Macroeconomic Implications of Restrictions on Size *

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Abstract

In this paper we develop a model economy suitable to address government policies that restrict the size of establishments. The economy studied is a two-sector generalization of the span-of-control model of Lucas (1978). In the model, production requires a managerial input, and individuals sort themselves into managers and workers. Since managers are heterogeneous in terms of their ability, establishments of different sizes coexist in equilibrium in each sector. We then study government policies that aim to change the size distribution of establishments in a given sector. Quantitatively, how costly are policies that distort the size of production units? What is the impact of these policies on productivity and size distribution of establishments? We find that these effects can potentially be large. Our findings are of relevance in light of a wide array of government policies across countries that either imposes size restrictions on large establishments, or promote small ones, either at the economy-wide level or at the sectorial level.

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1 Introduction

Policies that affect differently establishments and firms of different sizes are pervasive at the cross-country level. Different countries either restrict the size of large production units, or subsidize small production ones, or both. In some developing countries such policies take extreme forms. In India, for instance, in the late 1980s about 800 product groups were reserved for small scale firms, i.e. these goods could not be produced by large firms. Furthermore, these reserved product lines constituted about half of all product lines in some sectors, such as light engineering — see Little, Mazumdar, and Page (1987) for a detailed description of such policies in India. A perhaps more common practice, however, is differential tax treatment of firms of different sizes, as governments often find taxing larger firms an easier task than taxing small enterprises — see Gollin (1995) for a study of such differential tax treatment in Ghana.

These policies are by no means restricted to developing countries. Several rich countries, for example, have policies that regulate the size and operation of establishments in the retail sector. While countries like South Korea, the U.K., and Japan have explicit restrictions on larger establishments in retailing, France and Germany have regulations on location and operating hours in this sector – see Baily (1993) and Baily and Solow (2001). Japan is, in particular, concurrently unique among developed countries as it regulates heavily and at the national level the *size* of retail shops. These regulations have been in place for long time, and are still rather strict despite recent reforms. Given their prominence, we describe these regulations in detail below.

There is a number of observations that make the study of these policies of special relevance. First, several authors document large differences in Total Factor Productivity (TFP) across countries. It is natural to surmise that policy distortions contribute a great deal to measured differences. Nicoletti and Scarpetta (2003) find that product market regulation (measured by indicators such as the extent of state control, barriers to entrepreneurship, barriers to trade and investment, etc.) and Total Factor Productivity growth are strongly and negatively correlated for a set of OECD countries. Recent work has built models that link policy distortions to TFP differences; Schmitz (2001), Bergoeing, Kehoe, and Soto (2002), Parente and Prescott (2000) and Restuccia and Rogerson (2003) are examples.

Second, the fact that the retail sector is distorted in several countries might be of importance. There is evidence of substantial productivity growth in the service sector, and in the retail sector in particular. According to Basu, Fernald, Oulton, and Srinivasan (2003), the productivity growth in wholesale and retail trade between 1995 and 2000 was the second highest among all sectors in the U.S., second only to information technology producing sectors. Third, policies that affect the *size* of establishments are likely to be costly, as large establishments account for a disproportionate fraction of output and employment. This is generally the case across different sectors, and true in special for the retail sector. Some figures are stark: we calculate from the 1997 US Economic Census that retail establishments with 100 workers or more, constituted 2.4% of the total number of establishments in the sector, but accounted for about 32% of total employment.

Finally, as is discussed in a number of studies, the regulated retail sector in Japan is special in a number of ways. First, the number of stores per-person is rather high. Flath (2003) reports that there are about 11.2 stores per 1000 population in Japan, while the same number is 6.1 in US. Second, small retail establishments in Japan contribute disproportionately to employment in the retail sector. According to McKinsey Global Institute (2000) share of traditional mom-and-pop stores in total hours worked in retailing is about 55% in Japan and 19% in the U.S.[1] Finally, these studies point out that productivity in the sector is smaller than in the United States and other sectors of the Japanese economy. McKinsey Global Institute (2000) documents that output per-worker in merchandise retailing in Japan was about half of the level in the U.S in 2000 at common prices. In comparison, aggregate output per-worker in Japan was about 70% of the US in 2000.

In this paper we develop a simple framework to evaluate restrictions to the size of establishment at the sectorial level. The model economy is a two-sector generalization of Lucas (1978). There is a single representative household in the economy, which is inhabited by individuals that are heterogenous in terms of their endowment of sector-specific manage-

[1] More generally, the whole size distribution of the retail sector in Japan differs dramatically from the one in the US. For instance, we calculate from Japanese census data that establishments with 100 employees or more constituted less than 1% of total establishments, and accounted for 12% of total employment in the sector in 2001.

rial skills. As a result of the underlying heterogeneity, individuals sort themselves between managers and workers in each sector. Furthermore, since those who become managers are heterogeneous in terms of their skills, establishments of different sizes coexist in equilibrium in each sector. We parameterize and calibrate the model to reproduce observations of the United States, which we take as a relatively distortion-free economy for the purposes of this paper. We subsequently introduce distortions on the size of establishments in one of the sectors, which we calibrate to the US retail sector. We then ask: Quantitatively, how costly are policies that distort the size of production units? What is the impact of these policies on productivity? How do these policies affect the size distribution of establishments?

We find that policies that restrict the size of establishments in one of the sectors can generate nontrivial effects. In our calculations, output per worker in the distorted sector can decline by up to 8%, and average establishment size in the distorted sector can decline by up to 30%. Furthermore, the policies we consider generate sizeable increases in the number of establishments in the distorted sector (up to 42.5%). This finding is a simple and strong implication of our framework, and is qualitatively consistent with observations from the Japanese case. Finally, even when the distorted sector in our calculations is relatively small (about 11% of total output in the absence of distortions), we find that the welfare cost of restrictions on size can be up to 1%. This leads us to conclude that policies of this sort are potentially very costly.

The paper is organized as follows. Section 2 describes in some detail the regulations of the retail sector in Japan. Section 3 introduces the model economy we investigate. Section 4 discusses our choice of parameter values. Section 5 presents the findings from our experiments. Finally, section 6 concludes.

