Macroeconomic Implications of Size Dependent Policies*

Nezih Guner, Gustavo Ventura and Xu Yi†

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Abstract

Government policies that impose restrictions on the size of large establishments, or promote small ones, are widespread across countries. In this paper, we develop a simple framework to systematically study policies of this class. The economies we study are versions of the span-of-control model of Lucas (1978). 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. We parameterize the economies so that they are consistent with central properties of the data. Then, we ask: quantitatively, how costly are policies that distort the size of production units? What is the impact of these policies on productivity measures, the equilibrium number of establishments and their size distribution? We find that these effects are potentially large.

KEYWORDS: Size Distortions, Firm Size, Cross-Country Productivity Differences.

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†Dept. of Economics, The Pennsylvania State University. Corresponding author: Nezih Guner. Address: 619 Kern, University Park, State College, PA 16802-3306. E-mail: nguner@psu.edu

1 Introduction

The size of an establishment or a firm is often critically affected by different government policies. Several countries implement policies that either restrict the operations of large production units, or subsidize small ones, or try to do both. These policies are widespread across countries and emerge in several forms.

In some countries such policies can be extreme. In India, for instance, several products are reserved for small scale firms; simply put, these goods *cannot* be produced by large firms. The number of reserved products is not negligible, either. As of the late 1980s, production of these reserved items accounted for about 13% of total manufacturing output in India.[1] A perhaps more common practice in many developing countries is the differential enforcement of taxes and other regulatory policies, as governments often find taxing or regulating larger firms an easier task. These policies are by no means restricted to developing countries. Almost all countries, poor and rich, provide an array of subsidies to small and medium size enterprises. Labor market regulations in many OECD countries, like dismissal rules, bind only after a certain size. Finally, a number of rich countries, France, Japan, Germany and the U.K., implement policies that regulate the size and operation of establishments in the retail sector. In particular, Japan and France are unique among developed countries as they regulate heavily and at the national level the size of retail shops. Overall, in light of the prominence of size dependent policies in developing and industrialized economies, we document them in greater detail below.

In this paper we develop a simple framework to systematically evaluate distortions that depend on establishment or firm size. Our analysis is based on versions of the well-known Lucas (1978) model. There is a single representative household, which is inhabited by individuals that are heterogenous in terms of their endowment of managerial skills. Production requires three inputs: capital, labor and managerial services. As a result of the underlying heterogeneity, individuals sort themselves between managers and workers. Furthermore, since those who become managers are heterogeneous in terms of their skills, establishments of different sizes coexist in equilibrium. 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 analyze two different set of policies: those that restrict production of large establishments and those that encourage production by small ones. We also extend our framework to a two sector model, and introduce distortions on

[1] The Indian reservation policy remained essentially unchanged after the economic reforms of the early 1990's. See section 2.

the size of establishments in one of the sectors. We interpret one of the sector as the retail sector, with the other one being the rest of the economy, and calibrate it to the US retail sector. In each case, we 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?

Two sets of observations make the study of size-dependent policies of special interest. First, the size distribution of establishments differs significantly across countries and available evidence points to the role of policy differences.[2] The contrast between the size distribution of manufacturing plants in developing and industrial countries is dramatic – Tybout (2000). In developing countries the size distribution of establishments show a concentration of employment in small and large establishments with a missing middle group. This stands in contrast to the case of industrialized countries in which the share of total employment rises with size.[3] Rauch (1991) argues that such a missing middle can result from regulations or taxes that are only enforced among large firms. Firms are either small and avoid regulation or large enough to operate under regulation.[4]

Even among countries of comparable levels of development, size distributions differ sharply. Differences among the U.S., the E.U. and Japan are striking: small and medium size enterprises plays a significant role in Japan, but are much less significant in the U.S. with the E.U. being somewhere in the middle — European-Commission (1996). Surprisingly, the differences within the E.U. are also large. While small enterprises account for the bulk of employment in Italy, larger establishments play a more important role in other countries, like Sweden and the U.K.[5] Davis and Henrekson (1999) and Henrekson and Johansson (1999) argue that economic policy environment plays a key role in the prevalence of large establishments in Sweden. They point out, among other things, the role of labor regulations that affect all establishments in Sweden but only the larger ones in other countries, like Italy.

Furthermore, even countries that have similar size distribution for the economy as a whole can show significant differences in particular sectors. France and U.K. have quite

[2]Although we focus on the role of policy differences in this paper, there are obviously several factors that contribute to the cross country differences in size distribution, and these factors go well beyond the differences in government policies – see Kumar, Rajan, and Zingales (1999) for a recent review.

[3] Plants with 1 to 9, 10 to 49, and more than 50 workers accounted for 3.9%, 15.2%, and 81% of the total employment in manufacturing in the U.S. in 1992. The same numbers were 42%, 20%, and 38% in India in 1971, 58%, 11% and 31% in Thailand in 1978, and 52%, 13%, and 35% in Colombia in 1973 — Tybout (2000).

[4]See also de Soto (1989).

[5]Enterprises with 1 to 9 and more than 250 workers accounted for 45.8% and 21.5% of employment in Italy in 1991, while the same numbers were 29.2% and 44.5% in Sweden in 1992, and 15.4 and 50.2% in U.K. in 1993 — European-Commission (1996).

similar size distribution of employment for the whole economy.[6] In the retail, hotel, and catering sector, however, small enterprises play a much larger role in France than in the U.K.[7] Similarly, in Japan the number of retail establishments per-capita is rather high, and small retail establishments in Japan contribute disproportionately to employment in the retail sector. Flath (2003) reports that there are about 11.2 stores per 1000 population in Japan, while the same number is 6.1 in U.S. Second, small retail establishments in Japan contribute disproportionately to employment in the retail sector. According to McKinsey-Global-Institute (2000), the share of traditional mom-and-pop stores in total hours worked in retailing is about 55% in Japan and 19% in the U.S. Likewise, while retail establishments with more than 100 workers accounted for 32% of employment in the sector in the United States in 1997, they accounted for just 12% of retail employment in Japan in 2001.

