsidies for location in

[8]Excise-duty exemption to small scale units is mainly granted under notification no.175/86-CE dated 1.3.1986. This Excise Duty Exemption Scheme applies to the entire small scale industries spectrum, barring a few specified items. According to it, if the clearance of the operation ranges from 0 to Rs. 5,000,000 the rate of duty will be 0%. If it ranges from Rs.5,000,000 to Rs.10,000,000 the rate of duty will be 5%. And finally, if the clearance is above Rs. 10,000,000 the rate of duty will be the same as for large firms, which is 14%.

[9]An evidence of this is that in order to provide adequate credit to SSI, the Reserve Bank of India set up the Nayak Committee in 1991. The Committee submitted a report in 1992 which recommended that commercial banks may provide working capital to SSI units worked out at the rate of 20% of their annual turn-over subject to a limit of Rs. 10,000,000. Since then, the limit of working capital has since been raised to Rs. 50,000,000. In March 1999 there were around 390 specialized banks branches whose main goal was to provide personalized attention and increase the credit flow to SSI sector.

backward areas or subsidies for technical and feasibility studies for SSI.

3 The unrestricted model

We consider a model with three sectors. First, there is a sector that produces agriculture goods and services. This sector is characterized by a representative firm and hence we do not model the optimal firm size problem for it. We consider this sector purely for quantitative reasons as we want to give the manufacturing sector the actual weight in the Indian economy and we want the distortions to affect differently consumption and investment goods. Second, there are two different manufacturing sectors, sector 1 and sector 2, that produce two different types of manufactures. Production of these goods is subject to decreasing returns to scale at the plant level and hence the optimal size problem arises. In the restricted model, sector 2 will be subject to an upper bound in capital, whereas sector 1 will not. For convenience, we will consider these two manufacturing goods as intermediates for a final manufacturing good. The final manufacturing good can be either consumed or used to create productive capital. Instead, the outptut in the agriculture and services sector can only be consumed.[10]

3.1 Production of agriculture goods and services

The production of agriculture goods and services is carried out by a representative firm with a neoclassical production function $F^a(k, n)$ that combines capital k and labor n. The output of this sector has a price p^a. We will consider this sector as the numeraire and hence we set $p^a = 1$. Taking as given the prices r and w for each production factor, this problem implies the standard first order conditions:

$$F^a_k(k, n) = r \quad \text{and} \quad F^a_n(k, n) = w \tag{1}$$

3.2 Production of the final manufacturing good

The final manufacturing good y^m is produced by a representative firm that combines the two intermediate manufacturing goods y^1 and y^2 in a CES production function:

$$y^m = F^m(y^1, y^2) = [(1-\phi)(y^1)^\zeta + \phi(y^2)^\zeta]^{\frac{1}{\zeta}} \qquad \text{with} \;\; 0 < \phi < 1, \;\zeta < 1$$

[10]This is a simplifying assumption. Kongsamut, Rebelo, and Xies (2001) show that in the U.S. more than 90% of intermediates for investment goods come from manufacturing and construction. Echevarría (1997) and Schmitz (2001) also make this simplifying assumption.

Taking the prices p^m, p^1 and p^2 as given, the standard first order conditions are:

$$p^m F_1^m(y^1, y^2) = p^1 \quad \text{and} \quad p^m F_2^m(y^1, y^2) = p^2 \tag{2}$$

3.3 Production of the intermediate manufacturing goods

The technology to produce intermediate manufacturing goods is identical in the two sub-sectors. A manager with ability z has access to the production function:

$$y = Az^{1-\gamma}\left[k^{\nu}n^{1-\nu}\right]^{\gamma} \qquad 0<\gamma<1 \ \text{ and } \ 0<\nu<1$$

where γ is the span of control parameter that measures the degree of returns to scale, and A is the TFP at the plant level. Managers choose labor and capital to maximize the profit function:

$$\pi^i\left(z, p^i, w, r\right) = \max_{n,k}\left\{p^i A z^{1-\gamma}[k^{\nu}n^{1-\nu}]^{\gamma} - wn - rk\right\}$$

where p^i is the market price of the intermediate i. The first order conditions of this problem lead to the demand functions:

$$n^i(z, p^i, w, r) = (1-\nu)^{\frac{1}{1-\gamma}}\,\Theta_n (p^i)^{\frac{1}{1-\gamma}} z w^{\frac{\nu\gamma-1}{1-\gamma}} r^{\frac{-\nu\gamma}{1-\gamma}} \tag{3}$$

$$k^i(z, p^i, w, r) = \nu^{\frac{1}{1-\gamma}}\Theta_k (p^i)^{\frac{1}{1-\gamma}} z w^{\frac{\gamma(\nu-1)}{1-\gamma}} r^{\frac{-\gamma(\nu-1)-1}{1-\gamma}} \tag{4}$$

where Θ_n and Θ_k are combinations of constants. These equations show that the demand for labor and demand for capital are linear functions of the level of managerial ability z. If we substitute the optimal demands back into the production function and into the objective function we will obtain that both, the output function $y^i\left(z, p^i, w, r\right)$ and the profit function $\pi^i\left(z, p^i, w, r\right)$ are also linear in the managerial ability z.[11] Finally, note that both expressions together imply that the capital-labor ratio is the same for all z, that is:

$$\frac{k}{n} = \frac{\nu}{1-\nu}\frac{w}{r} \tag{5}$$

3.4 The household problem

There is a single representative household in the economy with a continuum of members. Each household member is endowed with $z \in \mathbb{R}_+$ units of managerial ability. $G(z)$ and $g(z)$ are the *cdf* and *pdf* functions that describe the distribution of managerial ability over

[11] See Appendix A for details.

household members. When they are workers instead of managers, all household members supply one unit of labor inelastically with the same productivity.

The household has to decide how much to consume of each good, how much to invest to create physical capital, and the occupational choice of its members. We first look at the occupational choice and then we integrate it into the dynamic problem.

3.4.1 Occupational choice

The occupational choice of the household requires to allocate each individual into one of the three mutually exclusive jobs: worker in any sector, manager in the manufacturing sector 1 and manager in the manufacturing sector 2. Firm profits in both sectors are linearly increasing in the manager ability z whereas labor income for workers is invariant in z. Hence, as in Lucas (1978) we will have a $\tilde{z}$ such that for $z < \tilde{z}$ an individual will be a worker and for $z > \tilde{z}$ an individual will be a manager. The household also has to decide in which of the manufacturing sectors the managers will operate. We can have three different situations. First, if $\pi^1(\tilde{z}, p^1, w, r) > \pi^2(\tilde{z}, p^2, w, r)$, given that the profit functions are (a) linear in z, (b) positively sloped, and (c) zero for $z = 0$, then it means that the profit function in sector 1 is larger than in sector 2 for all managerial ability $z > 0$ and hence all individuals with $z > \tilde{z}$ become managers in sector 1 and no production of the manufacturing good 2 takes place. The converse is true with the reversed inequality. Neither of these situations can be an equilibrium.[12] The third case is $\pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r)$, which implies that profits in the two sectors will be the same for all managers z. Hence, the household is indifferent about which sector to send its entrepreneurs. In this situation, for every $z > \tilde{z}$ the household sends a fraction $1 \geq \alpha(z) \geq 0$ of its members to sector 1 and a fraction $(1-\alpha(z))$ to sector 2. Notice that the choice of the function $\alpha(z)$ is undetermined when $\pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r)$; however, we will see that in equilibrium the first moment of this function over the distribution of talent is uniquely determined, and that higher order moments have no effects for aggregate allocations.

Therefore, at any point in time, the income of the household is given by,

$$\begin{aligned} I(\tilde{z}, \alpha(z), w, r) &= w\, G(\tilde{z}) \\ &+ \int_{\tilde{z}}^{\infty} \left[\pi^1\left(z, p^1, w, r\right) \alpha(z)\, g(z) + \pi^2\left(z, p^2, w, r\right)(1-\alpha(z))\, g(z)\right] dz \end{aligned}$$

[12] Neither of these situations can be an equilibrium because the production function F^m implies that the marginal rate of substitution between the two types of manufacturing good tends to infinity if one of the goods tends to zero. Hence, the relative price p^1/p^2 will adjust to increase profits in the sector where there is no manager until some production takes place.

with the threshold $\tilde{z}$ characterized by the static condition

$$w = \max\left\{\pi^1\left(\tilde{z}, p^1, w, r\right), \pi^2\left(\tilde{z}, p^2, w, r\right)\right\} \tag{6}$$

and the function $\alpha(z)$ given by,

$$\begin{cases} \text{if } \ \pi^1(\tilde{z}, p^1, w, r) > \pi^2(\tilde{z}, p^2, w, r), & \alpha(z) = 1 & \forall z \in [\tilde{z}, \infty) \\ \text{if } \ \pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r), & \alpha(z) \in [0, 1] & \forall z \in [\tilde{z}, \infty) \\ \text{if } \ \pi^1(\tilde{z}, p^1, w, r) < \pi^2(\tilde{z}, p^2, w, r), & \alpha(z) = 0 & \forall z \in [\tilde{z}, \infty) \end{cases} \tag{7}$$

3.4.2 The dynamic problem

The objective function of the household is given by,

$$\sum_{t=0}^{\infty} \beta^t u\left(c_t^a, c_t^m\right)$$

and the budget constraint,

$$c_t^a + p_t^m c_t^m + p_t^m x_t = I\left(\tilde{z}_t, \alpha_t(z), w_t, r_t\right) + r_t K_t \tag{8}$$

where investment x_t is done only with the manufacturing good and the aggregate stock of capital K_t evolves as,

$$K_{t+1} = (1-\delta) K_t + x_t$$

This yields the standard conditions,

$$\frac{u_a\left(c_t^a, c_t^m\right)}{u_m\left(c_t^a, c_t^m\right)} = \frac{1}{p_t^m} \tag{9}$$

and

$$u_m\left(c_t^a, c_t^m\right) = \beta u_m\left(c_{t+1}^a, c_{t+1}^m\right)\left[\frac{r_{t+1}}{p_{t+1}^m} + 1 - \delta\right] \tag{10}$$

where r/p^m is the interest rate in terms of the final manufacturing good.