2 Regulations on Size in Japan: The Case of the Retail Sector

Japan offers a unique and rather old case of protection of small retail shops. Owners of these shops constitute a strong pressure group, and as a result there exists national legislation that has aimed directly in the past, and indirectly in its present form, to protect and benefit

them.
The origins of the regulations of large retail stores goes back to 1937, with the first "Department Store Law" enacted in reaction to complaints from small shop owners due to the expansion of large department stores. This law was eliminated in 1947 under the American administration, but was brought back under the same name in 1956. This law estipulated a special procedure in order to get a license for the expansion of existing retail businesses, or the opening of new ones, beyond 1,500 square meters.
The 1956 law applied to department stores, and thus other retail formats such as supermarkets, discount stores, etc., were not covered. As a result, the subsequent growth of these stores constituted a source of complaints for the retail lobby. Furthermore, the law focused on retail *businesses* of the department store category. This opened up a loophole under which large department stores were divided into separate business entities within the same building, each of them not exceeding 1500 sq. mts (Larke (1994)). The complaints that this generated led to a major revision of the law, which took place in 1974. The new legislation, called Large Scale Retail Store Law, now focused on retail *stores*, closing thereby the loophole just described, and its scope was extended to include retail formats other than traditional department stores. The legislation specified an application process to get a license for retail stores above 3,000 sq. mts. in big cities, and 1,500 sq. mts. everywhere else.[2]
In 1979 the law was reformed. The reform expanded severely the scope of the regulations under pressure of the retail lobby. It created two types of stores subject to restrictions, a model that continued until recently. Type-1 stores were those larger than 1,500 sq. mts (3,000 sq. meters in large cities), while Type-2 stores covered a group of a substantially small size: between 500 sq. meters 1,500 sq. meters. Applications for stores of Type-1 were made to the Ministry of Trade and Industry (MITI), while applications for Type-2 were dealt at the local (prefectural) level.
The implementation of the law was altered in 1982, as the MITI introduced changes pertaining to stores of the first type. First, it provided local governments authority to restrict the

[2] An application had to specify at a minimum the proposed floor space, opening date, hours of operation, and the number of days in which the store would be closed during a year. See Ito (1992) for details. By the early nineties, the implementation of the law also set specified upper limits regarding closing times (7PM), and a minimum number of annual closed days (44).

opening of new stores in certain regions. Second, it created a new stage in the application process. This stage called for a concensus of interested parties, including those potentially affected by the opening (small, traditional stores). Notably, without concensus the whole process cold not begin. The natural strategy of affected parties was not to provide concensus, as Larke (1994), pp. 112, explains. As a result, most of the successful proposals for new stores in the 1980's took several years to complete.

By the mid-eighties, as a result of the law and the norms issued by the MITI governing its implementation, the process of obtaining approval for a new store at the Type 1 level was a long and costly one. It required a minimum of seven different stages, and a maximum of 16. The first stage was a critical one, the local concensus stage, which could force the abandonment of the plans altogether. At many of these stages, the plans for the proposed new store could be stopped, or business plans could be forced to change by those negatively affected. It is worth noting that, most likely due to the increased severity and complexity of the regulations, the number of applications of the first type fell from about 399 in 1974 to about 157 in 1986; for Type-2 stores, the number of application fell from 1029 in 1979 to about 369 in 1986.[3] To put these figures in perspective, it is worth emphasizing that the size of the Japanese population is of about 120 million, and that the Japanese economy grew at an annualized rate of about 3.6% from 1974 to 1985.[4]

In 1992 the law was significantly relaxed for the first time. The most important change was the simplification of the application process, with the elimination of the first (concensus) stage, and a maximum of a year for the whole application process. Still, nonetheless, the lobby of small retailers retained a critical influence in the application process. Other changes included the increase in the lower limit for type 1 stores to 3000 sq. mts (6,000 sq. mts in big cities).

In 2000, the Large Scale Retail Location Law replaced the previous one. The new law requires the approval for stores larger than 1000 sq. meters, while the parties affected by the opening a new store are still a critical part of the application process. The new legislation differs from the old one in two dimensions. First, all decisions are taken at the local level.

[3]Source: Larke (1994).

[4]McCraw and O'Brien (1986) make a similar point.

Second, the protection of small retail is no longer an explicit objective of the legislation. The decision criteria now takes into account environmental factors (noise, congestion, etc.). It can be argued that the new legislation is even more restrictive than before. First, the limit on size now kicks in at 1,000 square meters. Second, as McKinsey-Global-Institute (2000) discusses, local governments are unlikely to see net benefits from a more competitive retail environment; these receive only a small share of their revenues from taxation of businesses as their operations are mostly financed from transfers from the Federal government.

3 A Two Sector Model

We now describe a simple aggregative model with two production sectors and an endogenously determined size distribution of plants or establishments in each sector. The model is an extension of the Lucas (1978) span-of-control framework to multiple sectors. We first present the model economy without any distortion on size. We then proceed to put restrictions on size in one of the sectors.

The economy is inhabited by a single representative household. The household is comprised by a continuum of members of unit measure, who value two consumption goods, 1 and 2. The household is infinitely lived and maximizes

$$\sum_{t=0}^{\infty} \beta^t U(C_{1,t}, C_{2,t}), \tag{1}$$

where $\beta \in (0,1)$ and $C_{1,t}$ and $C_{2,t}$ denote the total household consumption of each good respectively. The function $U(.,.)$ is continuous, strictly increasing in both arguments and differentiable. Moreover, $U_1(., C_2)$ and $U_2(C_1, .)$ are strictly decreasing.

Endowments A fraction α of household members is of type 1 and a fraction $1-\alpha$ is of type 2. A household member of type $i = 1, 2$ is endowed with z_i units of managerial ability. These efficiency units are distributed with support in $[0, \bar{z}]$ with cdf $F_i(z_i)$ and density $f_i(z_i)$. Being of type 1 implies that the household member can be a worker in any sector, or a manager in sector 1, with incomes that we describe below. Similarly, a household member of type 2 can be a worker in any sector, or a manager in sector 2.