The second observation that makes these policy differences of special interest are the large differences in Total Factor Productivity (TFP) across countries; see Klenow and Rodriguez-Claire (1997) and Hall and Jones (1999) for instance. It is natural to surmise that policy distortions contribute a great deal to measured differences. For example, 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. Policies that affect the *size* of establishments are likely to be costly, as large establishments account for a disproportionate fraction of output and employment. In the case of the United States, a relatively undistorted economy, establishments with more than 100 workers correspond to 2.6% of the total number of establishments but account for 44.9% of total employment.[8]

In this regard, the fact that size in the retail sector is restricted in several countries might be of importance. First, the experience of the heavily regulated Japanese retail sector is particularly illustrative. 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. Second, 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

[6] The share of employment in enterprises with 1 to 9, 10 to 49, 50 to 249 and more than 250 workers were 17.8%, 21%, 17.5% and 43.6% in France in 1992 and 15.4%, 18.0%, 16.4%, and 50.2% in UK in 1993.

[7] Small enterprises with less than 50 workers account for about 61% of employment in this sector. The same number in the U.K. is only about 42%.

[8] Source: U.S. Economic Census (1997).

the second highest among all sectors in the U.S., second only to information technology producing sectors.

We find that the consequences of the policies we study can be substantial on a number of critical variables. For instance, in our benchmark case when establishments are implicitly taxed at a 10% rate if they demand capital services beyond the average value with no distortions, aggregate output falls by about 4.4% across steady states and the resulting welfare cost is 2.8%. These effects on output and welfare are systematically accompanied by sharp increases in the number of establishments, while standard measures of productivity non-trivially drop in most cases. This in line with data and occurs under restrictions on large establishments, subsidies to small ones, and also when policies are only sector-specific. For instance, if establishments are implicitly taxed at a 10% rate when they demand capital beyond the average value with no distortions, the number of establishments goes up by 11.1%, and average output per worker and per-establishment drop by 13.8%. Finally, the policies we study also generate sizeable effects in the size distribution of establishments. Mean size falls in all cases, while dispersion in size increases or decreases depending on the particular policy that is followed. In the same case mentioned above when size is measured by the number of employees, mean size declines by about 10.5% (from 17.1 to 15.3) while the coefficient of variation of size increases from 1.62 to 1.53.

This paper is connected to the growing literature that analyzes the relationship between policy distortions and differences Total Factor Productivity, or more broadly, differences in economic performance. Gollin (1995), Schmitz (2001), Bergoeing, Kehoe, and Soto (2002), Parente and Prescott (2000), Restuccia and Rogerson (2003), Blanchard and Giavazzi (2003), Cole and Ohanian (2004), Lagos (2004), and Herrendorf and Teixeira (2004) among others, are examples of papers in this group. Restuccia and Rogerson (2003) is in particular close to the current paper, as they share our emphasis on policies that are size dependent.

The paper is organized as follows. Section 2 documents key examples of size dependent policies in different countries. Section 3 introduces the model economy we investigate. Section 4 discusses our choice of parameter values. Section 5 presents the findings from our experiments in our benchmark case. Section 6 studies restrictions on size that are sector specific. Section 7 investigates other size dependent policies. Finally, section 8 concludes.

2 Size Dependent Policies Across Countries

Below we document key examples of policies that affect or restrict the size of firms and establishments across countries. As we argue below, these policies are present both in developed and underdeveloped countries, and are both economy-wide and sector-specific. The policy provisions in question provide protection to small production units either via subsidies or promotion schemes, or through restrictions on the size of large units. We document prominent cases where "size" for policy purposes is defined in terms of the use of labor, and also when it is defined in terms of the use of other inputs, namely capital and land services.

2.1 Manufacturing: India

As it has been recognized by many authors, India has a long tradition of protection for small businesses or Small Scale Industries (SSI). Given the scope and persistence of the regulations in place, it is probably the most striking case of size restrictions nowadays. Indeed, authors have attributed the poor economic performance of the manufacturing sector in India, and the disparities between the recent development patterns of India and China, to policies of this sort.[9]

The protection of small businesses started with the Industries Development and Regulation Act of 1951, which defined what constituted a small enterprise for policy purposes. Currently, there is a vast number of complex provisions in place. These policies are now under the administration and control of the recently created *Ministry of Small Scale Industries*, and are applied to the manufacting sector. Among the policy instruments, is the Small-Scale Reservation Policy that we discuss below. It is worth noting at this point that the liberalization reforms that started in 1991 did not affect fundamentally the policies in question.

Since 1951, what constitutes a small business for policy purposes depends on a threshold level of cummulative investment that has been increasing with inflation. By 1997, the level was Rs. 30 million in plants and machinery (about US$ 690,000). Interestingly, the cutoff level was revised downwards in 1999 to Rs. 10 million (US$ 230,000), and continues at this level today. Currently, the small sector is not necessarily small: it comprises about 95% of all industrial units, accounts for about 40% of value added in the manufacturing sector and for about 6.9% of GDP.[10]

Following Mohan (2002), the long and evolving list of policy provisions in place can be classified in 4 groups.

1. Fiscal Incentives: the provisions of the law determine that units below the small scale level are exempt, partially or totally, from excise and sales taxes and duties on their products and items purchased. According to Little, Mazumdar, and Page (1987), Table 3-1, using

[9] See Mohan (2002), Krueger (2002) and Tendulkar and Bhavani (1997).

[10] Source: Ministry of Small Scale Industries (2003).

the rates prevailing in 1980, the exemption rates associated only to excise taxes, ranged from 4.8% to 25.1%. A subsequent tax reform made these magnitudes more uniform across product lines. We note at this point that this clearly discourages the expansion or emergence of businesses beyond the specified limits; any expansion implies the loss of these benefits.