3.5 Equilibrium

We are going to focus on the equilibrium in steady state. All time periods are equal and all allocations and prices are time invariant.

Definition 1 (Steady State Equilibrium) *A steady state equilibrium is characterized* *by a set of prices $\{p^m, p^1, p^2, w, r\}$, capital and labor allocations in the agriculture sector $\{k^a, n^a\}$, capital and labor demands in the intermediate manufacturing goods sector $\{k^i(z, p^i, w, r), n^i(z, p^i, w, r)\}$, an aggregate capital stock K, an occupational choice $\{\tilde{z}, \alpha(z)\}$, and household consumption and investment plans $\{c^a, c^m, x\}$ such that,*

1. *The household solves its optimization problem, that is to say, equations (6), (7), (8), (9), (10) hold*

2. *The agriculture goods and services firm and the final manufacturing goods firm solve their optimization problems, that is to say, equations (1) and (2) hold*

3. *The intermediate goods firms solve their optimization problem, that is to say, equations (3) and (4) hold*

4. *The capital and labor markets clear,*

$$K = k^a + \int_{\tilde{z}}^{\infty} \left[k^1\left(z, p^1, w, r\right)\alpha(z) + k^2\left(z, p^2, w, r\right)(1-\alpha(z))\right] g(z)\,dz \tag{11}$$

$$G(\tilde{z}) = n^a + \int_{\tilde{z}}^{\infty} \left[n^1\left(z, p^1, w, r\right)\alpha(z) + n^2\left(z, p^2, w, r\right)(1-\alpha(z))\right] g(z)\,dz \tag{12}$$

5. *The good markets clear,*

$$y^1 = \int_{\tilde{z}}^{\infty} y^1\left(z, p^1, w, r\right)\alpha(z)\, g(z)\,dz \tag{13}$$

$$y^2 = \int_{\tilde{z}}^{\infty} y^2\left(z, p^2, w, r\right)(1-\alpha(z))\, g(z)\,dz \tag{14}$$

$$c^m + x = F^m\left(y^1, y^2\right) \tag{15}$$

$$c^a = F^a\left(k^a, n^a\right) \tag{16}$$

Notice that, since the functions $y^i(z, p^i, w, r)$ are linear in z, equations (13) and (14) only place conditions on the total amount of managerial talent, Z^1 and Z^2, allocated to each sector, that is to say, they place conditions on

$$Z^1 \equiv \int_{\tilde{z}}^{\infty} z\,\alpha(z)\, g(z)\,dz \quad \text{and} \quad Z^2 \equiv \int_{\tilde{z}}^{\infty} z\,(1-\alpha(z))\, g(z)\,dz$$

Likewise, since labor and capital demands in sectors 1 and 2 are also linear in z, equations (11) and (12) only place constraints in the total amount of managerial talent, Z^1 and Z^2, allocated to each sector. Therefore, any function $\alpha(z)$ that satisfies equations (13) and (14) implies a different allocation of managers across sectors but generates the same prices and aggregate allocations in equilibrium. Therefore, without loss of generality, we will restrict the function $\alpha(z)$ to be invariant in z and hence finding the equilibrium allocations of managers entails finding a constant α. Note, however, that while average talent and average firm size in the manufacturing sector will be independent of $\alpha(z)$ (and hence determined in equilibrium), average talent and average firm size within each manufacturing subsector are not independent of $\alpha(z)$, and hence the model is silent about them in the unrestricted equilibrium.

4 Restrictions on capital accumulation

We now look at the economy where size restrictions are in place. In particular, mimicking the small scale reservation laws we set an upper bound $\bar{k}$ to the capital level that firms in the managerial sector 2 can use. The choice problem for firms in the agricultural goods and services sector, final manufacturing good sector and intermediate manufacturing good 1 sector are unchanged.

For the intermediate manufacturing good 2, managers whose optimal demand of capital is below $\bar{k}$ will have optimal demands of capital and labor, and final output and profits unchanged. However, since the unrestricted demand of capital is increasing in z, there will be a $\hat{z}$ such that managers with $z > \hat{z}$ will be constrained in their demand of capital. Given the optimal demand of capital (3) this threshold $\hat{z}$ is given by,

$$\hat{z} = \bar{k}\left[\nu^{\frac{1}{1-\gamma}}\Theta_k(p^2)^{\frac{1}{1-\gamma}}w^{\frac{\gamma(\nu-1)}{1-\gamma}}r^{\frac{-\gamma(\nu-1)-1}{1-\gamma}}\right]^{-1} \tag{17}$$

Then, the optimal demand of labor for firms with $z > \hat{z}$ will be,

$$n^2\left(z, p^2, w, r\right) = \left[\frac{p^2}{w}Az^{1-\gamma}\gamma(1-\nu)\bar{k}^{\nu\gamma}\right]^{\frac{1}{1-(1-\nu)\gamma}} \tag{18}$$

This labor demand is increasing in z. Hence, for $z > \hat{z}$ the capital output ratio will not be identical across managers as in the unrestricted model but decreasing in z. Note, additionally, that the labor demand is not linear in z but concave. It can also be shown that the output and profit functions $y^2(z, p^2, w, r)$ and $\pi^2(z, p^2, w, r)$ will be linear on z until $\hat{z}$ and concave afterwards.

The occupational choice of the household members can be solved as follows. As in the unrestricted economy, the profit functions of both intermediate goods sectors are increasing in z. Hence, there will be a $\tilde{z}$ such that individuals with $z < \tilde{z}$ become workers and individuals with $z > \tilde{z}$ become managers. As in the unrestricted economy, equation (6) determines $\tilde{z}$. Now, to allocate managers into sectors we have three cases. First, if $\pi^1(\tilde{z}, p^1, w, r) > \pi^2(\tilde{z}, p^2, w, r)$ then all managers will go into sector 1. The reason is that $\forall z \in [\tilde{z}, \hat{z}]$, $\pi^1(z, p^1, w, r) > \pi^2(z, p^2, w, r)$, as both profit functions grow linearly and π^1 has a higher slope given that it is larger at $\tilde{z}$. For $z > \hat{z}$ the difference in profits will widen at a higher rate because π^2 grows at a less than linear rate (see top panel in Figure 1). Of course, this cannot be an equilibrium because there is no manager and hence no output in sector 2. Second, if $\pi^1(\tilde{z}, p^1, w, r) < \pi^2(\tilde{z}, p^2, w, r)$, then there will be a crossing point $\tilde{\tilde{z}} > \hat{z}$ such that $\pi^1(z, p^1, w, r) < \pi^2(z, p^2, w, r), \forall z < \tilde{\tilde{z}}$, and $\pi^1(z, p^1, w, r) > \pi^2(z, p^2, w, r), \forall z > \tilde{\tilde{z}}$. Hence, individuals with $z \in \left[\tilde{z}, \tilde{\tilde{z}}\right]$ become managers in sector 2 and individuals with $z \in \left[\tilde{\tilde{z}}, \infty\right)$ become managers in sector 1 (see bottom panel in Figure 1). Finally, if $\pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r)$ we will have that the profit functions are identical for $z \in [\tilde{z}, \hat{z}]$ and hence the managerial choice is indeterminate in that range. For $z \in [\hat{z}, \infty)$ we will have that $\pi^1(z, p^1, w, r) > \pi^2(z, p^2, w, r)$ and therefore managers will go into sector 1 (see center panel in Figure 1). Hence, we can characterize $\alpha(z)$, the optimal allocation of managers into sectors, as follows:

$$\begin{cases} \text{if } \ \pi^1(\tilde{z}, p^1, w, r) > \pi^2(\tilde{z}, p^2, w, r), & \alpha(z) = 1 \ \ \forall z \in [\tilde{z}, \infty) \\ \text{if } \ \pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r), & \begin{cases} \alpha(z) \in [0,1] & \forall z \in [\tilde{z}, \hat{z}] \\ \alpha(z) = 1 & \forall z \in [\hat{z}, \infty) \end{cases} \\ \text{if } \ \pi^1(\tilde{z}, p^1, w, r) < \pi^2(\tilde{z}, p^2, w, r), & \begin{cases} \alpha(z) = 0 & \forall z \in \left[\tilde{z}, \tilde{\tilde{z}}\right] \\ \alpha(z) = 1 & \forall z \in \left[\tilde{\tilde{z}}, \infty\right) \end{cases} \end{cases} \tag{19}$$

