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The reservation laws in India and the misallocation of production factors[☆]

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ABSTRACT

The Small Scale Reservation Laws (SSRL) in India are a unique case of firm-level size restrictions. We quantify their aggregate productivity costs by use of a span-of-control model extended into a multisector setting. The reallocation of top managers away from the distorted sector partly offsets the effect of the distortions. We calibrate our model using plant level data from India. Lifting the SSRL increases output by 6.8% in manufacturing and 2% in the overall economy, and TFP by 2% and 0.75% respectively. While large, the costs of this size-dependent policy cannot account for the existing gap in manufacturing TFP between the US and India.

1. Introduction

There are large differences in GDP per capita between countries and 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. One proposed explanation for the misallocation of productive resources has been the presence of government policies that impose barriers on the size of large firms or promote small ones. Often quoted examples of size-dependent policies are labor market regulations like in France, Italy or Spain, or the regulation in the retailing sector as in Germany, Japan or UK. Guner et al. (2008) and Restuccia and Rogerson (2008) argue that the potential impact of size-dependent policies is large. For instance, according to Hsieh and Klenow (2009), plant level distortions may account for up to 50 percent of the productivity gap between some developing economies like China and India, and the US. Because of this, there is a growing interest in quantifying the aggregate impact of specific size-dependent government policies.[2]

A unique case of restriction on size has been present in the Indian economy since the end of the 1960s. Several products in the manufacturing sector were reserved for production by small scale industries. A small scale industry is defined

[☆] A previous version of the paper has circulated under the title "Small Scale Reservation Laws and the Misallocation of Talent".

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

[2] A few recent examples are Guner et al. (2006), Gallipoli and Goyette (2011), Braguinsky et al. (2011), Garicano et al. (2012), or Gourio and Roys (2014).

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as a plant producing with a government-set upper bound in its capital stock. This implies that reserved goods cannot be produced by large firms. These laws receive the name of Small Scale Reservation Laws (SSRL). Several authors have attributed the poor economic performance of the manufacturing sector in India to the presence of these laws.[3]

In this paper we want to quantify the long run effects of the SSRL on aggregate productivity, aggregate output, and aggregate consumption of the Indian economy. To this end, we extend the span-of-control model by Lucas (1978) into a multisector setting and embed it into the neo-classical growth model.[4] The span-of-control model is a tractable framework that generates an endogenous distribution of firm sizes, and hence, it is a useful tool to think about size-dependent policies. In the Lucas (1978) model a representative household has to choose which individuals are workers and which individuals are entrepreneurs. The SSRL distort this allocation by limiting the scale of production of the best entrepreneurs and by diminishing the overall demand for labor, in which 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 SSRL apply, a second manufacturing sub-sector with no distortions, and a third sector for the rest of the economy where for simplicity there is no firm size problem.

Our main theoretical contribution is to model the occupational choice within this framework: in a multisector model the representative household has to choose into which sector to send its entrepreneurs, as well as who becomes an entrepreneur and who becomes a worker. The multisector model is important for two reasons. First, reassignment of managers between sectors dampens the effect of distortions: top managers can operate in the unrestricted sector where they do not see their scale of production reduced, while worse managers operate in the restricted sector to benefit from higher prices. We show that when size-dependent distortions are not too severe and apply to a small enough sector of the economy, reassignment of managers between sectors may leave the aggregate allocations of the economy unchanged. 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 misleading answers.[5] 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 SSRL 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 2001. To do so, we combine two different plant-level data sets to build a non-truncated distribution of firm sizes for India, which turns out to be much more tilted towards small firms than previously thought. In our calibration (a) we measure directly the severity of the distortion; (b) we measure the actual size of the distorted sector: 14% of manufacturing and 4% of total GDP; and (c) we back out the underlying distribution of managerial talent and the degree of diminishing returns to scale from the distribution of firm sizes in India.

Despite the small size of the restricted sector, the effects on productivity are substantial. We find that lifting the SSRL would increase output per worker by 2% in the whole economy, by 6.8% in manufacturing, and by 123% within the set of reserved goods. 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 SSRL there are too many small firms in equilibrium: lifting the constraint would imply a fall in the number of establishments in manufacturing sector of 12%, with the average establishment size increasing by 10%. And third, under the SSRL there is too little capital in all sectors of the economy. This is because capital goods are intensive in manufactures, and the price of the manufactured goods is too high in the restricted economy. In particular, we measure the share of manufactures in investment goods to be 71%, while it is only 13% in consumption goods. We find that lifting the constraint would increase the steady state capital-to-labor ratio by almost 3% for the whole economy.

The productivity gains of lifting the SSRL 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 Total Factor Productivity (TFP) as it is typically done in development accounting exercises. We find that lifting the SSRL would increase the TFP for the overall economy by 0.75% and the TFP for manufacturing by 2%. Therefore, 71% of the productivity gains in manufacturing come from capital deepening and not from measured TFP, while for the total economy this is 62%. Hsieh and Klenow (2009) argue that, if capital and labor were reallocated efficiently, the TFP gains in India would be around 50%. Hence, we conclude that, while the SSRL 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 SSRL. In Sections 3 we present the model economy without size restrictions, and in Section 4 we introduce the SSRL and discuss the different equilibria that may arise. Then, in Section 5 we calibrate our model economy and in Section 6 we present and discuss our quantitative results. Finally, Section 7 concludes.

[3] See among others Lewis (2005), Mohan (2002), Morris et al. (2001) and Unel (2003).

[4] We follow Erosa (2001), which is the first article to embed the span-of-control model of occupational choice into a well defined intertemporal consumption and saving problem, and Guner et al. (2008), who use it to measure the potential costs of size-dependent policies.

[5] Allowing for managerial skills to be transferable across sectors is key. Guner et al. (2006) also model a size distortion affecting one sub-sector of the economy. However, they assume that managers cannot switch between sectors. Direct empirical evidence of the effects of SSRL shows that reallocation of managers between sectors matters. See Section 6.5 for details.

2. The Small Scale Reservation Laws

The Small Scale Reservation Laws (SSRL) are one of the most striking cases of size-dependent policies in the world.[6] From 1960, the government of India has been reserving a large number of manufactured goods for exclusive production by Small Scale Industries (SSI). 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 8 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 2007, 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 (*SSI*): The Indian government defines a SSI according to the cumulative amount of investment in plant and machinery. This means that all the plants 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 (₹0.5 million in 1960 and has been periodically adjusted upward using inflation. In 1999 the limit was revised downward due to political pressure from the smaller SSI firms. This limit, ₹10 million (equivalent to $200,000 in 2002) remains today, and it is certainly low. For instance, according to Lewis (2005), a minimum efficient scale shirt manufacturing plant requires 5000 sewing machines. Countries such 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 20 sewing machines.

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 no clear criterion for the selection of goods to be reserved. For example, in clothing, cotton and woollen socks, scarfs, cloths and vests were reserved, while no linen, jute or hemp textile products were reserved. This suggests a high degree of substitutability between reserved and not reserved clothing items. There is also evidence 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 manufactured goods produced in India and sold in the Indian market. Second, the banking sector gives preferential treatment to the SSI. Until the 1990s the Priority Sector Lending program established that commercial banks had to allocate up to 40% of their lending to *priority sectors*, and do so at artificially low interest rates. The definition of priority sectors started with agriculture, exports and SSI, but it gradually increased over time to include other sectors like retail, small road and water transport operators, or individuals of particular castes. With reforms in the 1990s, interest rate subsidies were mostly eliminated, but some of the credit support remained. In particular, the 40% requirement to priority sectors is still in place, although the priority sector has been further expanded to include for instance the information technology sector.[7] 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. Fourth, 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 backward areas or subsidies for technical and feasibility studies for SSI. And fifth, all these domestic policies supporting SSI were complemented with exceptionally high barriers to imports, protecting SSI from international competition and hence making SSI privileges sustainable.[8]

Other policy distortions in manufacturing: The SSRL should not be mistaken for the Raj licensing system. The license Raj consisted of a centralized planning mechanism to limit firm entry into manufacturing production. Additionally, it also established the maximal output produced at each plant, the type and quantity of inputs to be used, and the technology and location of the plants. This planning system was dismantled during the late 1980s and early 1990s, sparking substantial academic research on the effects of its removal.[9]

3. The unrestricted model

We consider a model with three production sectors and two final goods. First, there are two manufacturing sub-sectors that produce two different types of manufactured goods with decreasing returns to scale technology. In the restricted model, sector 2 will be subject to an upper bound in capital, whereas sector 1 will not. Second, there is the agriculture and services sector, which is meant to capture the rest of the economy. The output of the two manufacturing sub-sectors is combined to form the aggregate manufactured good of the economy, which in turn is combined with output from the agriculture and services sector to form the economy's consumption and investment goods. These two final goods differ

[6] According to Morris et al. (2001), India is the only country that attempts to protect the space for small firms through this kind of policy.