Production Production of each good takes place respectively in sectors 1 and 2. Sector 1 produces a good that is both a consumption and an investment good (good 1). Sector 2 produces a consumption good (good 2). We use, from now on, good 1 as the numeraire.
A manager in sector 1 has access to the technology

$$y_1 = A_1 z_1^{1-\gamma_1+\psi}(g(k,n))^{\gamma_1},$$

where $g(.,.)$ is a concave, differentiable, constant returns to scale function, $0 < \gamma_1 < 1$ and $\psi \geq 0$. Thus, production requires a managerial input (z_1), capital (k), and labor (n). The manager maximizes profits taking input prices as given and obtains $\pi_1(z, w, R)$, which is the solution to

$$\max_{n,k} \left[A_1 z_1^{1-\gamma_1+\psi}(g(k,n))^{\gamma_1} - wn - Rk \right],$$

where w and R are the rental prices for labor and capital services respectively. In similar fashion, a manager in sector 2 has access to

$$y_2 = A_2 z_2^{1-\gamma_2+\psi}(g(k,n))^{\gamma_2}.$$

The manager maximizes profits and obtains $\pi_2(z, w, R, p)$, which is the solution to

$$\max_{n,k} \left[pA_2 z_2^{1-\gamma_2+\psi}(g(k,n))^{\gamma_2} - wn - Rk \right],$$

where p is the relative price of good 2 in terms of good 1.

The Household Problem The problem of the household is to choose sequences of consumption goods 1 and 2, the fractions of household members of each type who work as managers or workers, and the amount of capital to carry over to the next period.
If a household member becomes a worker, his/her efficiency units are transformed into 1 unit of labor and his/her income is then given by w. If instead he/she becomes a manager, his/her contribution to household's income is given by $\pi_1(z, w, R)$ or $\pi_2(z, w, R, p)$. Note that if both

sectors are active, there exist unique thresholds $\hat{z}_1$ and $\hat{z}_2$ such that those individuals with efficiency units below the thresholds become workers, and those with efficiency units above the thresholds become managers. This follows from the fact that the functions $\pi_1(., w, R)$ and $\pi_2(., w, R, p)$ are strictly increasing and convex functions of the first argument under diminishing returns to capital and labor jointly.

Formally the household problem is to select $\{C_{1,t}, C_{2,t}, K_{t+1}, \hat{z}_{1,t}, \hat{z}_{2,t}\}_0^\infty$ to maximize (1) subject to

$$C_{1,t} + p_t C_{2,t} + K_{t+1} = I_t(\hat{z}_{1,t}, \hat{z}_{2,t}, w_t, R_t, p_t) + R_t K_t + K_t(1 - \delta),$$

and

$$K_0 > 0.$$

The income from managerial and labor services, $I_t(\hat{z}_{1,t}, \hat{z}_{2,t}, w_t, R_t, p_t)$, is given by

$$w_t[\alpha F_1(\hat{z}_{1,t}) + (1-\alpha) F_2(\hat{z}_{2,t})] + \alpha \int_{\hat{z}_{1,t}}^{\bar{z}} \pi_1(z, w_t, R_t) f_1(z) dz + (1-\alpha) \int_{\hat{z}_{2,t}}^{\bar{z}} \pi_2(z, w_t, R_t, p_t) f_2(z) dz.$$

Let λ_t denote the Lagrange multiplier associated to the household's budget constraint. The solution to the household problem is then characterized by

$$\lambda_t = \beta \lambda_{t+1}(1 + R_{t+1} - \delta), \tag{2}$$

$$U_2(C_{1,t}, C_{2,t})/U_1(C_{1,t}, C_{2,t}) = p_t, \tag{3}$$

$$w_t = \pi_1(\hat{z}_{1,t}, w_t, R_t), \tag{4}$$

and

$$w_t = \pi_2(\hat{z}_{2,t}, w_t, R_t, p_t). \tag{5}$$

Condition (2) is the standard Euler equation for capital accumulation. Condition (3) simply states that the marginal rate of substitution between both consumption goods must equal its relative price at all t. Condition (4) states that the household member of type 1 with marginal ability $\hat{z}_{1,t}$ at t must receive the same compensation as a manager than as a worker (e.g. be indifferent). The last condition (5) is the equivalent one for a household member of type 2 and managerial ability $\hat{z}_{2,t}$. These indifference conditions defining occupational choice of household members are represented in Figure 1.

[Insert Figure 1 here]

Equilibrium In equilibrium, the markets for capital and labor services, as well as the markets for both goods must clear. Let $n_1(z_1, w, R)$ and $k_1(z_1, w, R)$ be the demands for capital and labor services of a manager of ability z_1 in sector 1. Similarly, let $n_2(z_2, w, R, p)$ and $k_2(z_2, w, R, p)$ be the demands for capital and labor services of a manager of ability z_2 in sector 2. Market clearing in the inputs markets requires

$$N_t^* = \alpha \int_{\hat{z}_{1,t}^*}^{\bar{z}} n_1(z, w_t^*, R_t^*) f_1(z) dz + (1-\alpha) \int_{\hat{z}_{2,t}^*}^{\bar{z}} n_2(z, w_t^*, R_t^*, p_t^*) f_2(z) dz, \tag{6}$$

where an $(*)$ over a variable denotes its equilibrium value, and N_t^*, aggregate labor supply at t, is given by

$$N_t^* \equiv \alpha F_1(\hat{z}_{1,t}^*) + (1-\alpha) F_2(\hat{z}_{2,t}^*).$$

Market clearing in the market for capital services requires:

$$K_t^* = \alpha \int_{\hat{z}_{1,t}^*}^{\bar{z}} k_1(z, w_t^*, R_t^*) f_1(z) dz + (1-\alpha) \int_{\hat{z}_{2,t}^*}^{\bar{z}} k_2(z, w_t^*, R_t^*, p_t^*) f_2(z) dz. \tag{7}$$

Let $y_{1,t}(z_1, w_t, R_t)$ and $y_{1,t}(z_2, w_t, R_t, p_t)$ denote the supply of goods of 1 and 2 by managers with abilities z_1 and z_2 respectively. Then, market clearing for goods 1 and 2 requires:

$$\alpha \int_{\hat{z}^*_{1,t}}^{\bar{z}} y_1(z, w^*_t, R^*_t) f_1(z) dz = C^*_{1,t} + K^*_{t+1} - K^*_t + \delta K^*_t. \tag{8}$$

and,

$$(1-\alpha) \int_{\hat{z}^*_{2,t}}^{\bar{z}} y_2(z, w^*_t, R^*_t, p^*_t) f_2(z) dz = C^*_{2,t}. \tag{9}$$

It is possible then to define a competitive equilibrium. A competitive equilibrium are sequences $\{C^*_{1,t}, C^*_{2,t}, K^*_{t+1}, \hat{z}^*_{1,t}, \hat{z}^*_{2,t}, w^*_t, R^*_t, p^*_t\}_0^\infty$, such that (i) given $\{w^*_t, R^*_t, p^*_t\}_0^\infty$, the sequences $\{C^*_{1,t}, C^*_{2,t}, K^*_{t+1}, \hat{z}^*_{1,t}, \hat{z}^*_{2,t}\}_0^\infty$ solve the household problem; (ii) The markets for capital and labor services clear for all t (equations (6) and (7) hold); (iii) The markets for goods 1 and 2 clear for all t (equations (8) and (9) hold).