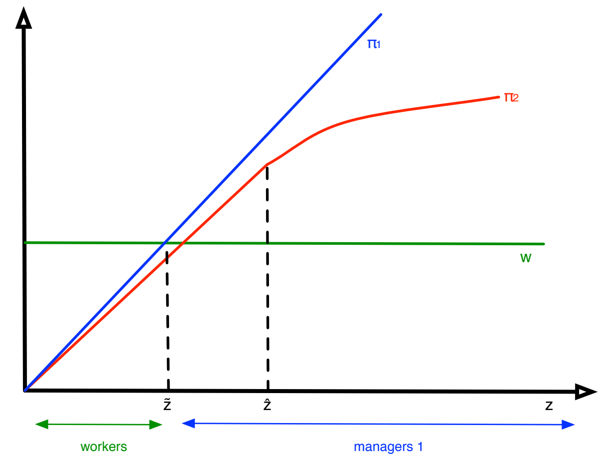
with the thresholds $\tilde{z}$ given by equation (6), $\hat{z}$ given by equation (17) and $\tilde{\tilde{z}}$ given by,

$$\pi^1\left(\tilde{\tilde{z}}, p^1, w, r\right) = \pi^2\left(\tilde{\tilde{z}}, p^2, w, r\right) \tag{20}$$

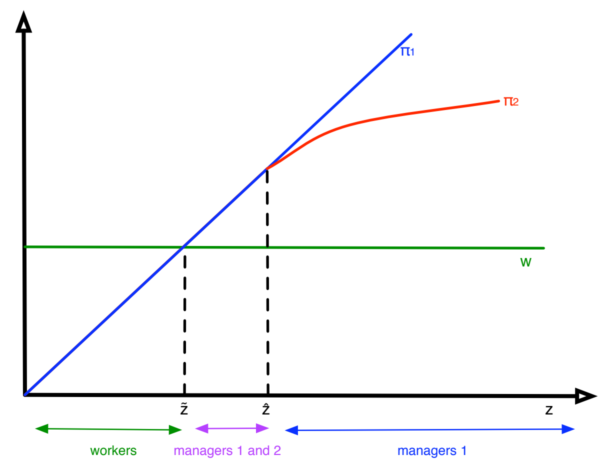
4.1 Equilibrium

The equilibrium description in the restricted economy is identical to the one in the unrestricted economy, but with the choice of $\alpha(z)$ determined by equation (19) instead of equation (7), the new thresholds $\hat{z}$ and $\tilde{\tilde{z}}$ given by equations (17) and (20), the labor demand for manufacturing firms in sector 2 with $z > \hat{z}$ given by equation (18) and their capital demand given by $\bar{k}$. We restricted model generates two types of different equilibria, which can be distinguished by the relationship between $\pi^1(\tilde{z}, p^1, w, r)$ and $\pi^2(\tilde{z}, p^2, w, r)$.

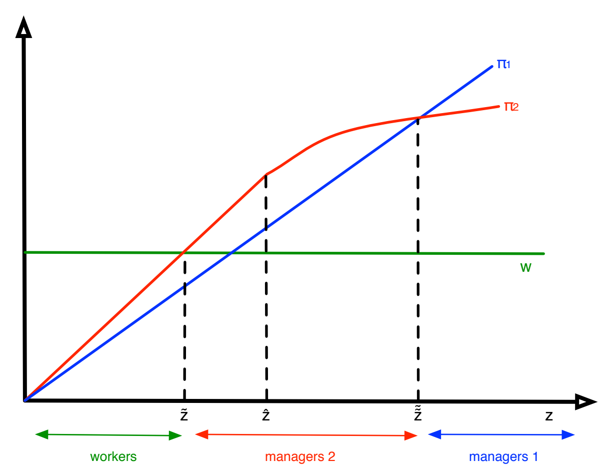
Figure 1: Occupational choice in the restricted model



(a) $\pi^1\left(\tilde{z}, p^1, w, r\right) > \pi^2\left(\tilde{z}, p^2, w, r\right)$



(b) $\pi^1\left(\tilde{z}, p^1, w, r\right) = \pi^2\left(\tilde{z}, p^2, w, r\right)$



(c) $\pi^1\left(\tilde{z}, p^1, w, r\right) < \pi^2\left(\tilde{z}, p^2, w, r\right)$

Depending on the model parameters we will have one or the other.[13]

First, we have the equilibrium characterized by $\pi^1(\tilde{z}, p^1, w, r) < \pi^2(\tilde{z}, p^2, w, r)$, which implies a unique equilibrium allocation of managers. We can rewrite the market clearing equations for capital and labor as,

$$\begin{aligned} K &= k^a + \int_{\tilde{z}}^{\tilde{\tilde{z}}} k^2\left(z, p^2, w, r\right) g(z)\, dz + \int_{\tilde{\tilde{z}}}^{\infty} k^1\left(z, p^1, w, r\right) g(z)\, dz \\ G(\tilde{z}) &= n^a + \int_{\tilde{z}}^{\tilde{\tilde{z}}} n^2\left(z, p^2, w, r\right) g(z)\, dz + \int_{\tilde{\tilde{z}}}^{\infty} n^1\left(z, p^1, w, r\right) g(z)\, dz \end{aligned}$$

and for the intermediate goods as,

$$y^1 = \int_{\tilde{\tilde{z}}}^{\infty} y^1\left(z, p^1, w, r\right) g(z)\, dz \qquad \text{and} \qquad y^2 = \int_{\tilde{z}}^{\tilde{\tilde{z}}} y^2\left(z, p^2, w, r\right) g(z)\, dz$$

And second, we have the case $\pi^1(\tilde{z}, p^1, w, r) = \pi^2(\tilde{z}, p^2, w, r)$, which does not imply a unique allocation of managers. In particular, all managers with $z > \hat{z}$ are allocated to sector 1. But only a fraction $\alpha(z)$ of managers with $z \leq \hat{z}$ are allocated to sector 1, whereas a fraction $1 - \alpha(z)$ are allocated to sector 2. We call this equilibrium the *ineffectual restricted equilibrium* for reasons that will be apparent in Proposition 1 below, and we can rewrite the market clearing equations for capital as,

$$\begin{aligned} K &= k^a + \int_{\hat{z}}^{\infty} k^1\left(z, p^1, w, r\right) g(z)\, dz \\ &+ \int_{\tilde{z}}^{\hat{z}} \left[k^1\left(z, p^1, w, r\right) \alpha(z) + k^2\left(z, p^2, w, r\right)(1 - \alpha(z))\right] g(z)\, dz \end{aligned} \tag{21}$$

for labor as

$$\begin{aligned} G(\tilde{z}) &= n^a + \int_{\hat{z}}^{\infty} n^1\left(z, p^1, w, r\right) g(z)\, dz \\ &+ \int_{\tilde{z}}^{\hat{z}} \left[n^1\left(z, p^1, w, r\right) \alpha(z) + n^2\left(z, p^2, w, r\right)(1 - \alpha(z))\right] g(z)\, dz \end{aligned} \tag{22}$$

[13] Recall that the case $\pi^1\left(\tilde{z}, p^1, w, r\right) > \pi^2\left(\tilde{z}, p^2, w, r\right)$ cannot be an equilibrium because no production of y^2 would take place.

and for the intermediate goods as,

$$y^1 = \int_{\tilde{z}}^{\hat{z}} y^1\left(z,p^1,w,r\right)\alpha(z)\,g(z)\,dz + \int_{\hat{z}}^{\infty} y^1\left(z,p^1,w,r\right)g(z)\,dz \tag{23}$$

$$y^2 = \int_{\tilde{z}}^{\hat{z}} y^2\left(z,p^2,w,r\right)(1-\alpha(z))\,g(z)\,dz \tag{24}$$

Finally, the total amount of managerial talent allocated to each sector is given by,

$$Z^1 \equiv \int_{\tilde{z}}^{\hat{z}} z\,\alpha(z)\,g(z)\,dz + \int_{\hat{z}}^{\infty} z\,g(z)\,dz \quad \text{and} \quad Z^2 \equiv \int_{\tilde{z}}^{\hat{z}} z\,(1-\alpha(z))\,g(z)\,dz$$

4.2 The ineffectual restricted equilibrium

In this type of equilibrium, the existence of an upper bound on capital accumulation in one sector does not change the aggregate allocations of the economy compared to an unrestricted economy. Hence, a policy like the Small Scale Reservation Laws would be irrelevant under this equilibrium. This type of equilibrium is more likely to arise when the upper bound on capital is large or when the size of the restricted sector is small. The next three propositions state formally these results.[14]

Proposition 1 *For a given $\bar{k}$, if we have an ineffectual restricted equilibrium, then*

(a) There is no manager with a binding capital demand;

(b) The relative output, managerial talent, capital and labor of sector 1 and 2 are as in the unrestricted economy. That is to say, y^1/y^2, Z^1/Z^2, k^1/k^2 and n^1/n^2 are the same in both economies;

(c) All aggregate allocations are as in the unrestricted economy.