2. Credit Support: Prior to economic reforms, 40% of all bank credit had to be allocated to priority sectors (SSI, agriculture, etc.) with a minimum of 15% to SSI at government dictated interest rates. This policy was applied to each commercial bank in the country. The reservation of credit has continued unchanged after the process of economic reforms, but the interest rates have been deregulated. According to Mohan (2002), this has led to subsequent policy measures aimed at reducing the effects of higher interest rates on loans to SSI's.

3. Promotion Programs: This encompasses preferences in procurement, provision of managerial and technical assistance, as well as a myriad of assistance programs at the state level.

In terms of procurement, since the 1960's the Federal government sets aside a set of manufactured products that can *only* be procured from SSI's. This list contains currently 358 products. In addition, there is a price preference (15%) given to SSI's in procurement tenders. As previously, note that this discourages the expansion or emergence of businesses beyond the specified limits.

4. Reservation Policy: This is the most notorious and known aspect of the policies. The reservation policy began in 1967, when the government set aside a group of manufactured products to be produced exclusively by SSI's. After the date of reservation, no new large units were allowed to operate. Existing units were allowed to operate only at frozen capacity at the reservation date.[11]

While the set of products reserved was initially small (47), it grew to 177 products in 1974, 504 in 1978, and to 847 product types in 1989. By 1987-88, reserved products accounted for about 29% of total output of small scale industries (Mohan (2002), Table 6.13). This implies that with a share of manufacturing in total output of about 21% by then and a share of SSI in manufacturing of approximately 45%, approximately 2.5-2.7% of GDP was accounted for by the production of reserved products. This is of course, an estimate of the size of the reserved sector *under* the reservation policy when output is measured at distorted prices.

After more than 10 years of economic reforms, the reservation policy is still in place, with only a trivial change in the number of reserved products; currently the number of reserved

[11] New large units were later allowed to operate if they export at least 50% of their production.

products is 799, while it was 836 in prior to the reforms.

2.2 Retail Sector I: Japan

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 stipulated 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.[12]

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.

[12] 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).

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 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.[13] 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.[14]

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 (consensus) 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. 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

[13]Source: Larke (1994).

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

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.

2.3 Retail Sector II: France

Prior to 1974, the opening of a store or the the expansion of an existing one in France required only a building permit. In December 1973, the French Parliament approved the *"Loi d'Orientation du Commerce et de l'Artisanat"* or the Loi Royer. The law had the explicit objective of protecting owners of small retail shops against the 'disordered' growth of new forms of distribution (Article 1). Among several measures, the law created an extra step, in addition to the standard building permit, in order to open a new retail outlet or expand an existing one above a nationally pre-specified limit.

Under the Loi Royer, any new store larger than 1,500 sq. meters (1000 sq. meters in cities with less than 40,000 people) requires the approval of a regional zoning committee created after the law. The same rules also apply to the expansion of existing stores, and the conversion of existing buildings into retail space. Interestingly, like in Japan under the Large Scale Retail Store Law, directly affected parties (owners of small retail shops and craftsmen) are represented in these committees.[15] If a proposal is rejected, there is an appeal possibility at the national level. At this level, a Ministry, advised by a national zoning commission, can overturn the decisions of the regional committee.[16]

Bertrand and Kramarz (2002) argue that the application process is a costly one, and show that a non-trivial fraction of proposals were effectively rejected by the regional committees. The mean approval rate across French departments from 1975 to 1998 was 42 percent, and projects for relatively large stores faced a lower probability of acceptance than small ones. They also show that there was variation across the country in terms of approvals; some departments in this period had approval rates as low as 10%.

2.4 Employment Protection in OECD countries

Employment protection legislation in several developed countries contains provisions that depend on the size of firms and/or establishments. This is present in many aspects of the prevailing provisions (e.g rules regarding fixed term contracts, reduncdacy procedures,

[15] They hold 9 out of 20 votes, and decisions are adopted by simple majority rule.

[16] According to Bertrand and Kramarz (2002), the law has become more strict in recent years, with a reduction in the threshold levels and with a stronger majority requirement for the approval of a project.

pre-notification periods, severance payments and requirements for collective dismissals) for countries like Italy, Germany, France and Spain.[17] In the case of the United States, despite the absence of employment protection legislation present in other OECD countries, there is legislation related to employment that depends on firm's size. The norms in question are contained in the Civil Rights Act of 1991 and in the American with Disabilities Act of 1990.

The case of employment protection legislation in Italy is interesting to describe in detail, as it clearly shows how the policy provisions that depend on size actually operate.[18] In a nutshell, firms with more than 15 employees face employment protection legislation that differs in many ways with the legislation faced by smaller firms. Within the Italian institutional setting, five type of regulations depend on firm's size: employment protection, mandatory quotas on hiring, firm level rights to organize union related institutions, firm safety standards and collective dismissal rules.

The key institutional constraint is about individual dismissal rules (Article 18 of the labor code). Individual dismissals must be supported by a just cause, and workers have the right to appeal firm initiated dismissals. Whenever a judge rules a dismissal unfair, workers are entitled to a compensation that hinges on firms size. Firms employing less than 15 employees must compensate the (unfairly) dismissed worker and pay a severance payment ranging from 2.5 to 6 months. Firms employing 15 workers or more, must *rehire* the worker and pay a compensation for the foregone wages from the dismissal's date to the date of the ruling.

It is worth noting how the law computes the threshold of 15 employees for dismissals. First, the 15 employees refer to establishments rather than firms. In addition, part-time workers should be included in proportion to their actual time and all temporary contracts should be counted. Apprentices and temporary workers below nine months are not taken into account.

Regarding hiring preferences, firms employing more than 10 workers are obliged to hire disadvantaged workers; that is, workers that are officially registered as long-term unemployed. Furthermore, as of 1999, firms employing more than 15 workers must employ disabled workers.