Discussion A couple of implications of the framework are important to note at this point. First, since individuals of both types face the same wage rate as workers, the size of the smallest and average establishment can differ significantly across sectors. They depend critically on the parameters governing span-of-control and returns to managerial ability; γ_i and ψ.

Second, even if the smallest establishments in each sector differ, both sectors can have in equilibrium a positive mass of relatively large establishments. This model feature is key for our application of the model to the questions at hand. In the data, large establishments coexist with small ones in all sectors. Restrictions affecting size will tend to affect most severely potentially large establishments (that is, those run by the most able managers). Thus, to account for large establishments is important to reproduce features of the data and to assess the potential effects of policies on size.

3.1 Restrictions on Size

Our representation of restrictions on size is meant to capture government policies which aim to affect the size of establishments via implicit taxes on input use. The central idea is that if an establishment wants to expand the use of an input beyond a given level, it faces a marginal cost of using the input in question that is larger than its price.

We focus on restriction imposed on the use of capital in sector 2. We posit that the total cost associated to capital use beyond a pre-determined level $\underline{k}$ is given by

$$R\underline{k} + R(1+\tau)(k-\underline{k}),$$

for some $\tau \in (0,1)$. If $k \leq \underline{k}$, then the total cost of capital use is just Rk. Note that this resembles a progressive tax, in which there are two implicit marginal tax rates, 0 and τ. If $k > \underline{k}$, the production unit pays $R\underline{k}$ for the first $\underline{k}$ units used, plus an amount that is proportional to the difference between k and $\underline{k}$.

Our modeling of restrictions implies that the total cost associated to capital use is continuous in k. As a result, the function $\pi_2(.)$ summarizing managerial rents, and establishment's demand functions for capital and labor are continuous. Profit maximization dictates that there are potentially three types of establishments in sector 2. Unconstrained ones are small establishments that choose $k(z, w, R, p; \underline{k}, \tau) \leq \underline{k}$. Thus, for these establishments the marginal product of capital equals the rental rate R. On the other extreme, are those whose managers have relatively high levels of z, and thus choose $k(z, w, R, p; \underline{k}, \tau) > \underline{k}$. For these units, the marginal product of capital is *higher* than the rental rate. Finally, there is an intermediate group of establishments for which the marginal product of capital is undefined. For these, $k(z, w, R, p; \underline{k}, \tau) = \underline{k}$. Since the demand for capital services is continuous and increasing in managerial ability, this ordering is mapped into levels of managerial ability. Hence, there exist thresholds z_2^- and z_2^+ so that: (i) unconstrained establishments are those with $z \in [\hat{z}_2, z_2^-)$; (ii) establishments in the intermediate group are those for which $z \in [z_2^-, z_2^+]$; (iii) the largest establishments have $z > z_2^+$.

It is important to note here that an implication of the model *without* distortions is that all establishments choose the same capital to labor ratio, regardless of their size. The reason for this is the assumption of constant returns to scale in the function $g(k, n)$, and the fact that all of them face the same prices for capital and labor services. With distortions on size, this is no longer true. It can be shown that under these circumstances, the capital labor ratio is a weakly decreasing function of managerial ability, as Figure 2 illustrates.

[Insert Figure 2 here]

We now briefly describe the modified household problem under restrictions on size. Resources taxed via restrictions on size are returned to the representative household in a lump-sum form. Formally, the household's budget constraint now equals

$$C_{1,t} + p_t C_{2,t} + K_{t+1} = I_t(\hat{z}_{1,t}, \hat{z}_{2,t}, w_t, R_t, p_t; \underline{k}, \tau) + R_t K_t + K_t(1-\delta) + X_t,$$

where X_t stands for lump-sum transfers which are taken as given by the household. In equilibrium, they equal

$$X_t^* = (1-\alpha)\tau R_t^* \int_{z_{2,t}^{+*}}^{\bar{z}} (k_2(z,.) - \underline{k}) f_2(z) dz.$$

4 Parameter Values

We now choose parameter values in order to compute solutions to our model, which we do by selecting most of them so as to match a number of critical observations in steady state. To this end, we use data pertaining to the United States, which we take as a relatively distortion-free economy for the purposes of this paper.

As a first step in this process, we choose a model period of a year. Second, we define sector 2 as the Retail sector as defined in the National Income and Product Accounts (NIPA); sector 1 constitutes the rest of the economy, excluding the government sector. Based on these choices, parameter values are selected as follows.

Preferences We assume that the utility function takes the form

$$U(C_1, C_2) = \log[H(C_1, C_2)],$$

where H is a C.E.S. aggregator, defined as

$$H \equiv [\theta C_1^\rho + (1-\theta) C_2^\rho]^{1/\rho}, \qquad \rho \in (-\infty, 1)$$

In our benchmark case, we report results for the $\rho = 0$ (unitary elasticity of substitution), and later explore the implications of $\rho = -1/3$ (elasticity of substitution equal to 0.75). We treat the parameter θ as an unknown, and choose its value so as to match the observed ratio of value added in the retail sector as a fraction of aggregate output, net of the government sector. This magnitude averaged about 11.0% for the period 1990-2000.[5]

Finally, we set the discount factor β equal to 0.94. This implies a rate of return on capital equal to 6.4% on an annual basis.

Technology We assume that the function $g(.,.)$ is the same in both sectors, and takes the Cobb Douglas form

$$g(k, n) = k^{\nu} n^{1-\nu}.$$

We then need to provide values for ν, the degrees of return to scale in both sectors, γ_1 and γ_2, as well as the parameter ψ defining returns to managerial ability. To pindown these unknown parameters, we add four observations that the model is forced to match: the mean establishment size in the non-retail sector, the mean establishment size in the retail sector, the fraction of workers in the labor force, and the aggregate capital to output ratio.