[7] See Panagariya (2008) for details.

[8] Barriers to imports of manufactured goods started to fall significantly in 1991, but they remained large. Final goods average ad valorem tariff fell from 95% to 30% between 1991 and 2002. Tariffs on intermediates fell significantly as well within the same period, going from 60% to 20%. See Kochhar et al. (2006) and Panagariya (2008) for details. Recent work by Goldberg et al. (2010), De Loecker et al. (2012), or Harrison et al. (2012) among others, attempt to quantify the effects of these trade reforms.

[9] Aghion et al. (2005) study theoretically the effects of an entry limitation system as in the License Raj. Aghion et al. (2008), Chari (2011), and Bollard et al. (2013) examine direct empirical evidence of its removal.

in their relative use of manufactures such that distortions in the manufacturing sector will affect differently the production of investment and consumption goods, thereby distorting capital accumulation.

3.1. Production of the intermediate manufactured goods

The technology to produce intermediate manufactured goods is identical in the two sub-sectors. Managers differ in their ability z and in a factor-neutral idiosyncratic distortion τ, which we model as a tax wedge over profits. We give more details on this distortion in Section 3.5. Managers in sector i hire capital k and labor n to maximize profits

$$\pi_i(z,\tau) = \max_{n,k}\{(1-\tau)[p_i z^{1-\gamma}(k^\nu n^{1-\nu})^\gamma - wn - rk]\}$$

where $0<\gamma<1$ is the span of control parameter that measures the degree of returns to scale, $0<\nu<1$ is the capital share parameter, p_i is the market price of the intermediate i, w is the wage rate, and r is the interest rate. The first order conditions of this problem lead to the factor demand functions:

$$n_i(z) = z\Theta(1-\nu)p_i^{1/(1-\gamma)} w^{(\nu\gamma-1)/(1-\gamma)} r^{-\nu\gamma/(1-\gamma)} \tag{1}$$

$$k_i(z) = z\Theta\nu p_i^{1/(1-\gamma)} w^{\gamma(\nu-1)/(1-\gamma)} r^{(-\gamma(\nu-1)-1)/(1-\gamma)} \tag{2}$$

where Θ is a combination of constants.[10] These equations tell us two important things. First, the demands for labor and capital are linear functions of the level of managerial ability z and do not depend on τ. Second, the capital–labor ratio is the same for all z and τ. If we substitute the optimal factor demands back into the production function and then into the profit function we obtain that the output function $y_i(z)$ is linear in z and independent of τ, and that the profit function $\pi_i(z,\tau)$ is linear in $z(1-\tau)$. In addition, the relative profits between sectors 1 and 2 for any manager type are given by the relative prices only, and depend neither on z nor τ:

$$\frac{\pi_1(z,\tau)}{\pi_2(z,\tau)} = \left(\frac{p_1}{p_2}\right)^{1/(1-\gamma)} \tag{3}$$

3.2. Production of agriculture goods and services

The technology to produce agriculture goods and services is described by a constant returns to scale technology, so we abstract from the optimal firm size problem. A price-taking representative firm chooses how much capital k_a and labor n_a to hire in competitive factor markets and uses a constant elasticity of substitution (CES) production function $F^a(k_a, n_a)$ to produce output y_a, which is sold at price p_a to the final goods firms.

3.3. Aggregation of manufactures

The aggregate manufactured good y_m is produced by a competitive representative firm that chooses how much to buy of each intermediate manufactured good y_1 and y_2, combines them in a CES aggregator $F^m(y_1, y_2)$, and sells the output at price p_m to the final goods firms.

3.4. Final consumption and investment goods

The production of the consumption and investment goods is characterized by a competitive representative firm each, with different CES aggregators $F^c(a_c, m_c)$ and $F^x(a_x, m_x)$, where a_c (a_x) and m_c (m_x) are the quantities of agriculture and services and manufactures used in the production of the final consumption (investment) good. The final good firms choose how much of the intermediate goods to buy at competitive prices p_m and p_a and sell the final output to households at the competitive prices p_c and p_x.

3.5. 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 and with an idiosyncratic tax distortion $\tau \in [-1, 1]$ on managerial profits. The idiosyncratic distortion τ is a wedge in the occupational choice decision between worker and entrepreneur, but it does not affect the optimal firm size of a given entrepreneur with ability z nor its choice of sector. The objective of this wedge is to bring an extra degree of freedom, such that the model can reproduce the particularly large amount of very small firms in India without compromising the shape parameter of the distribution of talent. We assume a particular functional form for

[10] Section A.1 in the online appendix (http://www.cemfi.es/~pijoan/Publications.html) contains a detailed development of the key model equations.

the joint *cdf* $G(z,\tau)$. As we will see, the calibrated model asks for a positive correlation between the talent and the tax wedge of entrepreneurs, such that low productivity individuals are on average subsidized to create a firm. Our interpretation of this wedge is that it can partly summarize, in a reduced form manner, other policy distortions that favor small firms like those described in Section 2. But it may also be capturing non-policy distortions. For instance, in a country with so many people living in rural areas, the wedges may reflect heterogeneous commuting costs to the nearest factory. The idea is that in some isolated areas people may start their own small businesses—despite being scarcely productive—just because it is hard to find large factories around.[11]

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 and 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.

3.5.1. Occupational choice

The occupational choice of the household requires it to allocate each individual of type $\{z,\tau\}$ 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 product $z(1-\tau)$, whereas labor income for workers is invariant in z and τ. Hence, there will be a threshold $\tilde{z}$ such that individuals of type $\{z,\tau\}$ become workers if $z(1-\tau)<\tilde{z}$ and entrepreneurs otherwise.

The household also has to decide in which of the manufacturing sectors the managers will operate. Eq. (3) shows that the relative profits between sectors are independent from the manager type and are given only by relative prices. In equilibrium $p_1=p_2$, which implies that profits in the two sectors will be the same for all managers of type $\{z,\tau\}$.[12] Hence, the household is indifferent about which sector to send its entrepreneurs. In this situation, for every $\{z,\tau\}$ such that $z(1-\tau)>\tilde{z}$ the household sends a fraction $1\geq\alpha_1(z,\tau)\geq 0$ of individuals to sector 1 and a fraction $\alpha_2(z,\tau)=1-\alpha_1(z,\tau)$ to sector 2. While the choice of $\alpha_1(z,\tau)$ is undetermined when $p_1=p_2$, we will see that in equilibrium the first moment of this function over the joint distribution of z and τ is uniquely determined, and that higher order moments have no effects for aggregate allocations.