Finally, norms governing the activity of unions within firms apply only to firms employing more than 15 workers. These norms entitle workers to establish a firm level institution that has the right to call union meetings, establish referenda, and post union related posters inside the workplace. Likewise, firms with more than 15 employees have the right to vote for a worker representative for safety related issues.

[17] See Bertola, Boeri, and Cazes (1999) for an extensive documentation.

[18] We follow Garibaldi, Pacelli, and Borgarello (2003) in the description of the Italian institutional setting.

2.5 Subsidies to Small Units

[to be completed]

3 Theoretical Framework

We now describe a simple one-sector aggregative model with an endogenously determined size distribution of plants or establishments. The model is based upon the Lucas (1978) span-of-control framework. We first present the model economy without any distortion on size. In subsequent sections we introduce size- dependent policies of different types. Later we extend the model to multiple sectors to accommodate policies that are sector-specific.

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

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

where $\beta \in (0, 1)$ and C_t denotes total household consumption at date t. The function $U(.)$ is continuous, strictly increasing and differentiable.

Endowments Each household member is endowed with z units of managerial ability. These efficiency units are distributed with support in $Z = [0, \bar{z}]$ with cdf $F(z)$ and density $f(z)$. Depending upon type, each household member can be a *worker* or a *manager*. We describe below this occupation decision and the associated incomes in detail.

Production A manager of type $z \in Z$ has access to the technology

$$y = z^{1-\gamma+\psi}(g(k, n))^{\gamma},$$

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

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

where w and R are the rental prices for labor and capital services respectively.

The Household Problem The problem of the household is to choose sequences of consumption, the fractions of household members 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 $\pi(z, w, R)$. Note that there exist a unique threshold $\hat{z}$ such that those individuals with efficiency units below this threshold become workers, and those with efficiency units above it become managers. This follows from the fact that the function $\pi(., w, R)$ is strictly increasing and convex in the first argument under diminishing returns to capital and labor jointly.

Formally the household problem is to select $\{C_t, K_{t+1}, \hat{z}_t\}_0^\infty$ to maximize (7) subject to

$$C_t + K_{t+1} = I_t(\hat{z}_t, w_t, R_t) + R_t K_t + K_t(1-\delta),$$

and

$$K_0 > 0.$$

The income from managerial and labor services, $I_t(\hat{z}_t, w_t, R_t)$, is given by

$$w_t F(\hat{z}_t) + \int_{\hat{z}_t}^{\bar{z}} \pi(z, w_t, R_t) f(z) dz.$$

The solution to the household problem is then characterized by the First Order Conditions:

$$U'(C_t) = \beta(1 + R_{t+1} - \delta)U'(C_{t+1}), \tag{2}$$

and

$$w_t = \pi(\hat{z}_t, w_t, R_t). \tag{3}$$

Condition (2) is the standard Euler equation for capital accumulation. Condition (3) states that the household member with marginal ability $\hat{z}_t$ at t must receive the same compensation as a manager than as a worker (e.g. be indifferent). This indifference condition defining occupational choice of household members is represented in Figure 1.

[Insert Figure 1 here]

Equilibrium In equilibrium, the markets for capital and labor services, as well as the markets for goods must clear. Let $n(z, w, R)$ and $k(z, w, R)$ be the demands for capital and labor services of a manager of ability z. Market clearing in the market for labor services requires

$$N_t^* = \int_{\hat{z}_t^*}^{\bar{z}} n(z, w_t^*, R_t^*) f(z) dz, \tag{4}$$

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

$$N_t^* \equiv F(\hat{z}_t^*).$$

Market clearing in the market for capital services requires:

$$K_t^* = \int_{\hat{z}_t^*}^{\bar{z}} k(z, w_t^*, R_t^*) f(z) dz. \tag{5}$$

Let $y_t(z, w_t, R_t)$ be the supply of goods by managers with ability z. Then, market clearing in the market for goods requires:

$$\int_{\hat{z}_t^*}^{\bar{z}} y(z, w_t^*, R_t^*) f(z) dz = C_t^* + K_{t+1}^* - K_t^* + \delta K_t^*. \tag{6}$$

It is now possible to define a competitive equilibrium. A competitive equilibrium is a collection of sequences $\{C_t^*, K_{t+1}^*, \hat{z}_t^*, w_t^*, R_t^*\}_0^\infty$, such that (i) given $\{w_t^*, R_t^*\}_0^\infty$, the sequences $\{C_t^*, K_{t+1}^*, \hat{z}_t^*,\}_0^\infty$ solve the household problem; (ii) the markets for capital and labor services clear for all t (equations (4) and (5) hold); (iii) the market for goods clear for all t (equation (6) hold).

3.1 Discussion

Some implications of the framework are important to note at this point. First, since all individuals face the same wage rate as workers, the size of the smallest and the average establishment can differ significantly. They depend critically on the parameters governing span-of-control and returns to managerial ability; γ and ψ. 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. Policies aimed at large establishments can potentially have important consequences, as these units account for a disproportionate fraction of total employment. Thus, to account for large establishments is important to reproduce features of the data and to assess the potential effects of policies on size.

Second, the competitive equilibrium is unique and in the absence of distortions, coincides with the Social Planner solution. This determines that *any* policy affecting size will be distorting.[19] Our analysis should thus be viewed as a natural benchmark to analyze the consequences of policies of this type: what effects are to be expected on a host of variables in equilibrium, and the magnitude of these.

Finally, the fact that the standard Euler equation for capital accumulation applies in this model determines that the rental rate for capital services is constant across steady states. This implies a simple and natural procedure to compute steady state equilibria. First, guess a value of the steady state capital stock, K_0. Second, given this value, calculate equilibrium factor prices from equations (4) and (5). Third, if the resulting rental rate for capital services differs from $(1/\beta - 1 + \delta)$, update the capital stock and start anew. Otherwise, a steady state equilibrium has been found. This procedure, which also applies when size distortions are introduced, is the one we use to calculate all the statistics we report in the paper.