The intuition of the proof is quite simple: in an *ineffectual restricted equilibrium* managers with $z > \hat{z}$ operate in sector 1 where they face no constraint. Hence, there is nobody constrained in equilibrium and then capital and labor demands, and output and profit functions are linear in z and identical across sectors. Since both the unrestricted and the *ineffectual restricted equilibrium* require $p^1 = p^2$, the relative output and the relative inputs in both sectors will be the same, and so will be the aggregate allocations of the economy.

[14]See Appendix B for the proofs.

Proposition 2 *The set of $\bar{k}$ that generate ineffectual restricted equilibria is given by the interval* $\bar{\mathbf{k}} \equiv \left[\bar{k}_{min}, \infty\right)$, *where* $\bar{k}_{min} > 0$.

The intuition of the proof is that for an *ineffectual restricted equilibrium* to exist we need that the amount of managerial talent that exists in the interval $[\tilde{z}, \hat{z}]$ is large enough such that the same total Z^2 can be obtained as in the unrestricted economy by just changing $\alpha(z)$ without any change in prices. If $\bar{k}$ is small, then $\hat{z}$ is small and the sum of talent allocated to sector 2 is smaller than under the unrestricted economy, so p^2/p^1 needs to increase compared to the unrestricted equilibrium and hence the *ineffectual restricted equilibrium* disappears.

Proposition 3 *The lower bound* $\bar{k}_{min}$ *that defines the set* $\bar{\mathbf{k}}$ *increases with the share* ϕ *of the restricted sector within manufacturing.*

The intuition is as follows. When the restricted sector is small (ϕ small), the equilibrium of the unrestricted economy requires little talent to be allocated to the restricted sector. Then a given $\bar{k}$ can be overcome easily by allocating small firms, which are not affected by the constrain, in the restricted sector, and let the better managers go to the restricted sector.

4.3 Comparing the economies with and without size distortion

In a model with only one sector, imposing an upper bound on capital $\bar{k}$ implies that managers with $z > \hat{z}$ —those with optimal demand of capital above $\bar{k}$ in the unrestricted economy— will decrease their demand for labor. This has the equilibrium effect of lowering wages and hence some marginal individuals that were workers in the free economy become small entrpreneurs in the restricted economy. Hence, in the constrained economy the fraction of population engaged in managerial jobs is too high, the average managerial ability is too low and the overall sum of managerial talent is too high.

In our economy with different sectors, this mechanism may be partly offset by the movement of managers across sectors. If the constraint only applies to one sector, this sector is not too big (ϕ is small enough), and the constraint is not very strong ($\bar{k}$ is high enough), then we would be in an *ineffectual restricted equilibrium*, a situation like the center panel in Figure 1. The very top managers —those with $z > \hat{z}$ —go to the unrestricted sector 1. Since there is a mass of indifferent managers in the interval $[\tilde{z}, \hat{z}]$, we may find a function $\alpha(z)$ such that Z^1 and Z^2 remain as in the unrestricted economy, and hence all prices and aggregate allocations remain unchanged. In this situation, the Small Scale Reservation Laws would have no aggregate effect.

Instead, if the constraint is strong enough ($\bar{k}$ is low enough), or the size ϕ of the sector where it applies is large enough, then the mass of managerial talent that migrates into the unrestricted sector 1 will be large enough such that, even if all managers into the interval $[\tilde{z}, \hat{z}]$ are sent to the restricted sector 2, Z^1 is larger and Z^2 is lower than in the equilibrium of the unrestricted economy. Then, prices will need to adjust and aggregate allocations will change. In particular, p^2/p^1 will raise such that supply and demand of the intermediate manufacturing goods is equalized again. This will raise the profits in sector 2 and diminish the profits in sector 1, so a situation like the bottom panel in Figure 1 emerges and more and more managers go into the restricted sector 2. As a result we will have the same type of distortions as in the model with one sector, plus the misallocation of productive resources between the two manufacturing sectors: compared to the free economy, in the restricted economy the ratio of managerial talent (and hence capital and labor) in the unrestricted sector 1 will be too large compared to the restricted sector 2. In addition, the misallocation of resources between the two manufacturing sub-sectors makes the price of manufactures to increase and hence investment goods become more expensive relative to the consumption bundle (which is composed also of agricultural goods and services) and as a result the steady state interest rate will be larger (see equation 9). This implies that the restriction on capital size decreases the equilibrium capital stock in all sectors of the economy.

5 Calibration

As mentioned in the Introduction, a key aspect of our empirical strategy is to measure the underlying distribution of entrepreneurial possibilities and key technological parameters from the observed firm size distribution in India. To this end, we use three different dataset: the World Bank Enterprise Survey (WBES), the Annual Survey of Industries (ASI) and the Census of Small Scale Industries (CSSI). Below, we describe the most important aspects of these data sets.

5.1 Datasets for India

Annual Survey of Industries (ASI). The ASI is an annual data set conducted and published by the Indian goverment's Central Statistical Organization since tha late 60's. We use the 2002-2003 wave. The ASI has the advantage of being the only publicly available source for large Indian plants data on output, employment, worker compensation, capital stocks, and other plant level data. However, by construction this data set oversamples large firms. The ASI consists of two parts. First, there is a census of all registered manufacturing plants in India with more than 100 workers. Second, there is a random sample of registered plants with more than 10 workers (20 if without power) but less than 100. This implies that small firms are not covered and hence that the firm size distribution that emerges from this survey is truncated.[15] We use the detailed plant level data in order to compute the aggregate capital and labor shares in the Indian manufacturing sector, which we will use to calibrate one of the technological parameters of our model.

Census of Small Scale Industries (CSSI). The CSSI is a data set organized by the Development Commissioner of the Ministry of Micro, Small and Medium Enterprises. It is a census that covers all the registered Small Scale Industry (SSI) units. Recall that a Small Scale plants is one with the capital stock below the government-set upper bound, regardless of which type of manufacturing goods are produced.[16] We use the Third Census, which refers to the period 2001-2002. We regard this data set as a very good description of the lower tail of the firm size distribution, and hence we will use it precisely to characterize this part of the firm size distribution.

World Bank Enterprise Survey (WBES). The Enterprise Survey is a collection of firm-level surveys of different countries conducted by the World Bank from 2002. The goal of this survey is to collect information about business environment and how it affects firm performance. We use the *Standardized data 2002-2005*. In this data we can find a 2002 sample for Indian manufacturing firms. An important aspect of this dataset is that the sampling methodology is a stratified (by firm size, sector and geographic region) random sampling with replacement. The strata for firm size are firms below 20 employees, firms between 20 and 100, and firms above 100. The sampling weights for each stratum are not provided. Hence, while the Survey allows computing estimates for each of the stratum with a high level of precision, a whole firm size distribution (or any of its moments) cannot be obtained. We will use this data set to obtain the average firm size within the second stratum and the average stock of capital within the first one.

5.2 Choosing parameter values and functional forms

We now choose functional forms and parameter values such that out model economy with capital constraints resembles the Indian economy until 2002-03, when the liberalization

[15] According to Unel (2003), registered manufacturing plants only represent about 58-67 percent of total manufacturing value added.

[16] Note that the incentives for an establishment to be registered are very large because registered small scale firms have a variety of benefits such as fiscal advantages, credit support, promotion programs and the possibility to produce reserved goods.

process started to take place. The calibration strategy is as follows. Once we choose the functional forms, the model contains 12 parameters. We take 3 parameters from outside the model and calibrate the remaining 9 parameters in equilibrium to ensure that the restricted model economy displays critical properties for the aggregate allocations and for the size distribution of firms that we observe in the data.[17] Table 1 summarizes the parameter values and Table 2 shows our targets and the performance of the model in terms of them. In the following subsections we detail the calibration process.

Table 1: Parameter values

Param.	Definition	Source	value	
			$\zeta = 0.0$	$\zeta = 0.5$
θ	Share of manufacturing in utility function	Calibrated	0.14	0.10
ρ	Elasticity parameter in utility function	Predetermined	-1.5	-1.5
β	Discount factor	Calibrated	0.91	0.91
δ	Depreciation rate	Calibrated	0.032	0.032
ϕ	Share of restricted sector in manufacturing	Calibrated	0.13	0.35
ζ	Elasticity parameter in manufacturing	Predetermined	0.0	0.5
μ	Capital share in A&S production	Predetermined	1/3	1/3
γ	Span of control parameter	Calibrated	0.54	0.53
ν	Capital share on $g(k, n)$	Calibrated	0.39	0.39
α	Frechet Shape	Calibrated	1.01	1.01
σ	Frechet Scale	Calibrated	0.23	0.23
$\bar{k}$	Capital threshold	Calibrated	38.22	28.07

Notes: The column $\zeta = 0.0$ refers to the main exercise. The column $\zeta = 0.5$ refers to the exercise with higher elasticity of substitution described in Section 6.4.