Therefore, at any point in time, the measure N of workers is given by

$$N=\int_{-1}^{1}\int_{0}^{\tilde{z}/(1-\tau)} g(z|\tau)\,dz\,g(\tau)\,d\tau$$

where $g(\tau)$ is the marginal density of τ and $g(z|\tau)$ is the density of z conditional on τ, and the non-capital income of the household is given by

$$I(\tilde{z},\alpha_1(z,\tau);w,r)=wN+\int_{-1}^{1}\int_{\tilde{z}/(1-\tau)}^{\infty}\sum_{i=1,2}[\pi_i(z,\tau)\alpha_i(z,\tau)]g(z|\tau)\,dz\,g(\tau)\,d\tau$$

3.5.2. The dynamic problem

The household maximizes the sum of discounted utilities $\sum_{t=0}^{\infty}\beta^t u(c_t)$ subject to the budget constraint and the law of motion for capital:

$$p_{c,t}c_t+p_{x,t}x_t=I(\tilde{z}_t,\alpha_{1,t}(z,\tau);w_t,r_t)+r_tK_t \tag{4}$$

$$K_{t+1}=(1-\delta)K_t+x_t \tag{5}$$

where c_t is the amount of final consumption good, x_t is the amount of final investment good, K_t is the stock of aggregate capital, $0<\beta<1$ is the discount factor, and $0<\delta<1$ is the depreciation rate. This yields the standard Euler equation:

$$u_c(c_t)=\beta u_c(c_{t+1})\frac{p_{x,t+1}/p_{x,t}}{p_{c,t+1}/p_{c,t}}\left[\frac{r_{t+1}}{p_{x,t+1}}+1-\delta\right] \tag{6}$$

3.6. Equilibrium

We are going to focus on the equilibrium in a steady state. All time periods are equal and all allocations and prices are time invariant. We set the final consumption good as the *numéraire* and hence normalize $p_{c,t}=1$. The exact definition of equilibrium can be found in Section A.3 in the online appendix. We restrict the function $\alpha_1(z,\tau)$ to be invariant in z and τ and hence finding the equilibrium allocation of managers entails finding a constant α. This is without loss of generality. To see

[11] Asturias et al. (2014) argue that the poor transportation infrastructure in India has substantial effects on the allocation of productive resources.

[12] A situation with $p_1\neq p_2$ cannot be an equilibrium. If $p_1>p_2$ all managers are allocated to sector 1, none into sector 2, and no production of the manufactured good 2 takes place. If $p_1<p_2$ the converse is true.

why, note that the aggregate output in each manufacturing sub-sector is given by

$$y_i = \int_{-1}^{1} \int_{\tilde{z}/(1-\tau)}^{\infty} y_i(z)\alpha_i(z,\tau)g(z|\tau)\,dz\,g(\tau)\,d\tau, \quad i=1,2 \tag{7}$$

Since the functions $y_i(z)$ are linear in z, Eq. (7) only places conditions on the total amount of managerial talent Z_1 and Z_2 allocated to each sector, that is to say, it places conditions on

$$Z_i \equiv \int_{-1}^{1} \int_{\tilde{z}/(1-\tau)}^{\infty} z\alpha_i(z,\tau)g(z|\tau)\,dz\,g(\tau)\,d\tau$$

Furthermore, the capital and labor market clearing conditions require

$$K = k_a + \int_{-1}^{1} \int_{\tilde{z}/(1-\tau)}^{\infty} \sum_{i=1,2} [k_i(z)\alpha_i(z,\tau)]g(z|\tau)\,dz\,g(\tau)\,d\tau \tag{8}$$

$$N = n_a + \int_{-1}^{1} \int_{\tilde{z}/(1-\tau)}^{\infty} \sum_{i=1,2} [n_i(z)\alpha_i(z,\tau)]g(z|\tau)\,dz\,g(\tau)\,d\tau \tag{9}$$

Since capital and labor demands in sectors 1 and 2 are also linear in z, Eqs. (8) and (9) only place constraints on the total amount of managerial talent Z_1 and Z_2 allocated to each sector. Therefore, any function $\alpha_1(z,\tau)$ that satisfies Eqs. (7) implies a different allocation of managers across sectors but generates the same aggregate allocations in equilibrium. Note that, while total talent allocated in each sector Z_i and average firm size $N/(1-N)$ are independent from $\alpha_1(z,\tau)$ and hence are determined in equilibrium, average talent and average firm size within each sub-sector are not independent of $\alpha_1(z,\tau)$, 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. Mimicking the SSRL, we set an upper bound $\overline{k}$ to the capital level that firms in the manufacturing sector 2 can use and leave unchanged the choice problem for the rest of sectors.

For the intermediate manufactured good 2, managers whose optimal demand of capital is below $\overline{k}$ will have factor demands, final output, and profits as in the unrestricted economy. However, since the unrestricted demand of capital is increasing in z, there will be a $\overline{z}$ such that managers with $z>\overline{z}$ will be constrained in their demand of capital and will employ only $\overline{k}$. Given the optimal demand of capital (see Eq. (1) this threshold $\overline{z}$ is given by

$$\overline{z} = \overline{k}[\nu\Theta p_2^{1/(1-\gamma)} w^{\gamma(\nu-1)/(1-\gamma)} r^{(-\gamma(\nu-1)-1)/(1-\gamma)}]^{-1} \tag{10}$$

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

$$n_2(z) = \left[\frac{p_2}{w} z^{1-\gamma}\gamma(1-\nu)\overline{k}^{\nu\gamma}\right]^{1/(1-(1-\nu)\gamma)} \tag{11}$$

This labor demand is increasing in z, although less than linearly. Hence, for $z>\overline{z}$ the capital-to-labor ratio will not be identical across managers as in the unrestricted model but decreasing in z. The output and profit functions $y_2(z)$ and $\pi_2(z,\tau)$ will also be linear in z until $\overline{z}$ and concave afterwards. Finally, note that as in the unrestricted problem, factor allocation and output do not depend on the distortion τ. See Section A.1 in the online appendix for details.

The occupational choice of the household members can be solved as follows. As in the unrestricted economy, the profit functions of both intermediate goods are increasing in z and in $(1-\tau)$, whereas wage earnings of workers are independent of both z and τ. Hence, for every different τ there will be a different threshold function $\tilde{z}(\tau)$ of managerial ability that separates workers from entrepreneurs such that individuals of type $\{z,\tau\}$ become workers if $z<\tilde{z}(\tau)$ and managers if $z>\tilde{z}(\tau)$. This function $\tilde{z}(\tau)$ will be increasing in τ because profits increase monotonically with z and decrease monotonically with τ.[13]

To allocate managers into sectors we distinguish three cases. First, if $p_1>p_2$ then all managers will go into sector 1. The reason is that for $z<\overline{z}$ the ratio of profits between sectors is given by the relative prices as in Eq. (3), and hence $\pi_1(z,\tau)>\pi_2(z,\tau)$. For $z>\overline{z}$ the ratio of profits will widen because π_1 grows linearly with z and π_2 grows at a less than linear rate. This situation is described in panel (a) of Fig. 1. Of course, this cannot be an equilibrium because there is no manager and hence no output in sector 2.

Second, if $p_1<p_2$, we will have an unambiguous partition of managers into each sector. Managers with $z<\overline{z}$ will go into sector 2: since these managers are unrestricted the ratio of profits is given by Eq. (3) and hence $\pi_1(z,\tau)<\pi_2(z,\tau)$. For managers with $z>\overline{z}$ profits in sector 2 increase less than linearly with z, while they still increase linearly with z in sector 1.

[13] See Section A.2 in the online appendix for the exact functional form of $\hat{z}$. In the unrestricted economy this function was simply $\tilde{z}/(1-\tau)$ because profits were linearly increasing in the product $z(1-\tau)$. In the restricted economy profits grow linearly on $z(1-\tau)$ only while $z<\overline{z}$ and less than linearly afterwards. Hence, $\tilde{z}(\tau)=\tilde{z}/(1-\tau)$ until $z<\overline{z}$, but not after that.