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. Based on this choice, parameter values are selected as follows.

Preferences We assume that the utility function takes the form

$$U(C) = \log(C)$$

and 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.

[19]Of course, this does not imply that size regulations are always inefficient when large establishments create negative externalities, for example.

Technology We assume that the function $g(.,.)$ takes the Cobb Douglas form

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

We then need to provide values for ν, the degree of return to scale, γ, as well as the parameter ψ defining returns to managerial ability. To pindown these unknown parameters, we add three observations that the model is forced to match: the aggregate capital to output ratio, mean establishment size and the fraction of workers in the labor force.

For the first target, we use the 1997 US Economic Census and calculate that the mean establishment size was 17.09 workers. 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. 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.[20] Chang (2000), using PSID data, calculates an even lower value for the fraction of workers (84%). Nevertheless, 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 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.[21] From this procedure, we calculate a depreciation rate of 8.1%.

Endowments We assume that the distributions of potential managerial ability is log-normal, so that $\log(z) \sim N(0, \sigma)$. In order to pindown σ, we add an observation relevant to the questions at hand, namely the dispersion in establishment size (in terms of workers). From the 1997 US Economic Census, we calculate that the coefficient of variation in the overall economy equalled 1.62. These 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.

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

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

Summary There are in total four parameters that we choose in order to reproduce observations. These are γ, ν, σ 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. Figure 2 shows that the model also reproduces well the shape of the actual size distribution.

Table 1: Parameter Values

β	δ	γ	σ	ν	ψ
0.94	0.081	0.848	2.135	0.493	0.051

Table 2: Targets

Statistic	Data	Model
Mean Size	17.09	17.10
Coeff. Variation	1.619	1.617
Fraction Workers	0.950	0.944
Capital Output Ratio	2.89	2.89

Insert Figure 2 here

5 Size-Dependent Policies: The Benchmark Case

Our representation of policies is meant to capture government policies which affect the size of establishments via implicit taxes or subsidies on input use. We discuss below what we label our *benchmark* case: implicit taxes that are applied only to the input units above an exogenously set level. 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 restrictions imposed on the use of capital; the case of restrictions on labor use is similar and we briefly discuss its implications later. 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 $\underline{k}$.

This modelling of restrictions implies that the total cost associated to capital use is continuous in k. As a result, the function $\pi(.)$ 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. Unconstrained ones are small establishments that choose $k(z, w, R; \underline{k}, \tau) \leq \underline{k}$. 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 $k(z, w, R; \underline{k}, \tau) > \underline{k}$. 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, $k(z, w, R; \underline{k}, \tau) = \underline{k}$. 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^- and z^+ so that: (i) unconstrained establishments are those with $z \in [\hat{z}, z^-)$; (ii) establishments in the intermediate group are those for which $z \in [z^-, z^+]$; (iii) the largest establishments have $z > z^+$.

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 3 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

$$C_1 + K_{t+1} = I_t(\hat{z}_t, w_t, R_t; \underline{k}, \tau) + R_t K_t + K_t(1 - \delta) + X_t,$$

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

$$X_t^* = \tau R_t^* \int_{z^{+*}}^{\bar{z}} (k(z, .) - \underline{k}) f(z) dz.$$

5.1 Findings

We proceed by comparing steady states of our model economy with steady states of the model economy under different cases. We report results for restrictions at two levels. In the first case, $\underline{k}$ equals average capital use in the economy without restrictions. In the second case, distortions are more severe, and $\underline{k}$ is equal to two thirds of average capital in the case without restrictions. For both cases, we report results for a relatively low value of the implicit tax rate ($\tau = .10$), and for a relatively high value ($\tau = .20$).

Aggregates and Productivity Table 3 summarizes the main findings for aggregate variables. Output falls by about 4.4% to 8.7%; 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. When 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, a reduction in the capital to labor ratio in distorted establishments, and a reduction in the supply of the single good produced. In equilibrium, this process is accompanied by an increase in the number of small establishments as Table 3 shows. It is worth emphasizing the phenomenon that total output decreases, despite the emergence of new, small establishments; this simply reflects the fact that large (distorted) ones account for a disproportionate share of total output.

Table 3: Aggregate and Productivity Effects

Statistic	$\tau = 0$	$\tau = 0.1$	$\tau = 0.2$
$\underline{k}$ = Mean Capital			
Aggr. Output	100	95.64	92.40
Output Per-Worker	100	96.26	93.50
Output Per-Efficiency Unit	100	92.84	87.78
TFP	100	98.86	97.68
Output per Establishment	100	86.15	76.98
Average Managerial Quality	100	92.87	87.81
Number Establishments	100	111.05	120.11
Welfare Cost	-	2.79	5.32
(% increase in C)			
$\underline{k}$ = (2/3) Mean Capital			
Aggr. Output	100	95.06	91.25
Output Per-Worker	100	95.75	92.51
Output Per-Efficiency Unit	100	91.96	86.04
TFP	100	98.78	97.52
Output per Establishment	100	84.55	73.97
Average Managerial Quality	100	92.03	86.09
Number Establishments	100	112.50	123.37
Welfare Cost	-	3.17	6.13
(% increase in C)			

We note that the increase in the number of small establishments is a simple and natural implication of our framework. Quantitatively, this increase in the number of small establishments is substantial, ranging from about 11.0% to about 23.4%. Why does this occur? The introduction of size restrictions leads to a new steady steady state with a *lower* wage rate. This fall in wages increases the managerial rents associated to operating small, undistorted establishments. In addition, the fall in the wage rate reduces the benefits of being a worker. The net result is the reduction in the productivity threshold $\hat{z}$, and the non-trivial increase in the number of small establishments that Table 3 shows.