For the first two targets, we use the 1997 US Economic Census and calculate that the mean establishment size in the non-retail sector is of about 17.8 employees, while the corresponding mean value in the retail sector is of about 14.0 employees. Regarding the fraction of workers in the labor force, we target a value of 95%. We note that to pindown who is a worker and who is manager in actual data is difficult, and so we take this value as a compromise. From census data, it is possible to calculate a lower bound on the fraction of workers, as about 85.7 % of the labor force performed non-managerial tasks in 2001.[6] Chang (2000), using PSID data, calculates an even lower value for the fraction of workers (84%). On the other extreme, a more literal interpretation of the model economy, which we prefer, suggests that each establishment is run by one manager. This consideration dictates a lower bound on

[5]Source: Economic Report of the President (2002), Table B-12. We use a 20% government to output ratio to calculate the ratio of value added to output we report.

[6]Source: Statistical Abstract of the US (2002), Table 588. This results from considering individuals under the occupation category "Executive, Administrative and Managerial".

the fraction of managers, which is obtained by dividing the number of active establishments in 1997 by the size of the work force in that year. This calculation leads to a fraction of workers in the population of about 96%.
In order to target a capital to output ratio, we must adopt first a notion of the capital stock. In the absence of an explicit government sector, we choose to exclude government-owned capital from this notion. Following the methodology outlined in Cooley and Prescott (1995), the relevant capital-output ratio for our purposes is of about 2.89.[7] From this procedure, we calculate a depreciation rate of 8.1%.

Endowments We assume that the distributions of potential managerial ability are log-normal and equal across sectors, so that $\log(z_i) \sim N(0, \sigma)$, $i = 1, 2$. In order to pindown σ and α, the fraction of individuals who have potential managerial abilities in sector 1, we add two observations relevant to the questions at hand. These are the dispersion in establishment size (in terms of workers), as measured by the coefficient of variation for both sectors. In the data, the distribution of establishment size is highly dispersed in both sectors, while both sectors display similar dispersion statistics. From the 1997 US Economic Census, we calculate that in the non-retail sector the coefficient of variation equaled 1.63, while in the retail sector the value for this statistic was 1.57.[8]

Summary There are in total seven parameters that we choose in order to reproduce observations. These are $\theta, \gamma_1, \gamma_2, \nu, \sigma, \alpha$ and ψ. Table 1 summarizes our choices. Table 2 lists the set of observations that constitute our targets, and shows the performance of the model in terms of them. The model has no problem in reproducing these targets, as the table demonstrates.

[7] The notion of capital includes capital equipment and structures, residential capital, inventories, consumer durables and land. See Ventura (1999) for details.

[8] The high levels of dispersion in establishment size are hard not to emphasize. To put them in perspective, we note that this distribution is much more disperse than the distribution of labor earnings in the US, which has a coefficient of variation of about 0.7. See Haider (2001) for instance.

Table 1: Parameter Values

Parameter	Value
β	0.94
δ	0.081
γ_1	0.852
γ_2	0.827
σ	2.125
ν	0.48
θ	0.857
ψ	0.050
α	0.872

Table 2: Targets

Statistic	Data	Model
Mean Size Sector 1	17.8	17.9
Mean Size Sector 2	14.0	14.0
Coeff. Variation Sector 1	1.63	1.60
Coeff. Variation Sector 2	1.57	1.57
Fraction Workers	0.95	0.95
Value Added Sector 2 (% GDP)	0.11	0.11
Capital Output Ratio	2.89	2.83

5 Findings

We now conduct experiments to quantitatively evaluate the impact of restrictions on size. We proceed by comparing steady states of our model economy with steady states of the model economy under different size restrictions. We report results for restrictions at two levels. In the first case, $\underline{k}$ equals average capital use in sector 2 in the steady state without restrictions. In the second case, distortions are more severe, and $\underline{k}$ is equal to two thirds of average capital in sector 2 in the steady state without restrictions. In both cases, we report results for a relatively low value of the implicit tax rate ($\tau = .20$), and for a relatively high value ($\tau = .50$).

Aggregates and Productivity Table 3 summarizes the main findings for aggregate variables. Output in the distorted sector drops by 3.8% to 8.3%; the magnitude in the fall depends on the interplay between the location of the distortion in the size distribution, and the increase in the magnitude of the implicit tax rate, τ. As τ increases, affected establishments either set their demand for capital services at $\underline{k}$, or demand capital services from a new, higher price $R(1+\tau)$. This process leads to a reduction in the total demand for capital services of the sector, a reduction in the capital to labor ratio in distorted establishments, and a reduction in the overall supply of the good produced by the distorted sector. In equilibrium, the relative price of good 2 increases, which is accompanied by an increase in the number of small establishments as Table 3 shows. It is worth emphasizing the phenomenon that total output of the distorted sector decreases, despite the emergence of new, small establishments; this reflects the fact that large (distorted) ones account for a disproportionate share of the total supply of the good in question.

Table 3: Aggregate and Productivity Effects

Statistic	$\tau = 0$	$\tau = 0.2$	$\tau = 0.5$
$\underline{k}$ = Mean Capital			
Aggr. Output	100	99.9	99.8
Aggr. Output (*)	100	99.5	99.0
Output Sector 2	100	96.2	93.0
Output Per-Worker Sector 2	100	96.1	92.9
TFP Sector 2	100	98.2	95.2
Number Establishments Sector 2	100	116.4	135.6
$\underline{k}$ = (2/3) Mean Capital			
Aggr. Output	100	99.9	99.8
Aggr. Output (*)	100	99.4	98.8
Output Sector 2	100	95.6	91.7
Output Per-Worker Sector 2	100	95.5	91.4
TFP Sector 2	100	98.1	94.9
Number Establishments Sector 2	100	120.6	142.5

(∗): At benchmark (undistorted) prices.

We note that the increase in the number of small establishments is a simple and natural implication of our framework; this is qualitatively consistent with the observations pertaining to the Japanese retail sector discussed earlier. Quantitatively, the increase in the number of small establishments is substantial, ranging from 16.4% to 42.5%.