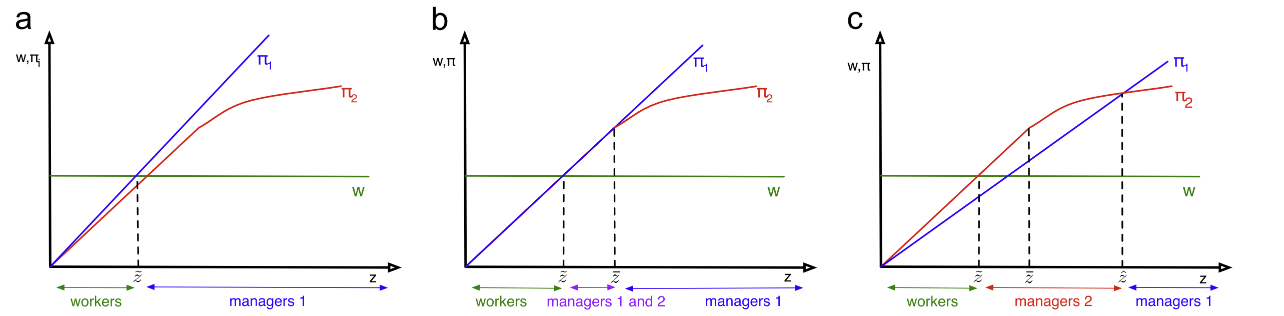

Fig. 1. Occupational choice in the restricted model. (a) $p_1 > p_2$, (b) $p_1 = p_2$ and (c) $p_1 < p_2$. *Note*: Each panel describes the occupational choice for individuals differing in managerial ability z and for a particular idiosyncratic distortion τ. Panels differ due to the relationship between the equilibrium prices of the two manufacturing sectors.

Eventually, as we increase z, the profit functions will cross at a $\hat{z} > \overline{z}$. Hence, managers with $z < \hat{z}$ go into sector 2 and managers with $z > \hat{z}$ go into sector 1.[14] This situation is described in panel (c) of Fig. 1.

Finally, if $p_1 = p_2$ we will have that the profit functions in both sectors are identical for $z < \overline{z}$ and hence the managerial choice is indeterminate in that range. For $z > \overline{z}$ we will have that $\pi_1(z,\tau) > \pi_2(z,\tau)$ and therefore managers will go into sector 1 (see panel (b) in Fig. 1).

4.1. Equilibrium

The equilibrium definition in the restricted economy is analogous to the one in the unrestricted economy, although with different optimality conditions in sector 2, different conditions for the occupational choice, and different market clearing conditions (see Section A.4 in the online appendix). Depending on the model parameters, two different types of equilibria will emerge. First, we may have an equilibrium characterized by $p_1 < p_2$. As discussed above, this equilibrium implies a unique allocation of managers to sectors: managers with $z > \hat{z}$ go to the unrestricted sector 1 while less talented managers go to the restricted sector 2. In this type of equilibrium the SSRL distort the allocation of productive factors and hence diminish the productivity of the overall economy. And second, we may have an equilibrium characterized by $p_1 = p_2$. In this situation, the allocation of managers to sectors is not completely determined. In particular, all managers with $z > \overline{z}$ are allocated to sector 1. But only an undetermined fraction $\alpha_1(z,\tau)$ of managers with $z \le \overline{z}$ are allocated to sector 1, whereas a fraction $\alpha_2(z,\tau) = 1 - \alpha_1(z,\tau)$ are allocated to sector 2. We call this equilibrium the *ineffectual restricted equilibrium* because the existence of an upper bound on capital accumulation in one sector does not change the aggregate allocations of the economy. In other words, the SSRL are irrelevant. 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.[15]

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

(a) *There is no manager with a binding capital demand.*
(b) *All aggregate allocations are as in the unrestricted economy.*

The intuition of the proof is quite simple: managers with $z < \overline{z}$ are not constrained, and in an *ineffectual restricted equilibrium* managers with $z > \overline{z}$ operate in sector 1 where they face no constraint either. Hence, there is nobody constrained in equilibrium and then capital and labor demands, 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 manufacturing sectors will be the same, and so will be the aggregate allocations of the economy.

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

Proposition 2 states that if some $\overline{k}_a$ generates an *ineffectual restricted equilibrium*, then any $\overline{k}_b > \overline{k}_a$ will also do. And equally important, small enough $\overline{k}$ do not lead to *ineffectual restricted equilibria*. The intuition is as follows. For an *ineffectual restricted equilibrium* to exist we need that the amount of managerial talent below $\overline{z}$ is large enough such that the same total Z_2 can be obtained as in the unrestricted economy by just changing $\alpha_1(z,\tau)$ without any change in prices. If $\overline{k}$ is small, then $\overline{z}$ is also small and hence the amount of talent available to allocate to sector 2 is smaller than the Z_2 of the unrestricted

[14] Note that $\hat{z}$ does not depend on τ because both π_1 and π_2 are linear in $(1-\tau)$. Also, note that the threshold $\hat{z}$ does not need to be above $\tilde{z}(\tau)$ for all τ. In particular, for high enough τ it will be the opposite, and we will have an occupational choice between workers and entrepreneurs in sector 1 only.

[15] See Section B in the online appendix for the proofs.

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* $\overline{k}_{min}$ *that defines the set* $\overline{\mathbf{k}}$ *increases with the relative size of the restricted sector within manufacturing.*

Proposition 3 states that the larger the relative size of the restricted sector, the less likely it is that a given bound $\overline{k}$ leads to an *ineffectual restricted equilibrium*, that is to say, the more likely it is that the distortion leads to output losses. The intuition is clear. When the restricted sector is large, the equilibrium of the unrestricted economy requires a large amount of managerial talent Z_2 allocated to sector 2. Then, a given restriction $\overline{k}$ will be too tight (leading to an effectively distorted equilibrium) if there is not enough managerial talent below $\overline{z}$ such that the least productive managers can be allocated to the restricted sector and operate without size restrictions to obtain the required aggregate Z_2.

5. Calibration

We calibrate our restricted economy to the year 2001, which is the year right before the process of dismantling the SSRL started. Since we solve our model in the Balanced Growth Path (BGP), we think of 2001 as a year in which the Indian economy is in a BGP. As we show in Section 5.1 below, the period 1988 to 2001 is not a bad approximation to this.[16] In Section 5.2 we describe the two firm-level data sets that we use, and the resulting descriptive statistics of the plant size distribution in India. In Section 5.3 we describe our calibration choices, and in Section 5.4 we assess the model fit to the data.

5.1. Macroeconomic aggregates

We want our model economy to have the same amount of aggregate capital and aggregate investment as the Indian economy, as well as the same weight of the manufacturing sector. In Fig. 2 we plot the time series between 1960 and 2001 for the ratio of gross investment to GDP (solid red line) and for the ratio of manufacturing value added to GDP (solid light blue line). We see that both series grow monotonically until the mid 1980s and then remain untrended until 2001. The stability of these two series during the period 1988–2001 is consistent with the BGP assumption. We hence take averages of macro ratios between 1988 and 2001, and obtain that the investment-to-output ratio is 24.3% and the share of manufacturing in total value added is 26.4%. We build the capital stock series by use of the perpetual inventory method, see Section C in the online appendix for details.

5.2. Plant-level data

A commonly used plant-level data set for India is the Annual Survey of Industries (ASI), which covers registered manufacturing plants. However, the set of registered plants is not the universe of manufacturing establishments in India: according to India's Factories Act of 1948, only establishments with more than 10 workers (20 if without power) are required to be registered. Hence, the ASI provides a severely truncated plant size distribution. This is a problem because, as we show below, plants under 10 employees account for 3/4 of manufacturing employment in India. To obtain data on smaller plants we use the National Sample Survey (NSS), which covers production units in the unorganized sector (plants with less than 10 workers or 20 workers if without power). Both data sets contain data on output, employment, worker compensation, capital stocks, use of intermediate inputs, some other relevant plant level data, and sampling weights. See Section D in the online appendix for details.

We use the sample weights to merge the two data sets and obtain a non-truncated distribution of plant sizes for the manufacturing sector in India. We find that the plant size distribution in India is characterized by a large incidence of self-employment—42.2% of plants are units with no employee in addition to the owner—and more generally, by a large share of employment in small plants. For instance, the average plant size is only 2.6 workers, and 95% of plants have 5 or less employees, accounting for 2/3 of total employment (see Table 1 and Fig. 3 for more details).[17]

5.3. Choosing parameter values and functional forms

Our calibration strategy is as follows. Once we choose the functional forms, our restricted economy is characterized by 14 parameters. We take 4 parameters from outside the model and calibrate the remaining 10 within the model. Of these 10, 2 can be set analytically, but the other 8 need to be calibrated in equilibrium by solving the model numerically. Table 2 summarizes the parameter values and Table 3 shows our targets and the performance of the model in terms of them. In the following subsections we detail the calibration process.