The size distortions have a direct and negative impact on productivity measures. We report in Table 3 several of them. The first one is simply average output per-worker (non-managers). 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

$$\text{TFP} = \frac{Y}{(N+Z)^{1-\nu\gamma} K^{\nu\gamma}},$$

where N and K stand for labor and capital employed, and Z stands out for the total amount of managerial input used. We also report the behavior of output per establishment, output per efficiency unit of labor (managers plus workers), as well as average managerial quality. These measures are respectively:

$$\frac{\int_z y(z,w,R) f(z) dz}{(1-F(\widehat{z}))},$$

$$\frac{\int_z y(z,w,R) f(z) dz}{F(\widehat{z}) + \int_z z f(z) dz},$$

$$\frac{\int_z z f(z) dz}{(1-F(\widehat{z}))}$$

All notions of productivity drop as restrictions are introduced. The drop in output per-worker ranges from 3.7% to 7.5%, while the drop in TFP ranges from about 1.1% to 2.5%. The reduction in output per-establishment and average managerial quality are more pronounced; the fall in these magnitudes range from 13.8% to 26.0%, and from 7.1% to 13.9%, respectively.

It is critical to understand why the fall in productivity measures takes place. We focus now in detail on the case of output per worker, as this is a statistic usually computed in productivity studies. In each establishment, physical output per-worker equals

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

independently of the presence of restrictions on size as we modeled them. Thus, absent any general equilibrium effect, size restrictions applied to the use of capital do *not* affect output per-worker. As a result, the fall in output per-worker reported in Table 3 is also the fall in the wage rate across steady states associated to the restrictions on large establishments.

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 15.3 to 13.7 employees, while it is of about 17.1 employees 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 drop in wage rates 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 6.5% to 14.8%. 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 10% to 20% 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 the undistorted value of 22.9% to 16.3% and 11.8% when $\underline{k}$ is equal to average capital in the absence of distortions, and from about 33.0% in the undistorted case to 23.9% and 17.6%

when $\underline{k}$ is equal to two thirds of average capital.

Table 4: Effects on Size Distribution

Statistic	$\tau = 0$	$\tau = 0.1$	$\tau = 0.2$
$\underline{k}$ = Mean Capital			
Mean Size	17.103	15.307	14.081
Coeff. Variation	1.617	1.526	1.403
Median Size	7.015	7.133	7.239
% Distorted ($k \geq \underline{k}$)	22.9	22.81	22.76
% Distorted ($k > \underline{k}$)	22.9	16.29	11.83
$\underline{k}$ = (2/3) Mean Capital			
Mean Size	17.103	15.102	13.670
Coeff. Variation	1.617	1.571	1.484
Median Size	7.0154	7.171	7.270
% Distorted ($k \geq \underline{k}$)	33.05	32.73	32.41
% Distorted ($k > \underline{k}$)	33.05	23.87	17.60

Welfare We now look at the welfare costs associated with the policies we investigate. We report in Table 3 the welfare cost associated to these policies, calculated as the percentage increase in consumption that is necessary in order to make the representative household indifferent between two steady states. The table shows welfare costs associated with these policies that are large by the standards of the applied general equilibrium literature; they range in our exercises from about 2.8% to 6.13%.

How big are the distortions we impose on our model economy? Surprisingly, they are not large. First, note that in our experiments only about 22.8% to 32.7% of establishments are affected by size restrictions, and only about 11.8% to 23.9% of the establishments effectively pay the implicit tax on capital services. Furthermore, 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. This calculation gives an average tax rate on payments to capital equal

$$\frac{\tau \int_{z^+}^{\overline{z}} (k(z,w,R) - \underline{k}) f(z) dz}{\int_{\hat{z}}^{\overline{z}} k(z,w,R) f(z) dz}.$$

In our experiments this average tax rate turns out to be relatively small. It ranges from 3.6% when $\tau = 0.1$ and $\underline{k}$ is equal to mean level of capital, to 7.0% when $\tau = 0.2$ and $\underline{k}$ is two thirds of the mean level of capital. To account for the significant welfare effects in Table 3, note while average tax rates 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 undistorted economy, establishments above the median size are responsible for about 87.1% of total output, while establishments above the mean account for about 70.0%.

A simple 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 3? Suppose that the capital share is of about 0.418, the overall value of payments to capital as a fraction of output in the undistorted case. Assume in addition that the discount factor and depreciation rates are the same as in Table 1. Then, capital income tax rates between 8% and 17% are needed to contain the range of welfare costs in Table 3.

5.2 Restrictions on Labor Use

We now discuss the implications of size restrictions when they depend on the use of labor services beyond a threshold value. This is an empirically relevant case as we argued in section 2. Table 5 summarizes the main results. In line with the previous case we set the threshold value, $\underline{n}$, to mean labor use and 2/3 of mean labor use in the absence of distortions, respectively.

Table 5: Size Dependent Restrictions on Labor Use

Statistic	$\tau = 0$	$\tau = 0.1$	$\tau = 0.2$
$\underline{n}$ = Mean Labor			
Aggr. Output	100	99.60	98.76
Output Per-Worker	100	96.72	94.21
TFP	100	97.48	95.41
Output per Establishment	100	86.34	76.75
Average Managerial Quality	100	90.35	83.50
Number Establishments	100	115.40	128.62
Mean Size	17.103	14.683	13.069
Coeff. Variation	1.617	1.492	1.331
Welfare Cost (% increase in consumption)	-	0.3995	1.2551
$\underline{n}$ = (2/3) Mean Labor			
Aggr. Output	100	99.67	98.76
Output Per-Worker	100	96.85	94.28
TFP	100	97.16	94.84
Output per Establishment	100	84.52	73.83
Average Managerial Quality	100	88.94	81.16
Number Establishments	100	117.93	133.88
Mean Size	17.103	14.352	12.526
Coeff. Variation	1.617	1.559	1.447
Welfare Cost (% increase in consumption)	-	0.3333	1.2602