The size distortions have a direct and negative impact on productivity measures. We report in Table 3 two of them. The first one is simply output per-worker (non-managers) in the sector. The second one, labeled as TFP, is an approximation to a notion of Total Factor Productivity in an economy of this type. It is equal to

$$\mathrm{TFP} = \frac{Y_2}{(N_2 + Z_2)^{1-\nu\gamma_2} {K_2}^{\nu\gamma_2}},$$

where N_2 and K_2 stand for labor and capital employed in the sector respectively, and Z_2 stands out for the total amount of managerial input used in the sector. Both notions of productivity drop as restrictions are introduced. The drop in output per-worker ranges from 3.9% to 8.6%, while the drop in TFP ranges from 1.8% to 5.1%. It is critical to understand why the drop in productivity occurs. We focus now in detail on the case of output per worker, as this is a statistic usually computed in productivity studies. To gain intuition, consider first a one-sector economy, with parameter φ defining returns to scale. In this case, it is easy to show that physical output per-worker equals

$$\frac{w}{(1-\nu)\varphi},$$

independently of the presence of restrictions on size as we modeled them. Thus, why does output per-worker drop as restrictions are introduced? The reason is simply that in a two-sector case, physical output per-worker (y_2/n_2) in any establishment equals[9]

$$\frac{w}{p(1-\nu)\gamma_2}.$$

[9] To calculate output per-worker, we first calculate the optimal demands for inputs for each establishment, and then obtain the respective supply function, $y_2(z, w, R, p)$. We then obtain physical output per-worker as $y_2(z, w, R, p)/n(z, w, R, p)$.

Therefore, as the relative price increases, output per worker drops. We note that this simple calculation has important implications for measurement. Two economies, one distorted and one distortion-free, under equal wage rates, will have the same output per-worker if output is measured at distorted prices (py_2/n_2), as this measure is equal to

$$\frac{w}{(1-\nu)\gamma_2}.$$

Thus, the drop in output per-worker measured in physical units that we report is equivalent to a drop in output per-worker, when output is measured at undistorted prices.

Size Distribution Effects Table 4 shows key statistics related to the effects of restrictions on the size distribution of establishments, and shows that they have rather substantial consequences on it. Mean establishment size under restrictions ranges from 11.9 to 9.6, while it is about 14.0 in the undistorted case. In contrast, the size of the median establishment moves in the opposite direction. This occurs in spite of the appearence of small establishments at the bottom of the distribution. The expansion of undistorted establishments in response to the increase in the relative price accounts for this.

Dispersion in size, measured by the coefficient of variation, drops as Table 4 indicates. It is worth mentioning that several forces influence the dispersion in the size distribution. On the one hand, everything else constant, the emergence of new, small establishments tend to increase dispersion. On the other hand, the reduction in the size of distorted establishments contribute to reduce dispersion, while the increase in size of undistorted ones has an uncertain effect. Overall, the effects that lead to a reduction in dispersion dominate, as the results show.

It is worth mentioning the effects that restrictions have upon the mass of establishments at or above $\underline{k}$, the level where these restrictions kick-in. In the first place, note that the restrictions create a sizeable mass of establishments concentrated at $\underline{k}$; the mass of establishments at this level jumps from theoretical level of zero in the undistorted case, to values ranging from 10.8 to 26.4. Both the contraction of some distorted establishments, which now demand capital services at $\underline{k}$, and the expansion of previously undistorted ones account for this phenomenon. Second, the relatively severe increase in the implicit tax rate from 20% to 50% does *not* change significantly the overall mass of distorted establishments. It is worth emphasizing that this phenomenon can lead to an erroneous conclusion, such as that an increase in the severity of the restrictions does not matter. To see this, notice that the increase in the implicit tax rate leads to a significant decrease in the number of establishments strictly above $\underline{k}$. Quantitatively, when τ increases, this magnitude drops from 13.8% to 6.7% when $\underline{k}$ is equal to average capital sector 2 without distortions, and from 20.7% to 10.8% when $\underline{k}$ is equal to two thirds of average capital.

Table 4: Effects on Size Distribution

Statistic	$\tau = 0$	$\tau = 0.2$	$\tau = 0.5$
$\underline{k}$ = Mean Capital			
Mean Size Sector 1	17.94	17.91	17.88
Mean Size Sector 2	13.93	11.90	10.29
Coeff. Variation Sector 1	1.60	1.60	1.60
Coeff. Variation Sector 2	1.57	1.40	1.11
Median Size Sector 2	5.96	6.20	6.32
% Distorted ($k \geq \underline{k}$)	23.3	24.6	25.5
% Distorted ($k > \underline{k}$)	23.3	13.8	6.7
$\underline{k}$ = (2/3) Mean Capital			
Mean Size Sector 1	17.94	17.93	17.89
Mean Size Sector 2	13.93	11.60	9.76
Coeff. Variation Sector 1	1.60	1.60	1.60
Coeff. Variation Sector 2	1.57	1.47	1.23
Median Size Sector 2	5.96	6.24	6.48
% Distorted ($k \geq \underline{k}$)	33.9	35.7	37.2
% Distorted ($k > \underline{k}$)	33.9	20.7	10.8

Welfare We now look at the welfare costs associated with the policies we investigate. We calculate the welfare cost associated to these policies as the percentage increase in both goods that is necessary in order to make the representative household indifferent between two steady states. That is, we find the value of Δ that solves

$$V^* = U(C_{1d}(1+\Delta), C_{2d}(1+\Delta))\ (1-\beta)^{-1},$$

where V^* is the discounted utility level in the undistorted steady state, and C_{1d} and C_{2d} are the consumption of good 1 and good 2 in the steady state with distortions. Table 5 shows that welfare costs associated with these policies can be significant; they range in our exercises from 0.4% to 1%. The relatively large decline in the consumption of good 2 reported previously is responsible for such high welfare costs.

How large are the distortions we impose on our model economy? Surprisingly, they are rather small. First, note from Table 1 that consumption of good 2 has a share of only about 15% in total utility. Second, in our experiments only about 24% to 37% of the establishments in sector 2 are affected by size restrictions, and only about 14% to 11% of the establishments effectively pay the implicit tax on capital services. Finally, the establishments that pay this tax, only pay a penalty on the amount of capital they rent above the threshold level, $\underline{k}$. Indeed, one can calculate in this economy the total value of tax payments as a percentage of total payments for capital services in sector 2. This calculation gives an average tax rate on payments to capital in sector 2 equals

$$\frac{\tau \int_{z_2^+}^{\overline{z}} (k_2(z, w, R, p) - \underline{k}) f_2(z) dz}{\int_{\hat{z}_2}^{\overline{z}} k_2(z, w, R, p) f_2(z) dz}.$$

In our experiments this average tax rate turns out to be relatively small. It ranges from 5.66% when $\tau = 0.2$ and $\underline{k}$ is equal to mean level of capital used in sector 2, to 9.75% when $\tau = 0.5$ and $\underline{k}$ is two thirds of the mean level of capital used in sector 2. To account for the significant welfare effects in Table 5, note while the average tax rates applied on sector 2 are low, the implicit tax rate τ affects the decisions at the margin of large establishments. These establishments account for the bulk of output in the sector: in the undistorted economy, establishments above the median size are responsible for about 86.4% of total output of sector 2, while establishments above the mean account for 69.1%. Therefore, if instead we place the average tax rate of 9.75%, the highest average tax rate in our experiments, on *all* establishments, the welfare cost would be about 0.25%. That is, only about half the smallest welfare cost reported in Table 5!