[16] While in the early 1990s there were substantial economic reforms (such as the end of the Raj licensing or the removal of interest rate subsidies to privileged sectors), Fig. 2 below shows that these policy changes do not seem to have been affected by the key macro ratios.

[17] The use of the ASI without the NSS would give an average plant size of 46 workers. See Section D in the online appendix for more details.

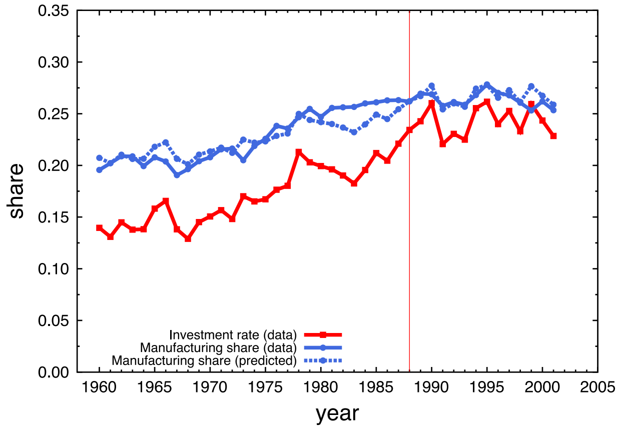

Fig. 2. Investment rate and manufacturing share. Note: Investment rate is *Domestic Gross Capital Formation* divided by *Gross Domestic Product*. Manufacturing share is *Value Added in Industry* (which comprises manufacturing, but also mining, construction, electricity, water and gas) divided by *Gross Domestic Product*. The data on *Gross Domestic Product* and *Value Added in Industry* comes from the World Development Indicators, while the data on *Domestic Gross Capital Formation* comes from the Reserve Bank of India. (For interpretation of the references to color in this figure caption, the reader is referred to the web version of this paper.)

Table 1
Plant size distribution.

Data vs Model	Mean	Percentiles					
(A) Mean and selected percentiles of the distribution of plants							
	Mean	P_{50}	P_{75}	P_{90}	P_{95}	P_{99}	$P_{99.9}$
Data	2.63	2	2	4	5	13	86
Model	2.65	2	2	3	5	13	59
(B) Share (%) of employment in plants of size up to							
	1	3	5	10	20	50	200
Data	16.2	55.5	67.7	77.2	82.1	86.1	91.2
Model	11.9	51.4	63.1	74.4	82.2	89.0	94.8

Notes: Data refers to the merged ASI and NSS data sets for 2001, see Section 5.2. Model refers to the benchmark restricted economy calibrated in Section 5.3.

Preferences and capital accumulation: We assume a log utility function for the representative household.[18] The discount factor β and the capital depreciation rate δ are calibrated to the capital-to-output ratio (2.15) and to the investment-to-output ratio (24.3%) respectively. See Section 5.1 for details.

Aggregators for final goods: We impose the aggregators of consumption and investment goods to be Cobb–Douglas, with manufacturing share parameters θ_c and θ_x respectively. The unit elasticity of substitution assumption is useful because it allows us to recover the share parameters from the observed time series evolution of the investment rate and the aggregate manufacturing share.[19] In particular, note that the value added share of manufacturing in total output can be written as

$$\frac{p_m(m_x+m_c)}{y}=\frac{p_m m_x}{p_x x}\frac{p_x x}{y}+\frac{p_m m_c}{p_c c}\frac{p_c c}{y}=\theta_x\frac{p_x x}{y}+\theta_c\left(1-\frac{p_x x}{y}\right)$$

We have time series data for the value added share of manufacturing and for the investment rate between 1960 and 2002. We run an OLS regression of the former against the latter and a constant term to obtain $\theta_x=0.71$ and $\theta_c=0.13$, which confirms that investment goods are much more intensive in manufactures. In Fig. 2 we plot the two time series (solid lines) plus the manufacturing share predicted by our estimated parameters (dashed line). We can observe an excellent fit. By construction, our regression strategy implies that the predicted series reproduces the 24.3% average of the manufacturing share between 1960 and 2002 and its correlation with the investment rate; but our predicted series also tracks the actual time series for the manufacturing share very well in all years, and it reproduces exactly the average manufacturing share of 26.4% in the calibration period 1988–2002.[20]

[18] Since we are comparing steady states the curvature of the utility function does not play any role.

[19] Admittedly, a unit elasticity is on the high side. Authors like Duarte and Restuccia (2010), Moro (2012) and Rogerson (2008) use an elasticity of substitution between manufactures and services equal to 0.4.

[20] Note that to obtain θ_x and θ_c we have departed from our strategy of using aggregate data only from 1988 to 2002. We do so because the trend movements of the investment rate and the manufacturing share outside the BGP are informative about the importance of manufacturing within investment goods. There is no inconsistency with the BGP in the model because the assumed unit elasticity of substitution implies that changes in relative prices outside the BGP do not affect shares of manufacturing within investment and consumption goods.

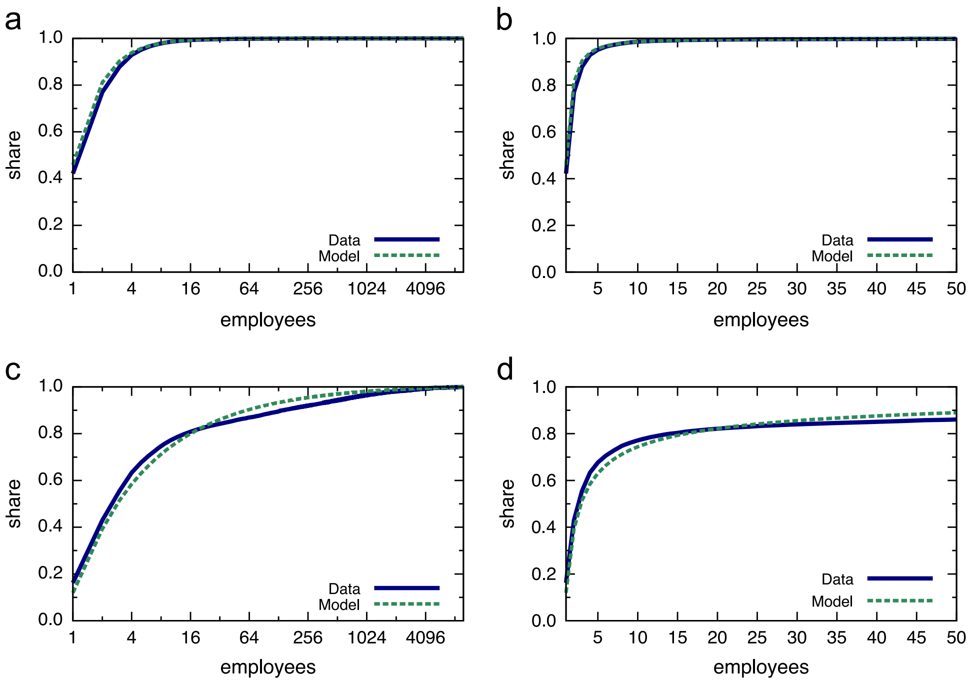

Fig. 3. Plant size distribution. *Notes*: Data refers to the merged ASI and NSS data sets for 2001, see Section 5.2. Model refers to the benchmark restricted economy calibrated in Section 5.3. Panels (a) and (c) are in log scale. (a) Distribution of plants, whole range, (b) distribution of plants, reduced range, (c) distribution of employment, whole range and (d) distribution of employment, reduced range.

Table 2
Parameter values.