Preferences and capital accumulation. We assume a log utility function for the representative household and a constant elasticity of substitution aggregator for the two types of consumption goods:

$$u(c_m, c_a) = \log \left[\theta c_m^{\rho} + (1-\theta) c_a^{\rho}\right]^{\frac{1}{\rho}}$$

We choose $\rho = -1.5$, which yields an elasticity of substitution between manufacturing goods and services of 0.4. This low elasticity is consistent with the values used in Duarte and Restuccia (2010), Moro (2009) and Rogerson (2008), and it reflects the low level of

[17]This can also be seen as an exactly identified Simulated Method of Moments.

substitutability between well differentiated large aggregate classes of goods as agriculture or services and manufactures. We calibrate θ to match the observed share of the manufacturing sector as a fraction of aggregate output, which was 26 percent in 2002 according to *World Development Indicators* of the World Bank.[18]

Regarding the discount factor β and the capital depreciation rate δ, we follow the standard practice of calibrating them to the capital to output ratio and to the investment to capital ratio respectively. For the period 1990-2000 the capital to output ratio averaged about 2.1 and the investment to capital ratio averaged about 3.2 percent.[19]

Table 2: Calibration targets

Param.	Statistic	Data	Model $\zeta = 0.0$	Model $\zeta = 0.5$
θ	Share Manufacturing in total output (%)	26.0	26.4	26.1
β	Capital-Output ratio	2.1	2.1	2.1
δ	Investment-Capital ratio	0.032	0.032	0.032
ϕ	Share SSI sector in total output (%)	3.1	3.5	3.5
γ	Mean Size (in number of employees) of median firms	37.0	36.2	37.0
ν	Capital share over labor share in manufacturing	0.63	0.60	0.60
α	Proportion of SSI with 1-6 employees (%)	64.8	65.5	63.9
σ	Proportion of firms w/ 300 relative to firms w/ 100 (%)	42.8	40.2	42.7
$\bar{k}$	Threshold capital / average capital (small firms)	1.3	1.3	1.3

Notes: The column $\zeta = 0.0$ refers to the main exercise. The column $\zeta = 0.5$ refers to the exercise with higher elasticity of substitution described in Section 6.4.

Technology in the production of manufacturing goods. We calibrate ϕ to match the observed share of the restricted sector as a fraction of total GDP. According to Mohan (2002) the share of reserved sector on SSI value added is around 30 percent and the share of SSI in total manufacturing sector is around 40 percent. This yields a share of the restricted sector on total manufacturing of 12 percent, and of total output of 3 percent. The elasticity of substitution between the two types of manufactures is not easy to pin down. If the list of reserved goods in sector 2 was such that they were very different from (and hence hard to substitute by) the rest of manufacturing goods, then a lower bound on

[18] We could have assumed a more general CRRA utility instead of log. However, since we are comparing steady states the curvature of the utility function does not play any role.

[19] See Mishra (2008) for the former statistic. We computed the latter by use of data from the Federal Reserve Bank of India.

the elasticity of substitution should be 0.4 (that is, $\zeta = -1.5$, which is the standard value for the substitutability between manufactured goods and agriculture goods, see above). However, as we discuss in Section 2, the list of reserved goods seems rather arbitrary and, arguably, with reasonable substitutes not reserved for SSI. Hence, we will look at higher elasticities of substitution. For our benchmark calibration we choose a unitary elasticity of substitution by imposing a Cobb-Douglas function ($\zeta = 0$). In Section 6.4 we re-calibrate again our economy by imposing an elasticity of substitution equal to 2 ($\zeta = 0.5$).

Technology in the production of A&S sector. Regarding the agriculture and services sector, we use a Cobb-Douglas production function

$$F^a(k^a, n^a) = (k^a)^{\mu}(n^a)^{1-\mu}$$

This functional form restricts the elasticity of substitution between capital and labor to be equal to one, which is a standard choice when looking at aggregate production factors. The capital share parameter μ is set equal to 1/3.

Technology in the production of the intermediates manufacturing goods. We first normalize the parameter A to 1. We need to give values to the span-of-control parameter γ and to the capital share parameter ν. The ideal target for the first parameter would be the mean establishment size (in terms of number of employees) in total manufacturing sector. According to the ASI this mean is 25 employees. However, because of the reasons explained above this average corresponds to a truncated distribution. Instead, we use the data in the 20-100 stratum of the ESWD to compute average firm size for firms between 20 and 100 employees, which turns out to be 37. To calibrate ν we target the ratio of capital and labor shares in manufacturing. Equation (5) shows that, in absence of distortions, ν would directly drive this ratio. With the distorted firms, we need to calibrate this parameter in equilibrium. We use the ASI to measure the ratio of the capital share to the labor share.[20] The ratio of capital to labor income obtained is 0.63.

Distribution of talent. We want the distribution of talent $G(z)$ to reproduce several statistics of the firm size distribution in India. The firm size distribution in most countries typically has a Pareto-like shape. However, the Pareto distribution is not very flexible as there is only one parameter. Instead, as Eaton and Kortum (2002) we choose our

[20] Capital income is given by *rent paid*, *interest paid* and *depreciation*, whereas labor income is given by *wages and salaries*, *employers contribution as provident fund* and *staff welfare expenses*.

distribution of talent to be a Frechet, which allows for two parameters and hence a better description of the size distribution of firms:

$$G(z) = e^{-\left(\frac{\sigma}{z}\right)^{a}} \qquad \text{with } \sigma > 0,\ \alpha > 1$$

We choose values of σ and α in order to match a lower tail and an upper tail statistic of the firm size distribution. First, the observed proportion of small-scale establishments with a number of employees between 1 and 6, which is 64.8 percent according to the CSSI. Second, the observed proportion of firms with more than 300 workers relative to the proportion of firms with more than 100 workers, which is 0.42 according to the ESWB.

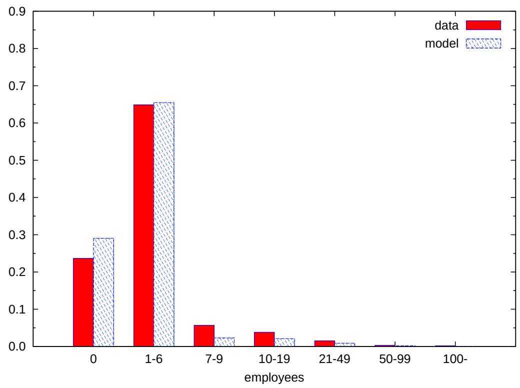
Restriction on capital accumulation. The restricted economy is characterized by a maximum capital $\bar{k}$ that firms in manufacturing sector 2 can use in production. In 2002 this upper bound was \$230,000. To convert this value into model units we want to compare it to a measure of average capital stock held by Indian manufacturing firms. According to the *United Bank of India*, the upper bound in capital is defined in terms of "cumulative investment in plant and machinery (original cost)". We interpret this as the un-depreciated value of stock of plant and machinery for a given establishment. The ESWB is the only dataset that contains this measure of capital. Such measure is given by *Gross Value (Acquisition Cost) of machinery, equipment, land and buildings.* Using this notion, the average capital for small firms (less than 20 employees) was around 0.77 times the maximum capital imposed by the goverment. So we set $\bar{k}$ such that in the model $\bar{k}$ over the average capital of firms with less than 20 employees equals 1.3.

5.3 Summary of calibration results.

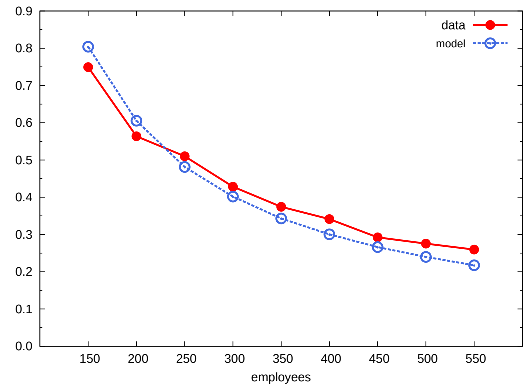
Our model economy produces a very good description of the relevant statistics of the Indian economy: Table 2 shows a very good fit for the calibration targets. In Figure 2 we show the lower tail and the right tail of the firm size distribution in India and in the model. Panel (a) plots an histogram of the number of employees in firms with capital below the threshold that defines the Small Scale firms. The data come from the CSII. The second column (1-6 employees) is a calibration target. Panel (b) plots the distribution of firms over the number of employees conditional on firms having more than 100 employees. The data come from the ESWB. The fourth data point (300 employees) is a calibration target. In both cases we get a reasonable fit to the data, showing that the Frechet assumption is quite useful. The calibrated model delivers and average firm size of 19.7 workers.

The calibrated span-of-control parameter γ is equal to 0.54. This is smaller than the

Figure 2: Firms size distribution: tails.