An alternative way to assess how costly restrictions are, is to ask: What would it take in a well known framework, the one sector growth model, to get welfare costs of the magnitude reported in Table 5 ? Suppose that the capital share is 0.36, utility is logarithmic, and the discount factor and depreciation rates are the same as in Table 1. Then, a tax rate on net capital income of about 7-8 % is required to generate a welfare cost of 1%.

Table 5: Welfare Costs

(% increase in consumption)

Distortion Location	$\tau = 0.2$	$\tau = 0.5$
$\underline{k}$ = Mean Capital	0.37	0.78
$\underline{k}$ = (2/3) Mean Capital	0.42	0.96

The role of the elasticity of substitution In our benchmark economy we assumed a unitary elasticity of substitution between two consumption goods and set $\rho = 0$. In this section we revisit the effects of restrictions on size when two goods are less substitutable. In the absence of empirical estimates of this elasticity, we restrict our attention to a value of it less than one (0.75); there are a number of reasons to suspect that the degree of substitution in preferences between retail and non-retail consumption goods is low. We follow the same procedure we used before to select the parameters: we set $\beta = 0.94$ and $\delta = 0.081$, and then choose the remaining seven of parameters (γ_1, γ_2, σ, ψ, ν, θ, and α), so as to match the same seven targets in Table 2.[10]

In Table 6 we report the effects of restrictions on size when $\underline{k}$ equals the average capital use in sector 2 without any size restrictions (the results when $\underline{k}$ is at 2/3 of the average capital use are similar). The basic picture that emerges from Table 6 (compared to Tables 3 and 4) is that a lower elasticity of substitution magnifies the consequences on the variables of interest, albeit slightly. Output per worker declines by 4.1% (instead of 3.9%) when $\tau = 0.2$, and by 7.4% (instead of 7.1%) when $\tau = 0.5$. The number of establishments in sector 2 increases by 18.7% (instead of 16.5%) when $\tau = 0.2$, and by 37.3% (instead of 35.6%) when

[10]The values are now $\gamma_1 = 0.853$, $\gamma_2 = 0.828$, $\sigma = 2.11$, $\nu = 0.485$, $\theta = 0.912$, $\psi = 0.05$ and $\alpha = 0.872$.

$\tau = 0.5$. Similarly, the decline in the average establishment size in sector 2 is slightly higher. From these results, we conclude that a moderate reduction in the elasticity of substitution between the goods, when the rest of the parameters are adjusted to reproduce observations, does not change the quantitative findings we reported previously in a significant way.

Table 6: Effects with $\rho = -1/3$

($\underline{k}$= Mean Capital)

Statistic	$\tau = 0$	$\tau = 0.2$	$\tau = 0.5$
Aggr. Output	100	99.9	99.8
Aggr. Output (*)	100	99.4	98.9
Output Sector 2	100	97.0	94.3
Output Per-Worker Sector 2	100	95.9	92.6
TFP Sector 2	100	98.3	95.5
Number Establishments Sector 2	100	118.7	137.3
Mean Size Sector 2	13.88	11.78	10.26
Coeff. Variation Sector 2	1.57	1.40	1.11
Median Size Sector 2	5.95	6.13	6.31
% Distorted ($k \geq \underline{k}$)	23.2	24.5	25.6
% Distorted ($k > \underline{k}$)	23.2	13.6	6.6

($*$): At benchmark (undistorted) prices

When the elasticity of substitution between two goods is low, size restrictions have a larger effect on the relative price of good 2. When $\underline{k}$ is at the average level of capital use in an economy without any restrictions on size and $\rho = 0$, the relative price of good 2 rises by 4.1% with $\tau = 0.2$, and by 7.7% with $\tau = 0.5$. The corresponding numbers when $\rho = -1/3$ are 4.3% and 8.3%, respectively. A larger price increase leads to a larger decline in output per worker in sector 2. It also causes a larger increase in the number of small establishments, by making the production of the second sector more attractive for small establishments. Not surprisingly, we also get slightly larger welfare effects as Table 7 demonstrates.

Table 7: Welfare Costs with $\rho = -1/3$

(% increase in consumption)

Distortion Location	$\tau = 0.2$	$\tau = 0.5$
$\underline{k}$= Mean Capital	0.42 (0.37)	0.88 (0.78)
$\underline{k}$= (2/3) Mean Capital	0.48 (0.42)	1.02 (0.96)

6 Conclusion

In this paper we analyze government policies that target establishments of different sizes. To this end, we develop a two-sector model economy in which agents differ in terms of their sector-specific skills, and sort themselves into managers and workers. We interpret these two sectors as the retail and the remaining sectors, and calibrate our benchmark economy to be consistent with observations from the U.S. economy. We then consider policies that increase factor prices for larger establishments in the retail sector.

We find that these policies can have potentially large effects. Our simulations show that such policies reduce output per worker in the distorted sector, while leading to a significant increase in the number small establishments. We view these results as consistent with observations on Japanese retail sector — a sector with strict size regulations. Our simulations also show that these policies can generate significant welfare losses. The presence of large establishments which accounts, both in the model and in the data, for a disproportionate large fraction of output in each sector, plays a key role in these results.

We take the simple model of this paper as a stepping stone for future work. Two issues we have abstracted from that will be worth investigating in the future are the interplay between technical progress and restrictions on size, and the role of these restrictions on the intersectoral allocation of managerial talent.

References

Baily, M. N. (1993). Competition, Regulation, and Efficiency in Service Industries. *Brookings Papers on Economic Activity*, *1993*, 71–159.

Baily, M. N., & Solow, R. M. (2001). International Productivity Comparisons Built from the Firm Level. *Journal of Economic Perspectives*, *15*, 151–172.

Basu, M., Fernald, J., Oulton, N., & Srinivasan, S. (2003). The Case of Missing Productivity Growth: Or, Does Information Technology Explain Why Productivity Accelerated in the United States But Not in the United Kingdom. NBER Working Paper 10010.