Param.	Definition	Value	
		$\epsilon_{12}=3$	$\epsilon_{12}=5$
(A) Parameters off the shelves			
μ	Capital share in the agriculture and services sector	1/3	1/3
ρ	Elasticity parameter in final goods aggregator	0.0	0.0
ζ	Elasticity parameter in manufacturing aggregator	2/3	4/5
z_{min}	Scale parameter Pareto	1	1
(B) Parameters calibrated with the model			
β	Discount factor	0.99	0.99
δ	Depreciation rate	0.11	0.11
θ_c	Value added share of manufacturing in consumption goods	0.13	0.13
θ_x	Value added share of manufacturing in investment goods	0.71	0.71
ϕ	Employment share of restricted sector in manufacturing	0.37	0.43
ν	Elasticity of output to capital in manufacturing plants	0.30	0.30
γ	Span of control parameter	0.58	0.57
Φ_0	Shape parameter Pareto (1)	2.02	1.84
Φ_1	Shape parameter Pareto (2)	−0.69	−0.49
$\overline{k}$	Capital threshold	0.12	0.12

Notes: The first column refers to the benchmark economy with elasticity of substitution between the two manufacturing sub-sectors equal to 3. The second one refers to the exercise with higher elasticity of substitution, see Section 6.4.

Aggregators for manufactures: We impose the aggregator of manufactures to belong to the constant elasticity of substitution class:

$$y_m = F^m(y_1, y_2) = [(1-\phi)(y_1)^\zeta + \phi(y_2)^\zeta]^{1/\zeta} \quad \text{with } 0<\phi<1, \ \zeta<1 \tag{12}$$

The elasticity of substitution $\epsilon_{12} = 1/(1-\zeta)$ between the two types of manufactures is not easy to pin down. As we discuss in Section 2, the list of reserved goods seems rather arbitrary and, arguably, with reasonable substitutes not reserved for SSI. Furthermore, for many goods reservation takes place at the 6-digit level, and for the rest it goes up to 9-digit level. Both things together make us to think that manufactured goods in sectors 1 and 2 are rather good substitutes. Broda and Weinstein (2006) report estimates of the elasticity of substitution for 3, 5 and 10 digits of disaggregation. At the 5-digit level

Table 3
Calibration targets.

Param.	Statistic	Data	Model	
			$\epsilon_{12}=3$	$\epsilon_{12}=5$
β	Capital–output ratio	2.15	2.15	2.15
δ	Investment–output ratio (%)	24.3	24.3	24.3
θ_c	Average share manufacturing	26.4	26.4	26.4
θ_x	Correlation invest. and manuf. shares	0.92	0.92	0.92
ϕ	Employment share of restricted sector (%)	13.1	13.7	13.3
ν	Capital–output ratio in manufacturing	1.27	1.29	1.28
γ	Average plant size	2.63	2.65	2.70
Φ_0	Share of employment in plants with employees ≤ 20 (%)	81.3	81.2	81.5
Φ_1	Share of plants with 5 or less employees (%)	95.2	95.7	95.3
$\overline{k}$	Capital in SSI/total capital in manufacturing (%)	4.6	4.4	4.2

Notes: The first model column refers to the benchmark economy with elasticity of substitution between the two manufacturing sub-sectors equal to 3. The second one refers to the exercise with higher elasticity of substitution, see Section 6.4.

they find that the mean elasticity of substitution is around 6, once some outlier industries are dropped, and the median is 2.7. We make a conservative choice and pick an elasticity $\epsilon_{12}=3$ by setting $\zeta=2/3$. This value is the same used by Hsieh and Klenow (2009). In Section 6.4 below we re-calibrate again our economy by imposing a higher value for the elasticity of substitution and show that our results change little. Finally, we want to calibrate ϕ to reproduce the size of the restricted sector in the economy. This is hard to do as there is no centralized information on the value added share of these goods. According to the *Third Census of Small Scale Industries*, the employment in plants producing the 100 most important reserved goods is 13.1% of all employment in manufacturing in 2001. We hence choose ϕ to pin down the employment share of the manufacturing sub-sector 2 with respect to all manufacturing.

Technology in the agriculture and services sector: We use a Cobb–Douglas production function with the capital share parameter μ set to 1/3.

Technology in the production of the intermediates manufactured goods: We need to give values to the span-of-control parameter γ and to the capital share parameter ν. For the former we target the average establishment size in manufacturing, which in our data set gives 2.63 employees. For the latter we want to reproduce the capital intensity in manufacturing. In order to do so, we target the average ratio of capital to establishment value added in our merged plant-level data set, which turns out to be 1.27.

Distribution of talent and distortions: We want the joint distribution of talent and idiosyncratic distortions $G(z,\tau)$ to reproduce several statistics of the plant size distribution in India. Instead of parameterizing G we parameterize the marginal probability density function of the distortion $g(\tau)$, and the probability density function of talent conditional on the distortion $g(z|\tau)$. We choose a continuous uniform distribution in $[-1,1]$ for the former and a Pareto distribution for the latter. In particular,

$$g(z|\tau)=\frac{a(\tau)z_{min}^{a(\tau)}}{z^{a(\tau)+1}}$$

where $a(\tau)=\Phi_0+\Phi_1\tau$. This functional form for the Pareto shape parameter allows us to control both the distribution of talent and the sign and magnitude of the relationship between talent and distortions. With Φ_1 negative and large in absolute value, individuals with very low z have on average $\tau<0$ and are hence subsidized, finding profitable to become entrepreneurs. Yet their small z makes them choose a small plant size. Hence, negative Φ_1 helps account for the big mass of very small entrepreneurs that we find in our data. Accordingly, we choose Φ_1 to reproduce the share of plants with 5 or less employees, which is 95.2%. Then we use Φ_0 to reproduce the employment share of firms with more than 20 employees, which is 18.9%.

Restriction on capital accumulation: The restricted economy is characterized by a maximum capital $\overline{k}$ that plants in manufacturing sector 2 can use in production. In 2001 this upper bound was ₹10 million ($200,000 in 2001 dollars). To convert this value into model units we want the total amount of capital in manufacturing below this upper bound to be as in the data. In other words, we want the proportion of capital owned by SSI's in the model to be similar to the one we observe in the data. According to *United Bank of India*, the upper bound in capital for SSI's is defined in terms of “cumulative investment in plant and machinery (original cost)”. Our data sets contain this measure of capital. Such measure is given by *Value of plant and machinery owned by the establishment*. Using this notion, the proportion of capital in manufacturing employed by SSI's is 4.6%. So we set $\overline{k}$ such that the model reproduces a similar number.

5.4. Summary of calibration results

The model economy matches the calibration targets well (see Table 3), and it delivers a distorted equilibrium where the SSRL are binding. In particular, p_2 is 14% larger than p_1 (see Table 4). Under our calibration, for the SSRL to deliver an *ineffectual restricted equilibrium* with $p_2 = p_1$ the upper bound on capital $\overline{k}$ would need to be around 12 times larger than the one in 2001, which would amount to ₹120 million ($2,417,000 in 2002 dollars).

Fig. 3 shows the cumulative distribution of plant sizes (panels (a) and (b)) and the cumulative distribution of employment (panels (c) and (d)), both for the model and the actual data. Table 1 shows some selected statistics of both distributions. Overall, the model is consistent with the observed firm size distribution in India. It is important to understand how the model works to fit these data. Due to the large share of small plants in India, the standard Pareto assumption for the talent distribution would not be enough to replicate the firm size distribution. Making the Pareto shape parameter dependent on the idiosyncratic distortion is key. The calibrated parameters of the joint distribution of talent and distortions imply that the managerial talent of entrepreneurs with no distortion ($\tau = 0$) follows a Pareto distribution with shape parameter equal to 2.03. The shape parameter $\alpha(\tau)$ falls as the distortion τ increases, which reflects a positive correlation between entrepreneurial talent and distortions.[21] To have a sense of the order of magnitude of this positive correlation, the average distortion is -0.10 among the bottom 25% of the distribution of managerial ability, whereas it is 0.15 among the top 25%. The overall sum of the absolute value of these taxes/transfers is 6.4% of GDP. Finally, note that the supports of the talent distribution in sectors 1 and 2 do not overlap: less talented managers go to the restricted sector and more talented managers go to the unrestricted one. Together with the positive correlation between talent and taxes, this means that managers in the restricted sector enjoy large subsidies: in particular, managers in sector 2 receive transfers that account for 40% of their total profits. Instead, in the unrestricted sector there are some subsidized small businesses and some taxed large firms.[22] Overall, the average firm size is 1.5 in the restricted sector and 3.6 in the unrestricted one.