Some key features of the results are worth discussing in themselves, and in relation to the previous case. First, the consequences on mean size and the number of establishments are larger than when restrictions are applied to the use of capital services. To understand this result, note that unlike the case of restrictions on capital use, restrictions on labor use directly impact the market for labor services. This results in larger reductions in the equilibrium wage rate relative to the case of restrictions on the use of capital services. For instance, when the threshold equals mean labor (mean capital) use and the implicit tax rate is 20%, the drop in w equals 9.1% (6.5%). Thus, by creating larger changes in the demand for labor services these policies provide larger incentives for the emergence of new, small establishments. This, together with the direct effects on large establishments, contributes to a larger reduction in mean size and size dispersion. Second, the aggregate effects on output and consumption are smaller. This results follows from the fact that restrictions on labor use affect capital accumulation indirectly, resulting in smaller effects on capital accumulation, and thus on output, across steady states.

Finally, note that while output per-worker falls by less than in the case when size restrictions depend on capital use, the opposite occurs for other measures of productivity. The latter phenomenon is accounted for by, again, the fact that the number of establishments increases more when restrictions depend on the use of labor services, and that the new establishments are of operated by managers of relatively low quality. Regarding the smaller decline in output per-worker, it is key to bear in mind that for large establishments which pay the implicit tax, output per worker equals

$$\frac{w\ (1+\tau)}{(1-\nu)\gamma}$$

Hence, for fixed wage rates, output per-worker *goes up* for establishments that pay the implicit tax. There are then two opposing forces that operate as τ increases across distorted and undistorted steady states. On the one hand, wage rates fall, reducing output per-worker of establishments not paying the implicit tax. On the other hand, relatively large establishments become also high output per-worker establishments due to the payment of the implicit tax. Put differently, large establishments appear to be more productive precisely because of the restrictions on their size.

6 Sector-Specific Policies

In this section we investigate the consequences of policies that are sector-specific. This is a critical case to study as there are numerous cross-country examples of size-dependent policies that are applied only to certain sectors (e.g. manufacturing in India, the retail sector in Japan and other countries, etc.) To this end, we modify the benchmark framework in a simple way.

The Model There are two goods and two sectors in the economy, 1 and 2. Sector 1 produces good 1, which is both a consumption and an investment good, while good 2, a pure consumption good, is produced in sector 2. From now on, we use good 1 as a numeraire.

The representatitve household maximizes

$$\sum_{t=0}^{\infty} \beta^t U(C_{1,t}, C_{2,t}), \tag{7}$$

where $C_{1,t}$ 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.

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. Similarly, a household member of type 2 can be a worker in any sector, or a manager in sector 2.

A manager in sector $i = 1, 2$ has access to the technology

$$y_i = z_i^{1-\gamma_i+\psi}(g(k, n))^{\gamma_i},$$

where $g(.,.)$ is a concave, differentiable, constant returns to scale function, $0 < \gamma_i < 1$ and $\psi \geq 0$. Thus, production requires a managerial input (z_i), capital (k), and labor (n). Profit maximization determines managerial rents $\pi_1(z, w, R)$ and $\pi_2(z, w, R, p)$, the latter being the solution to

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

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

The problem of the household is then 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. 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 (7) 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

$$K_0 > 0.$$

where $I_t(\hat{z}_{1,t}, \hat{z}_{2,t}, w_t, R_t, p_t)$ stands for the income from managerial and labor services.

Parameter Values 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. 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

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

We report results for the $\rho = 0$ (unitary elasticity of substitution), and also 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.[22]

We assume that the function $g(.,.)$ is the same in both sectors, and takes the Cobb Douglas form with capital share ν, as in the one-sector case. 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. The values for the other two remaining targets are the same than in the one-sector case.

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

[22]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.

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.

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 6 summarizes our choices.[23]

Table 6: Parameter Values

	β	δ	γ_1	γ_2	σ	ν	θ	ψ	α
$\rho = 0$	0.94	0.081	0.852	0.857	2.125	0.480	0.857	0.05	0.872
$\rho = -1/3$	0.94	0.081	0.853	0.828	2.110	0.485	0.912	0.05	0.872

Findings We report in Table 7 results when restrictions are applied to capital use in sector 2, and the threshold level equals mean capital in sector 2. We report results for two cases, one with a relatively low value for the implicit tax ($\tau = 0.2$), and another one with a relatively high implicit tax ($\tau = 0.5$).

Two results are worthy of discussion, the changes in output per-worker and in the number of establishments. What accounts for the fall in output per-worker when restrictions are introduced? Note that in the two sector case, *physical* output per-worker in sector 2 equals

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

Therefore, while restrictions imposed on a relatively small sector affect w only slightly, changes in p make output per-worker to fall in the distorted sector. Quantitatively, this drop is a non-trivial one as Table 7 demonstrates. 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.

[23] Again, we find the model has no problem to reproduce simultaneously the targets we impose.

The changes in the relative price, p, also account for the increase in mean establishment size. Now the relevant condition for occupational choice of agents in sector 2 is $w = \pi_2(\hat{z}_2, w, R, p; , \underline{k}, \tau)$. While w changes slightly across steady states, the increase in the relative price of good 2 leads to an increase in the rents associated to the operation of an establishment in this sector. The result is the sizeable increase in the number of establishments displayed in Table 7.