Bergoeing, R., Kehoe, P., & Soto, R. (2002). A Decade Lost and Found: Mexico and Chile in the 80's. *Review of Economic Dynamics*, *5*, 166–205.

Chang, Y. (2000). Wages, Business Cycles and Comparative Advantage. *Journal of Monetary Economics*, *46*, 143–171.

Cooley, T. F., & Prescott, E. C. (1995). Economic Growth and Business Cycles. In Cooley, T. F. (Ed.), *Frontiers of Business Cycle Research*, chap. 1. Princeton University Press, Princeton.

Flath, D. (2003). Regulation, Distribution Efficiency, and Retail Trade. NBER Working Paper 9450.

Gollin, D. (1995). Do Taxes on Large Firms Impede Growth? Evidence from Ghana. Economic Development Center, University of Minnesota.

Haider, S. (2001). Earnings Instability and Earnings Inequality of Males in the United States: 1967-1991. *Journal of Labor Economics*, *19*(4), 799–836.

Ito, T. (1992). *The Japanese Economy*. MIT Press, Cambridge.

Larke, R. (1994). *Japanese Retailing*. Routledge, London and New York.

Little, I., Mazumdar, D., & Page, J. M. (1987). *Small Manufacturing Enterprises: A Comparative Analysis of India and Other Economies*. Oxford University Press for the World Bank.

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

McCraw, T., & O'Brien, P. (1986). Production and Distribution: Competition Policy and Industry Structure. In McCraw, T. (Ed.), *America vs Japan*. Harvard Business School Press.

McKinsey-Global-Institute (2000). *Why the Japanese Economy is not Growing: Microbarriers to Productivity Growth*. McKinsey Global Institute.

Nicoletti, G., & Scarpetta, S. (2003). Regulation, Productivity and Growth: OECD Evidence. OECD Economics Department Working Paper 226.

Parente, S., & Prescott, E. (2000). *Barriers to Riches*. Cambridge: MIT Press.

Restuccia, D., & Rogerson, R. (2003). Policy Distortions and Aggregate Productivity with Heterogeneous Plants. Mimeo, University of Toronto.

Schmitz, J. (2001). Government Production of Investment Goods and Aggregate Labor Productivity. *Journal of Monetary Economics*, *47*, 163–87.

Ventura, G. (1999). Flat Tax Reform: A Quantitative Exploration. *Journal of Economic Dynamics and Control*, *23*, 1425–1458.

Figure 1--- Occupational Choice

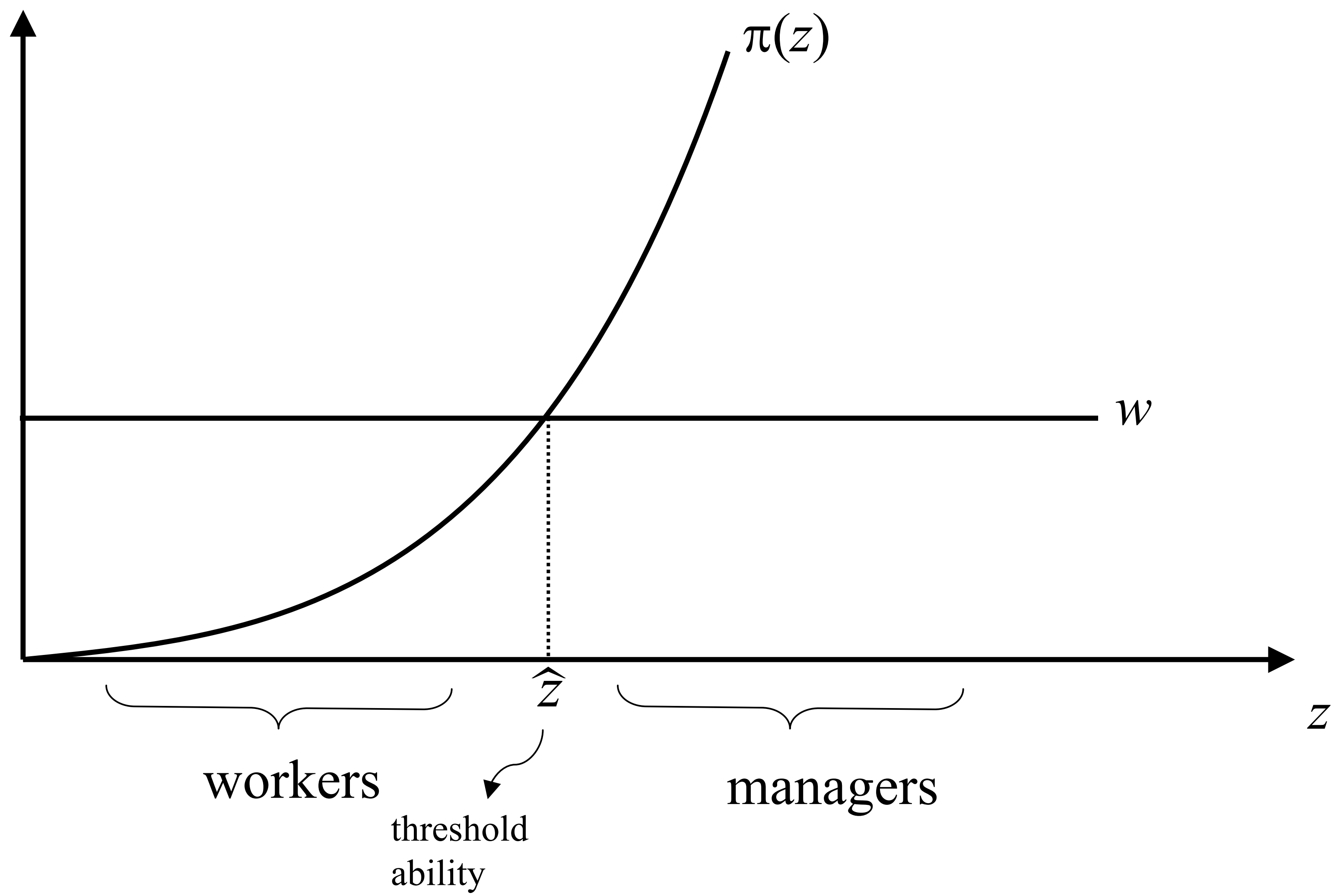

Figure 2 --- The Effects of Restrictions on Size