(a) Left Tail



(b) Right Tail

Notes: Panel (a) describes the firm size distribution for Small Scale firms, data from CSSI as reported by Indian Minister of Micro, Small&Medium Enterprises. Panel (b) describes the firm size distribution conditional on firms with more than 100 employees, data from the WBES

values around 0.8 obtained for the US economy.[21] However, it is more or less consistent with the average factor payments by manufacturing firms in the ASI. In particular, the capital share and labor share in the ASI add up to a fraction of 63 percent of the value added. In an economy without distortions γ would give the sum of the labor and capital shares in manufacturing. In our benchmark economy with distortions the sum of average capital and labor compensation over value added in manufactures equals 0.53, not too different from the value of 0.52 implied by an unrestricted economy.[22] A span of control parameter in a developing economy lower than the one estimated for the US economy is also consistent with the literal interpretation of this parameter in the Lucas (1978) model: the ability to organize and supervise groups of workers must be lower in economies where monitoring technology is lower. Indeed, this is why it is important to calibrate the model parameters to the economy under study instead of relying in calibration strategies based in US data.

6 Findings

Now we describe our quantitative results. We want to measure the impact of lifting the restriction on the efficiency of the use of factors in this economy, and its implications

[21]See Atkeson and Kehoe (2005), Guner, Ventura, and Yi (2008) and references therein.

[22]Hence, our calibrated γ generates a share of profits 14 percentage points off the ones measured in the ASI data, whereas if we used a γ more like the one estimated in the U.S. data the share of profits would be around 27 percentage points off.

on aggregate productivity, aggregate allocations and welfare. To do so, we solve for the steady state of the economy with and without restrictions. Throughout this section we label the restricted economy as E_r and the economy without the size restrictions as E_f.

6.1 Four channels of inefficiency

The misallocation of resources in the restricted economy comes from four different sources.

First, in the economy without restrictions the optimal capital-labor ratio is the same for all managers z in both manufacturing subsectors.Instead, in the restricted economy the upper bound $\bar{k}$ means that the capital-labor ratio will be declining with managerial ability z in the manufacturing sector 2 for $z > \hat{z}$.[23] Hence the model predicts that the average capital-labor ratio in the restricted sector 2 will be inefficiently low compared to sector 1. In the first two rows of panel (A) of Table 3 we report the capital-labor ratio in each manufacturing sector. We find that in the restricted economy the capital-labor ratio is 10.77 in sector 2 and 19.19 in sector 1. Hence, the capital-labor ratio is more than 46 percent lower in the restricted sector. When we lift the constraints, the capital-labor ratio in both sectors is equalized. It increases 89 percent in sector 2 and 6 percent in sector 1.

Second, given the constraint in capital accumulation in sector 2, the overall demand for labor in this sector and the market wage rate are lower than under the free economy. Hence the threshold $\tilde{z}$ that separates individuals between managers and workers is too low compared to the free economy, which generates a large mass of low productivity entrepreneurs. Therefore the model implies that the mass of entrepreneurs will be inefficiently high, their average productivity inefficiently low and the resulting average firm size also too low. Panel (B) in Table 3 reports the number of entrepreneurs in manufacturing relative to the total population in the model, $1 - G(\tilde{z})$; the average talent of entrepreneurs, $(Z^1 + Z^2) / (1 - G(\tilde{z}))$; and the average firm size. We find that in the restricted economy a 0.74 percent of the population becomes manager. When we lift the constraints we have that only 0.21 percent of the population are entrepreneurs, more than two thirds reduction. The average talent in manufacturing is too low in the restricted economy: when we lift the constraint the increase in average talent is 253 percent. And in the last row we observe how the excess of small entrepreneurs, together with the direct effect of the constraint, translate into low average firm size. In the restricted economy average firm size is 19 employees whereas the model predicts that in the free economy the average firm size would raise to 69 employees.

[23] Recall that equation (18) tells us that for $z > \hat{z}$ labor demand increases with z despite capital being fixed to $\bar{k}$.

Table 3: Allocations of resources across sectors

	E_r	E_f	Δ (%)
(A) Capital to labor ratio			
Manufacturing 1	19.19	20.33	5.94
Manufacturing 2	10.77	20.33	88.79
Manufacturing All	18.07	20.33	12.48
Agriculture and services	12.86	13.63	5.94
Overall economy	13.62	14.59	7.10
(B) Entrepreneurs in Manufacturing			
Fraction of entrereneurs	0.74	0.21	-72.11
Average talent*	1.00	3.54	253.87
Average firm size	19.42	69.07	255.68
(C) Managerial talent			
Manufacturing 1	19.53	17.90	-8.37
Manufacturing 2	1.37	2.73	99.01
Ratio 1 to 2	14.22	6.55	-53.96
Manufacturing All	20.91	20.63	-1.32

Notes: *Average talent relative to average talent in Manufacturing for the E_r economy. E_r refers to the restricted economy; E_f refers to the economy without size restrictions; Δ refers to relative change between them.

Third, given the asymmetry between sectors 1 and 2, the allocation of managerial talent is tilted towards the unrestricted sector 1: top managers can operate at full capacity in sector 1, whereas not so good managers go to sector 2 where they are either (a) not affected by the constraint (if $z < \hat{z}$); or (b) they are affected (if $z > \hat{z}$), but the cost of not operating at full capacity is more than compensated by the large price p^2 of goods in sector 2. The model hence predicts that the ratio of managerial talent between sectors 1 and 2 will be inefficiently high. Panel (C) in Table 3 reports the allocation of managerial talent into each sub-sector and into overall manufacturing. We observe that lifting the constraint implies that the ratio Z^1/Z^2 more than halves. This is due to both, the large increase of talent in sector 2 (more than double) and the 8 percent fall of talent from sector 1.

Finally, the inefficient allocation of resources within manufacturing makes the price of manufactured goods relative to agriculture and services, p^m, too high compared to the free economy. This implies that the investment goods, which are more intensive in manufactures than the consumption goods, are more expensive in the steady state of the restricted economy. Therefore, the steady state interest rate of the restricted economy is too high and this implies low capital labor ratios in all sectors of the economy.[24] In the last three rows of Panel (A) in Table 3 we report the capital to labor ratio for overall manufacturing, for agriculture and services and for the overall economy. We observe that lifting the constraint implies increases of capital labor ratio of 12 percent in manufacturing, 6 percent in agriculture and services and 7 percent for the overall economy.

Table 4: Prices

	$\zeta = 0.0$			$\zeta = 0.5$		
	E_r	E_f	Δ (%)	E_r	E_f	Δ (%)
	(1)	(2)	(3)	(4)	(5)	(6)
w	1.51	1.53	1.75	1.39	1.43	3.03
r	0.050	0.048	-3.96	0.060	0.056	-6.73
p^2/p^1	1.85	1.00	-46.1	1.88	1.00	-46.7
p^m	0.39	0.37	-3.96	0.46	0.43	-6.73

Notes: columns (1), (2) and (3) refer to the benchmark exercise with unit elasticity of substitution between the two manufacturing subsectors. Columns (4), (5) and (6) refer to the exercise with higher elasticity of substitution described in Section 6.4. E_r refers to the restricted economy; E_f refers to the economy without size restrictions; Δ refers to relative change between them.

All these channels of inefficiencies can also be seen in the equilibrium prices. In Table 4 we report all the steady state prices for both the restricted and unrestricted economies. As discussed in the above paragraphs, in the restricted economy the wage w is too low, and the interest rate r, the price of the reserved goods relative to the non-reserved goods p^2/p^1 and the price of manufactures p^m too high.

6.2 Productivity

All the misallocation of productive resources between the two managerial sectors described above has important implications in productivity.

In Panel (A) of Table 5 we report output per worker in all sectors of the economy, which has been obtained dividing output produced by all people present in the production process, both employees and managers. We report changes in productivity while holding relative prices constant, as we are interested in reflecting changes in real units. When we lift the restriction we find an increase in output per worker in manufacturing equal to

[24] See equation (10).

Table 5: Productivity

	$\zeta = 0.0$		$\zeta = 0.5$	
	E_r	Δ (%)	E_r	Δ (%)
	(1)	(2)	(3)	(4)
(A) Output per worker				
Manufacturing 1	4.57	-3.78	4.31	-2.60
Manufacturing 2	3.29	147.90	3.08	155.57
Manufacturing All	4.35	9.80	4.09	14.62
Agriculture and services	2.15	1.75	1.99	3.03
Total output	2.48	3.20	2.30	5.12
(B) Total Factor Productivity				
Manufacturing All	1.49	3.65	1.55	6.40
Total output	1.10	0.85	1.11	1.42

Notes: columns (1) and (2) refer to the benchmark exercise with unit elasticity of substitution between the two manufacturing subsectors. Columns (3) and (4) refer to the exercise with higher elasticity of substitution described in Section 6.4. E_r refers to the restricted economy; Δ refers to the steady state change between the free economy and the restricted economy while keeping prices constant.