The calibrated span-of-control parameter γ is equal to 0.58, which is substantially smaller than the values around 0.8 obtained for the US economy.[23] This is 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. It is also consistent with poorer management practices in India, as argued by Bloom et al. (2013). More importantly, the lower γ in India is consistent with the average factor payments by manufacturing plants measured in our data.[24]

Finally, we do not have a measure of the value added share of the reserved sector within the economy for 2001. For calibration, we have used instead the employment share of reserved goods in manufacturing and the value added share of manufacturing in the economy. Our model delivers a value added share of the reserved sector in manufacturing equal to 13.7%—a number close to the 12.3% reported by Mohan (2002) for 1987—and equal to 3.7% in the overall economy (see Table 6).

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 on aggregate productivity and aggregate allocations. 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. Three channels of inefficiency

The misallocation of resources in the restricted economy comes from three different sources. First, in the economy without restrictions the optimal capital–labor ratio is the same for all managers z in both manufacturing sub-sectors. Instead, in the restricted economy the upper bound $\overline{k}$ implies that the capital–labor ratio will be declining with managerial ability z in the manufacturing sector 2 for $z > \overline{z}$. 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 4 we report the capital–labor ratio in each manufacturing sector. We find that in the restricted economy the capital–labor ratio is 0.24 in sector 2 and 0.84 in sector 1. Hence, the capital–labor ratio in the restricted sector is around one third of the one in the unrestricted sector. When we lift the constraints, the capital–labor ratio in both sectors is equalized. It increases 252% in sector 2 and 1.1% in sector 1.

Second, given the constraint in capital accumulation in sector 2, the overall demand for labor in this sector and hence the market wage rate are lower than under the free economy. Then the threshold $\tilde{z}(\tau)$ 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 (a) the mass of entrepreneurs will be inefficiently high, (b) their average

[21] At the extremes, entrepreneurs with the top level of taxes ($\tau = 1$) face a talent distribution with shape parameter equal to 1.33 and entrepreneurs with the top subsidy ($\tau = -1$) face a talent distribution with shape parameter equal to 2.72.

[22] The idiosyncratic distortions are important to reproduce the firm size distribution, but they do not determine the size of the restricted sector: if we remove them, the value added share of the restricted sector becomes 3.4% instead of 3.7%.

[23] See Atkeson and Kehoe (2005) and Guner et al. (2008) for estimates of γ in the US.

[24] In an economy without distortions, γ would give the sum of the labor and capital shares in manufacturing, whereas $1-\gamma$ would be the share of profits. In our model economy with distortions, the sum of the capital and labor shares in manufacturing equals 0.56. When we compute the sum of capital and labor share in our firm-level data set, we obtain a value of 0.47. This is certainly lower than the model-implied 0.56, but much better than what would obtain with a larger γ like the one in the US economy.

Table 4
Allocations of resources across sectors.

Model outcome	$\epsilon_{12}=3$ E_r (1)	$\epsilon_{12}=3$ E_f (2)	$\epsilon_{12}=3$ Δ (%) (3)	$\epsilon_{12}=5$ E_r (4)	$\epsilon_{12}=5$ E_f (5)	$\epsilon_{12}=5$ Δ (%) (6)
(A) Capital-to-labor ratio[a]						
Manufacturing 1	1.01	1.03	1.09	1.01	1.03	1.28
Manufacturing 2	0.29	1.03	252.88	0.29	1.03	260.09
Manufacturing All	0.92	1.03	12.01	0.92	1.03	11.96
Agriculture and services	1.02	1.03	1.08	1.02	1.03	1.28
Overall economy	1.00	1.03	2.86	1.00	1.03	3.01
(B) Entrepreneurs in manufacturing						
Fraction of entrepreneurs (%)	9.71	8.59	– 11.84	9.33	8.27	– 11.3
Average talent[b]	1.00	1.10	9.80	1.00	1.10	9.7
Average plant size	2.65	2.90	9.63	2.70	2.96	9.55
(C) Prices						
w	0.418	0.420	0.46	0.420	0.423	0.55
r	0.212	0.211	– 0.61	0.211	0.290	– 0.72
p_2/p_1	1.14	1.00	– 12.73	1.15	1.00	– 12.99
p_m/p_a	1.81	1.79	– 1.06	2.31	2.28	– 1.26
p_x/p_c	1.75	1.74	– 0.61	1.74	1.72	– 0.72

Notes: Columns (1)–(3) refer to the benchmark economy with elasticity of substitution between the two manufacturing subsectors equal to 3. Columns (4)–(6) refer to the exercise with higher elasticity of substitution, see 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.

[a] Capital labor ratios relative to the one for the overall economy in E_r.

[b] Average talent relative to average talent in manufacturing for the E_r economy.

productivity inefficiently low, and (c) the resulting average plant size also too low. Panel (B) in Table 4 reports the number of entrepreneurs in manufacturing relative to the total population in the model, $(1-N)$, the average talent of entrepreneurs, $(Z_1+Z_2)/(1-N)$, and the average plant size, $N/(1-N)$. First, we find that in the restricted economy a 9.71% of the population becomes a manager. When we lift the constraints we have that only 8.59% of the population are entrepreneurs, more than a 11% reduction. Second, the average talent in manufacturing is too low in the restricted economy: when we lift the constraint the increase in average talent is 9.6%. And third, in the restricted economy average plant size is 2.65 employees whereas the model predicts that in the free economy the average plant size would raise to 2.90 employees, a 9.6% increase.

Finally, the inefficient allocation of resources within manufacturing makes the price of manufactured goods relative to agriculture and services 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, as it is clear in the steady state version of Eq. (6), 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. In the last three rows of Panel (A) in Table 4 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 the capital-to-labor ratio of 12% in manufacturing, 1.1% in agriculture and services, and around 3% for the overall economy.

All these inefficiencies can also be seen in the equilibrium prices. In Panel (C) of 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, while the interest rate r, the price of the reserved goods relative to the non-reserved goods p_2/p_1, the price of manufactured goods relative to agriculture and services p_m/p_a, and the price of investment goods relative to consumption goods p_x/p_c are all too high.

6.2. Productivity

The misallocation of productive resources described above has important implications for aggregate 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 6.80%. This comes from a 123.32% increase in the reserved sector and a 9.74% 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 0.32% due to the capital increase. Altogether, output per worker in the economy increases by 1.97%. We find this to be a large number given that the size of the restricted sector is only 3.7% of the Indian economy.

Finally, we want to measure how much of the increase in output per worker that arises from lifting the SSRL comes from capital deepening and how much from better allocation of resources between sectors. To do so, we compute a measure

Table 5
Productivity.

Model outcome	$\epsilon_{12}=3$		$\epsilon_{12}=5$	
	E_r (1)	Δ (%) (2)	E_r (3)	Δ (%) (4)
(A) Output per worker				
Manufacturing 1	1.22	−9.74	1.33	−9.62
Manufacturing 2	0.49	123.32	0.53	125.38
Manufacturing all	0.64	6.80	0.66	6.87
Agriculture and services	0.60	0.32	0.60	0.38
Total output	0.61	1.97	0.62	2.03
(B) Total Factor Productivity				
Manufacturing all	0.68	2.00	0.69	2.13
Total output	0.66	0.75	0.67	0.79

Notes: Columns (1)–(2) refer to the benchmark exercise with elasticity of substitution between the two manufacturing subsectors equal to 3. Columns (3)–(4) refer to the exercise with higher elasticity of substitution, see 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.

of Total Factor Productivity (TFP) for the aggregate economy and for the manufacturing sector as it is typically done in development accounting exercises. 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 TFP in manufacturing is 2.00% larger in the free economy than in the restricted economy, while TFP for the overall economy is 0.75 larger. Hence, 38% of the increase in output per worker in manufacturing comes from the direct effect of allocating managerial talent across manufacturing sectors, while 62% comes from the increase in capital accumulation that arises as a consequence.