9.80 percent. This comes from a 148 percent increase in the reserved sector and a 3.78 percent fall in the unrestricted sector. These changes reflect the increase in capital in both sectors and the reallocation of managerial talent between sectors. The productivity in the agriculture and services sector also increases 1.75 percent due to the capital increase. Altogether, output per worker in the economy increases 3.2 percent. We find this to be a very large number given that the size of the restricted sector is only 3 percent of the Indian economy.

Exercises in development accounting measure how much of the dispersion of output per capita between countries comes from differences in productive factors (capital and labor) and how much from differences in aggregate TFP. As we have seen, the Small Scale Reservation Laws reduce capital accumulation by making investment goods more expensive and, given a certain amount of factors, distort aggregate productivity by misallocating factors between plants and between sectors. To see how much of the increase in output per worker that arises from lifting these constraints comes from capital deepening and how much from better allocation of resources between sectors, we compute a measure of TFP for the aggregate economy and for the manufacturing sector. We impose a Cobb-Douglas representative firm and use the aggregate data generated by the model to measure the increase in TFP.[25] We report this measure in the Panel (B) of Table 5. We find that in the free economy TFP in manufacturing is 3.65 percent larger than in the restricted economy, and TFP for the overall economy is 0.85 larger. Hence, 37 percent of the increase in ouput per worker in manufacturing comes from the direct effect of allocating talent across manufacturing sectors, and 63 percent comes from the increase in capital accumulation that arises as a consequence.

6.3 Aggregates and welfare

In Table 6 we report changes in aggregates and relative sizes of the different sectors. The total GDP lost to the the Small Scale Reservation Laws is 3.2 percent (see Panel A). The change in relative prices implies an increase of 1.8 percent in the share of manufactures in the economy and a fall of 0.7 percent in the share of agriculture and services (see Panel B). Within manufacturing there is also substantial rebalancing, with the share of the reserved sector increasing 71 percent.[26] The increase in capital accumulation due to the lifting of the constraints has a counterpart on the share of output devoted to investment: there is an increase of 4.3 percent in the share of output invested in producing capital goods.

Overall, in real terms lifting the constraints implies increasing consumption of manufactured goods in 4.2 percent and consumption of agriculture and services by 2.5 percent (see Panel A). This implies steady state welfare gains equivalent to an increase in consumption of manufactures of 15.7 percent (see Panel C).

6.4 Robustness: the elasticity of substitution between manufacturing goods

In the main exercise we have chosen a unit elasticity of substitution between those manufacturing goods reserved for SSI and the rest. The inspection of the list of reserved goods seems to suggest that there are reasonable substitutes for the reserved goods that are free to produce with unconstrained firm size. Of course, other things equal, the larger the elasticity of substitution between reserved and non-reserved goods, the less important the quantitative effects of the Small Scale Reservation Laws: if the there are size distortions that make production of the reserved goods inefficient and hence expensive, the economy can move away from them and use the non-distorted goods at very little productivity and utility cost. Therefore, it is important to explore how much the results change when we increase the elasticity of substitution.

[25]See Appendix C for details.

[26]Of course, with the Cobb-Douglas assumption, the share of the reserved sector does not change when measured at market prices.

Table 6: Aggregate allocations

	$\zeta = 0.0$			$\zeta = 0.5$		
	E_r	Δ (%)	Δ (%)	E_r	Δ (%)	Δ (%)
	(1)	(2)	(3)	(4)	(5)	(6)
(A) Aggregates						
Total Output	2.48	3.2	2.1	2.30	5.1	3.2
Investment	0.17	7.7	3.4	0.15	12.2	4.6
Consumption manufactures	0.49	4.2	0.1	0.44	6.9	-0.3
Consumption agriculture and services	1.83	2.5	2.5	1.70	4.0	4.0
(B) Output Shares (%)						
Manufacturing	26.5	1.8	-1.2	26.1	3.0	-2.2
Reserved sector in manufacturing	13.3	71.0	0.0	13.4	182.2	68.0
Investment	6.7	4.3	1.3	6.7	6.7	1.4
Consumption manufactures	19.8	1.0	-2.0	19.4	1.7	-3.4
Consumption agriculture and services	73.5	-0.7	0.4	73.9	-1.1	0.8
(C) Welfare Cost	—	15.7	—	—	28.6	—

Notes: columns (1), (2) and (3) refer to the benchmark exercise with unit elasticity of substitution between the two manufacturing subsectors. Columns (4), (5) and (6) refer to the exercise with higher elasticity of substitution described in Section 6.4. E_r refers to the restricted economy; In columns (2) and (5) Δ refers to the steady state change between the free economy and the restricted economy while keeping prices constant, whereas in columns (3) and (6) it refers to the changes at market prices.

In this section, we impose the elasticity of substitution to be equal to 2 by choosing $\zeta = 0.5$. We recalibrate the economy to the same targets as before (see Tables 1 and 2). The calibration for the more elastic economy yields a very important difference: the share parameter ϕ in the manufactures aggregator becomes 0.35 instead of 0.13, impyling that the reserved sector is ore important in the more elastic economy. The reason for this is that in 2001, with size distortions in place, manufacturing goods reserved for SSI accounted for 13 percent of value added in manufacturing. Hence, when we assume that reserved and non-reserved goods are very good substitutes, given that reserved goods are more expensive, for the economy to keep producing the same share we need the reserved goods to be very important in the manufactures aggregator. In other words, if reserved goods are very easy to substitute, the fact that they are bought in equilibrium when they are more expensive must be because they are very important in the economy. The size of

ϕ is critical. With a higher ϕ the size distortions apply to a larger sector and hence have the potential of generating larger output and productivity losses.

In effect, as shown in Tables 4, 5 and 6, the quantitative effects of the Small Scale Reservation Laws are larger when measured with a more elastic economy.[27] Lifting the constraints would imply an increase in output per worker in manufacturing of 15 percent, and in the whole economy of 5 percent; the TFP in manufacturing would increase by 6 percent, and in total output by 1.5 percent. Hence, despite the fact that a more elastic economy would have less problems substituting expensive goods by cheap goods, the more elastic economy also requires the importance of the reserved goods to be larger in order for this economy to be consistent with data, and hence the size distortions matter more.

7 Conclusions

Our measurement of the effect of the Small Scale Reservation Laws in the Indian economy gives output per worker losses of 3.2 in the whole economy (9.8 percent in manufacturing) and TFP losses of 0.8 percent (3.6 percent). Given that the size of the restricted sector is small (12 percent of manufacturing, 3 percent of GDP) and that our measurement tool allows for mobility of entrepreneurs between sectors, we find these numbers very high. Assuming a larger degree of substitutability between the reserved and non reserved goods would increase the productivity losses measured with our model: a doubling of the elasticity of substitution increases productivity losses by more than 50 percent. However, while big, the TFP losses are much smaller than what has been measured by Hsieh and Klenow (2009) for the Indian economy, or by Guner, Ventura, and Yi (2008) and Restuccia and Rogerson (2008) more generally for broad classes of size dependent policies.

One reason for this difference is that our goal differs from the one of these previous papers. Hsieh and Klenow (2009), and the other papers, attempt to measure the effect of all possible distortions affecting the allocation of resources between firms. We do not do that. Instead, we identify a very striking case of size-dependent policy and we measure its marginal effect. Of course, we do not think that Small Scale Reservation Laws are the only benefits accruing to small firms. In Section 2 we have discussed a wide battery of measures. So in this respect, our results can be seen as complementary to the ones by Hsieh and Klenow (2009).

A second reason for this difference is that the papers by Hsieh and Klenow (2009), Guner, Ventura, and Yi (2008) and Restuccia and Rogerson (2008) impose the underlying

[27] We have also carried robustness exercises with elasticities of substitution lower than unity and all the results are reversed. Results available upon request.

distribution of talent of the US to the distorted economies. We do not do so. We think that the underlying distribution of talent has to do with innate difference in IQ (which should be similar in all countries) but also with other differences such as the distribution of human capital (which is not). Hence, by attributing the difference in firm size between the US and other economies to the existence of size dependent distortionary policies, these papers possibly overstate the importance of these type of policies. In contrast, we measure directly the size distortion.

Our measurement of the effect of the Small Scale Reservation Laws is done through a clear and admittedly simple model. The model allows for the size distortions to misallocate capital, labor and managerial talent between firms and between sectors, and to misallocate output between the production of consumption and investment goods. However, more involved theories may generate larger effects of the Reservation Laws in output per worker or in measured TFP. For instance, in models of development like Hansen and Prescott (2002), the TFP level determines when an economy switches from mainly an agrarian Malthusian world into an industrial economy with sustained growth. Small Scale Reservation Laws, by lowering the economy TFP, may delay and slow down this process and hence have larger effects on output per worker. In models of endogenous schooling decisions, as Erosa, Koreshkova, and Restuccia (2010), differences in TFP can account for differences in human capital investment across countries. Small Scale Reservation Laws, by lowering the economy TFP, may also lower human capital accumulation, which would have a larger impact on output per worker and, whenever labor is measured as working age population, also on TFP. Finally, one could get larger effects on output per worker and on measured TFP with a model of endogenous technology adoption. For instance, Lewis (2005) has argued that many farmers in India do not adopt new labor-saving technologies embedded in new machinery because of the very low price of labor services in the Indian economy. Our results show that lifting the Reservation Laws would increase labor demand and hence wages. This in turn could spur new labor-saving technology adoption, which would further increase the Indian measured TFP.

A Model equations

The problem stated in Section 3.3 yields the FOC:

$$\begin{aligned} p^i A z^{1-\gamma}\gamma\nu(k^\nu n^{1-\nu})^{\gamma-1}(k^{\nu-1}n^{1-\nu}) &= r \\ p^i A z^{1-\gamma}\gamma(1-\nu)(k^\nu n^{1-\nu})^{\gamma-1}(k^\nu n^{-\nu}) &= w \end{aligned}$$

Rearranging we obtain the demand functions (3) and (4), with the constants Θ_n and Θ_k given by,

$$\Theta_n = \left[A\gamma\left(\frac{\nu}{1-\nu}\right)^{\nu\gamma}\right]^{\frac{1}{1-\gamma}} \Theta_k = \left[A\gamma\left(\frac{\nu}{1-\nu}\right)^{\gamma(\nu-1)}\right]^{\frac{1}{1-\gamma}}$$

The function $y^i\left(z, p^i, w, r\right)$ that gives the optimal output by an entrepreneur z in sector i with prices p^i, w and r is given by substituting the optimal demands of labor and capital into the production function,

$$y^i\left(z, p^i, w, r\right) = zA\Gamma(p^i)^{\frac{\gamma}{1-\gamma}} r^{\frac{-\nu\gamma}{1-\gamma}} w^{\frac{-(1-\nu)\gamma}{1-\gamma}}$$

where

$$\Gamma = (1-\nu)^{\frac{\gamma(1-\nu)}{1-\gamma}} \nu^{\frac{\gamma\nu}{1-\gamma}} \Theta_n^{\gamma(1-\nu)} \Theta_k^{\gamma\nu}$$

Above we see that $y^i\left(z, p^i, w, r\right)$ is linear in z. Then, given that output, labor demand and capital demand are all linear in z, so is the profit function.

B Theorems and proofs

Proposition 1 *For a given $\bar{k}$, if we have an ineffectual restricted equilibrium, then*

(a) There is no manager with a binding capital demand;

(b) The relative output, managerial talent, capital and labor of sector 1 and 2 are as in the unrestricted economy. That is to say, y^1/y^2, Z^1/Z^2, k^1/k^2 and n^1/n^2 are the same in both economies;

(c) All aggregate allocations are as in the unrestricted economy.

Proof: Part (a) is obvious from the optimal allocation of managers in expression (19) and the definition of $\hat{z}$ in equation (17): all managers with $z > \hat{z}$ produce in sector

1 where there is no constraint and all managers with $z < \hat{z}$ are unrestricted regardless of the sector where they operate.

To prove (b), note that an *ineffectual restricted equilibrium* is characterized by the condition $\pi^1(z, p^1, w, r) = \pi^2(z, p^2, w, r)$ for $z \leq \hat{z}$. Since the profit functions for $z \leq \hat{z}$ are identical in both sectors, this means that $p^1 = p^2$. This condition, $p^1 = p^2$, also holds in the unrestricted economy for the same reason. Then, the FOC in (2) and the constant returns to scale of F^m imply that the ratio of y^1 to y^2 will be the same in the two economies. Regarding the managerial talent allocated in each sector, given that $y^2(z, p^2, w, r)$ for $z < \hat{z}$ and $y^1(z, p^1, w, r)$ are linear in z and equal to each other (and given that $p^1 = p^2$), dividing equations (23) and (24) we see that Z^1/Z^2 equals y^1/y^2. The same is true in the unrestricted economy, so Z^1/Z^2 is the same in both economies. Finally, the same argument applies for capital and labor, so given that Z^1/Z^2 is the same in both economies so will the ratio of capital and labor employed in each sector.

To prove (c) one only needs to note that all the remaining equilibrium conditions in both economies are the same, and so will be aggregate allocations and prices. ■

Proposition 2 *The set of $\bar{k}$ that generate ineffectual restricted equilibria is given by the interval $\bar{\mathbf{k}} \equiv [\bar{k}_{min}, \infty)$, where $\bar{k}_{min} > 0$.*

Proof: According to Proposition 1, all $\bar{k}$ that generate an *ineffectual restricted equilibrium* will have the same prices and aggregate allocations. Since the *ineffectual restricted equilibrium* implies that manufacturing good 2 can only be produced by managers with $z \in [\tilde{z}, \hat{z}]$, for such an equilibrium to exist we need that the total sum of managerial talent available for manufacturing good 2, $\int_{\tilde{z}}^{\hat{z}} zg(z)\,dz$, is not smaller than the total amount of managerial talent Z^2 allocated to sector 2 in the unrestricted economy. Now, $\tilde{z}$ is the same in all *ineffectual restricted equilibria* and equation (17) says that $\hat{z}$ is linearly increasing in $\bar{k}$. Hence, take some $\bar{k}_a > 0$. Then for any $\bar{k}_b > \bar{k}_a$ we will have $\hat{z}_b > \hat{z}_a$ and therefore

$$\int_{\tilde{z}}^{\hat{z}_b} zg(z)\,dz > \int_{\tilde{z}}^{\hat{z}_a} zg(z)\,dz$$

Hence, if the economy with $\bar{k}_a$ displays an *ineffectual restricted equilibrium* so will the economy with $\bar{k}_b$. Finally, $\bar{k}_{min} > 0$ because for $\bar{k} \leq 0$ no production of goods would take place in sector 2. ■

Proposition 3 *The lower bound $\bar{k}_{min}$ that defines the set $\bar{\mathbf{k}}$ increases with the share ϕ of the restricted sector within manufacturing.*

Proof: Let's define Z_f^2 as the total amount of talent allocated to the sector 2 in the unrestricted economy. Then, following proposition 2, $\bar{k}_{min}$ is implicitly defined by

$$\int_{\tilde{z}}^{\hat{z}_{min}} zg(z)\,dz = Z_f^2$$

with $\hat{z}_{min}$ defined by plugging $\bar{k}_{min}$ in equation (17).

To see how $\bar{k}$ varies with ϕ note that equation (17) is not affected by ϕ. Hence, any effect of ϕ on $\bar{k}_{min}$ comes through changes in Z_f^2. Note that equations (2) imply that

$$\frac{p^1}{p^2} = \frac{F_1(y^1, y^2)}{F_2(y^1, y^2)} = \frac{1-\phi}{\phi}\left(\frac{y^2}{y^1}\right)^{1-\zeta}$$

Since, the ratio of prices p^1/p^2 is equal to one in the unrestricted equilibrium, any increase in ϕ translates into increases in the y^2/y^1 ratio. To increase y^2/y^1 we need Z^2/Z^1 to increase. Hence, equilibria with larger ϕ are equilibria with larger Z_f^2 and hence $\bar{k}_{min}$ are larger. ■

C Measured TFP

Total Factor Productivity is a residual that arises from measuring aggregate GDP, aggregate capital, aggregate labor and then embedding them into a simple production function. Using a standard Cobb-Douglas production function to characterize a representative firm, we can determine how much —according to our model— the conventionally measured TFP would increase if the reservation laws were lifted. Within our model it is straightforward to measure output, aggregate capital and aggregate labor for both the restricted and the non-restricted economies. However, measuring the capital share is not so direct because we have different sectors with different capital shares. We use the model data on factor payments to construct the capital share in the way it is normally done with National Accounts data.

We impose a Cobb-Douglas production function:

$$Y = AK^{\xi}L^{1-\xi}$$

Let's denote aggregate profits by Π. Note that factor payments exhaust output:

$$rK + wG(\tilde{z}) + \Pi = Y$$

We impute wage income $wG(\tilde{z})$ to labor compensation, and interest income rK to capital compensation. Then, we have to decide how much of entrepreneurial profits are to be considered compensation to labor and how much compensation to capital. We follow the standard practice of asking the share of profits that we impute to capital and labor to be equal to the aggregate capital and labor share.[28]

Then, we obtain the aggregate capital share ξ by solving

$$\xi = \frac{rK + \xi\Pi}{Y}$$

And the increase in TFP is given by,

$$\frac{A_f}{A_r} = \frac{Y_f}{Y_r}\left(\frac{K_r}{K_f}\right)^{\xi}$$

since we measure labor as total number of people in the economy, which is constant.

An analogous exercise can be done for the manufacturing sector with the capital share given by

$$\xi = \frac{r(K - k^a) + \xi\Pi}{p^m y^m}$$

And the increase in TFP given by,

$$\frac{A_f}{A_r} = \frac{y_f^m}{y_r^m}\left(\frac{K_r - k_r^a}{K_f - k_r^a}\right)^{\xi}\left(\frac{1 - n_r^a}{1 - n_f^a}\right)^{1-\xi}$$

[28]See Cooley and Prescott (1995) for details.

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