6.3. Aggregates

In Table 6 we report changes in aggregates (panel A) and in relative sizes of the different sectors (panel B). We report the changes at constant prices (second column) and at current prices (third column). We find that in real terms the SSRL imply a GDP loss of 1.97%, a consumption loss of 1.28%, and an investment loss of 4.14%. We also find that the share of the reserved goods in total manufacturing increases by more than 41% at constant prices when removing the SSRL. However, due to the relatively large elasticity of substitution between reserved and non-reserved goods, the total share of manufacturing in the economy would increase by only 1.64%.[26]

6.4. Robustness: the elasticity of substitution between manufactured goods

In the main exercise we have chosen an elasticity of substitution between reserved and non-reserved manufactured goods equal to 3. As discussed in Section 5.3, this is likely to be a lower bound. In this section, we impose the elasticity of substitution to be equal to 5 by choosing $\zeta = 4/5$ and we recalibrate the economy to the same targets as before (see the last columns in Tables 2 and 3).

Other things equal, the larger the elasticity of substitution between reserved and non-reserved goods, the less important the quantitative effects of the SSRL. If 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 relatively little cost. However, other things are not equal: the calibration for the more elastic economy yields a share parameter ϕ in the manufactures aggregator equal to 0.43 instead of 0.37, implying that the reserved sector is inferred to be more important in the more elastic economy. The reason for this is that if reserved goods are easier to substitute, the fact that they are bought in equilibrium of the distorted economy is that they are more important in the production function. 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.

As shown in Tables 5, the quantitative effects of the SSRL are slightly larger when measured with a more elastic economy. Lifting the constraints would imply an increase in output per worker in manufacturing of 6.80%, and in the whole economy of 2.03%; the TFP in manufacturing would increase by 2.13%, and in total output by 0.79%. Hence, the larger calibrated share parameter ϕ turns out to be more important than the larger elasticity.

[25] See Section E in the online appendix for details.

[26] The share of manufacturing within consumption and within investment does not change when measured at current prices because of the Cobb–Douglas aggregator. However, since investment goods are more intensive in manufactures than consumption goods, the increase in the investment rate of the economy increases the share of manufacturing in the economy at current prices by 0.86%.

Table 6
Aggregate allocations.

Model outcome	$\epsilon_{12}=3$			$\epsilon_{12}=5$		
	E_r (1)	Δ (%) (2)	Δ (%) (3)	E_r (4)	Δ (%) (5)	Δ (%) (6)
(A) Aggregates						
Total output	1.000	1.97	1.82	1.000	2.03	1.84
Investment	0.243	4.14	3.49	0.243	4.19	3.42
Consumption	0.757	1.28	1.28	0.757	1.34	1.33
(B) Output shares (%)						
Agriculture and services	72.9	−0.61	−0.32	72.9	−0.64	−0.30
Manufacturing	27.1	1.64	0.86	27.1	1.73	0.80
Reserved sector in manufacturing	13.7	41.34	25.96	13.3	77.50	58.07
Reserved sector in economy	3.7	43.66	27.03	3.6	80.58	59.34

Notes: Columns (1)–(3) refer to the benchmark exercise with elasticity of substitution between the two manufacturing subsectors equal to 3. Columns (4)–(6) refer to the exercise with higher elasticity of substitution, see 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.

6.5. Discussion

The model predicts an increase in average firm size of 10% if the SSRL were lifted, with associated output per capita gains of 2%. This relationship between increases in firm size and aggregate productivity gains is in the same order of magnitude as the one found by other studies of size-dependent policies. Guner et al. (2008) predict a loss of output per capita of 3.86% associated to a size distortion in capital accumulation that generates reductions in average firm size of 10%. Garicano et al. (2012) predict a 4.5% increase from lifting the labor market regulations in France, which is associated to an output gain of 0.82%. Braguinsky et al. (2011) impute the 60% fall in firm size in Portugal between 1986 and 2008 to labor market regulations. Their calibrated model quantifies the associated output per capita losses between 5% and 9%.

The gradual abolition of the SSRL started in 2002. Since then, a few papers have examined the micro-data to identify causal effects of the SSRL. Bollard et al. (2013) look for direct empirical evidence of productivity increases for plants producing reserved goods before and after the SSRL removal, but they do not find any significant effect. Instead, Martin et al. (2014) find that, while dereservation did not change firm size for incumbents, new entrants in the production of formerly reserved goods increased in size rapidly. In the same line of results, Tewari and Wilde (2013) find that dereservation is associated with firm exit from the formerly reserved goods, and with other firms operating in non-reserved sectors expanding their product base to produce formerly reserved goods. These results are consistent with one of the main mechanisms highlighted in our study: the self-selection of more skilled entrepreneurs away from the reserved sector, and the arrival of managerial talent to the production of reserved goods once the restrictions are lifted.[27]

Finally, regarding the macroeconomic implications of removing the SSRL, the model predicts increase in the share of manufactures and the investment rate, and fall in the prices of manufactured goods and investment goods. Due to the gradual process of de-reservation, it is hard to identify a single year to use as a start of the policy change. In particular, despite starting in 2002, the bulk of de-reservation happened between 2005 and 2008 (see Section 2 for details). When looking at the aggregate data (see Fig. C.1 in the online appendix), we find increases in the share of manufactures in GDP and the investment rate starting in 2002, after a long period of untrended series. Relative prices also decline as predicted, but only after 2005.

7. Conclusions

Our measurement of the effect of the Small Scale Reservation Laws (SSRL) in the Indian economy gives output per worker losses of 2% in the whole economy (6.8% in manufacturing) and TFP losses of 0.75% (2%). Given that the size of the restricted sector is small (4% of GDP, 14% of manufacturing) and that our measurement tool allows for mobility of entrepreneurs between sectors, we find these numbers quite high. 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 et al. (2008) and Restuccia and Rogerson (2008) more generally for broad classes of size dependent policies.

[27] These types of empirical results have to be taken with caution for several reasons. First, while the SSRL identify reserved goods at the 6-digit level (or more), the firm level data from ASI and NSS report the sector of activity of their plants only at a 5-digit level. Second, while the ASI data is available at an annual basis, the NSS data is available only every 5 years. This implies that information on small plants is scarce; in particular right now it is only available in 2005–2006 and 2010–2011. For this reason (and because in the NSS one cannot link establishments across time) the mentioned papers only use the ASI. And third, for most goods dereservation may still be too recent for large effects to appear.

The main reason for this difference is that our goal differs from the one of these previous papers. Hsieh and Klenow (2009) attempt to measure the effect of all possible distortions affecting the allocation of resources between plants. Instead, we identify a particular size-dependent policy and we measure its marginal effect. Of course, we do not think that the SSRL are the only benefits accruing to small plants. In Section 2 we have discussed a wide battery of measures, and some of them may be captured in reduced form by our idiosyncratic distortion τ. So in this respect, our results can be seen as complementary to the ones by Hsieh and Klenow (2009).

Our measurement of the effect of the SSRL 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 SSRL 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. The SSRL, by lowering the economy TFP, may delay and slow down this process and hence have larger effects on output per worker. Bhattacharya et al. (2013) argue that the incentives to invest in human capital may also be distorted by size-dependent policies as would-be managers anticipate lower returns to their accumulated knowledge. Finally, as argued by Ranasinghe (2013), and Restuccia and Rogerson (2013), idiosyncratic firm distortions may produce larger effects on output per worker and on measured TFP in models of endogenous technology adoption.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jmoneco.2014.04.017.

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