Table 7: Two-Sector Case ($\underline{k}$ = Mean Capital)

Statistic	$\tau = 0$	$\tau = 0.2$	$\tau = 0.5$
$\underline{\rho = 0}$			
Aggr. Output (*)	100	99.5	99.0
Output Sector 2	100	96.2	93.0
Relative Price (p)	100	104.1	107.7
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
Mean Size Sector 2	13.93	11.90	10.29
Coeff. Variation Sector 2	1.57	1.40	1.11
Welfare Cost	-	0.37	0.78
(% increase in consumption 1 and 2)			
$\underline{\rho = -1/3}$			
Aggr. Output (*)	100	99.4	98.9
Output Sector 2	100	97.0	94.3
Relative Price p	100	104.3	108.3
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
Welfare Cost	-	0.42	0.88
(% increase in consumption 1 and 2)			

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

We emphasize that the increase in the number of small establishments in the distorted sector, as well as the fall in output per worker, emerge also naturally in the two-sector framework. Qualitatively, it is consistent with the observations pertaining to the Japanese retail sector we discussed earlier: a large number of retail establishments per-capita and a low productivity in the sector. Note also that for both variables, the effects are more pronounced as the goods become less substitutable. This is not surprising; a lower substitution elasticity implies higher increases of the relative price, p. In similar fashion, when the goods are less substitutable, welfare costs go up as Table 7 indicates.[24]

7 Other Policies

We now concentrate on the consequences of two variations of size-dependent policies. In the first case, we study size restrictions that affect input use not only in the margin. In the second case, we evaluate the effects of subsidies to small units. For both cases, we assess the effects of these policies in the benchmark (one-sector) version of the model.

7.1 Restrictions Affecting All Units

So far, we have analyzed restrictions on the use of inputs that apply only to input units beyond a pre-specified limit. We study the case in which if an establishment wants to expand input use beyond a limit, it faces implicit taxes on *all* input units (marginal and inframarginal).

We concentrate on the case of restrictions on labor use, as these policies resemble size-dependent employment protection in OECD countries. If labor use is $n > \underline{n}$, the cost associated to labor services equals $w(1+\tau)n$, while this cost equals wn if $n \leq \underline{n}$. Therefore, labor costs are discontinuous at $\underline{n}$. There are then thresholds z_{-} and z^{+} that define three types of establishments as in the benchmark case, with those with $z \in [z_{-}, z^{+}]$ choosing $\underline{n}$. The difference with the case with benchmark distortions is that the discontinuity at $\underline{n}$ implies that z^{+} is determined by

$$\pi(w, R, z; \underline{n}, \tau)_{\underline{n}} = \pi(w(1+\tau), R, z; \underline{n}, \tau)$$

where $\pi(w, R, z; \underline{n}, \tau)_{\underline{n}}$ are the managerial rents associated to $n = \underline{n}$. This indifference condition results in the existence of a set of inputs that will not be demanded, $[\underline{n}, n^{+}]$, where n^{+} is the demand for labor services associated to z^{+}. The interesting observational implication of this type of policy is a "gap" in the size distribution for establishments by employment (or by capital use).

Table 8 presents the main results when $\underline{n}$ equals mean labor use in the undistorted case. The policies under consideration have, not surprisingly, stronger and more distorting effects than under the benchmark policies; they lead to larger increases in the number of establishments, as well as to larger reductions in output and productivity measures. For instance when $\tau = 0.2$, restrictions affecting all units increase the number of establishments

[24]To assess the *magnitude* of these findings, it is important to bear in mind that as ρ changes, all model parameters change as well to reproduce the statistics we target.

by about 33.9%, and reduce output per worker and managerial quality by about 6.1% and 18.8%, respectively. The corresponding figures for (benchmark) distortions affecting only marginal input use are 28.6%, 5.8% and 16.5%, respectively.

Table 8: Size Restrictions on All Units ($\underline{n}$ = Mean Labor)

Statistic	$\tau = 0$	$\tau = 0.1$	$\tau = 0.2$
$\underline{n}$ = Mean Labor			
Aggr. Output	100	99.35	98.00
Output Per-Worker	100	96.57	93.86
TFP	100	96.87	94.47
Output per Establishment	100	83.50	73.27
Average Managerial Quality	100	88.37	81.16
Number Establishments	100	119.02	133.88
Mean Size	17.103	14.220	12.534
Coeff. Variation	1.617	1.568	1.409
% Distorted ($n \geq \underline{n}$)	22.9	24.08	25.09
% Distorted ($n > \underline{n}$)	22.9	8.36	4.97
Welfare Cost (% increase in consumption)	-	0.66	2.04

Note the fact that by implicitly taxing both marginal and inframarginal units, the resulting mass of establishments that is strictly above $\underline{n}$ is substantially smaller than in the benchmark case. It is now 8.4% for $\tau = 0.1$ and 5.0% for $\tau = 0.2$; the corresponding values for the benchmark case are 17.1% and 12.9%, respectively.

7.2 Size-Dependent Subsidies

We now explore the consequences of subsidies to "small" units, a policy of widespread acceptance across countries. We concentrate on subsidies associated to the use of capital services. If an establishment uses $k \leq \underline{k}$, it faces a cost per-unit $R(1-s)$, whereas if it chooses $k > \underline{k}$ it faces the rental rate R. Thus, by expanding capital use beyond $\underline{k}$, the establishment gives up the subsidy. This feature creates a discontinuity in the cost of capital use as in the previous case. The observable implication is a "gap" in the model implied size distribution; that is, values of employment and/or capital use not chosen by any establishment.

To conduct quantitative experiments, we assume that the subsidies are financed by a consumption tax. This allows us to isolate the allocative effects of the subsidies, as consumption taxes in the current environment do not affect capital accumulation or occupational choice. Results are presented in Table 9 for subsidies that kick-in at 1/4 and 1/3 of mean capital use, when subsidy rates are equal to 5% and 10%. The results indicate that these policies have effects that differ in some ways from those emerging from restrictions on the size of large establishments. Quantitatively, the consequences of size dependent subsidies are also significative, despite the relatively small size of the rates and thresholds considered.

First, it is key to note that the capital stock increases as subsidies foster capital accumulation. However, this new capital stock is misallocated: new establishments now demand capital services while existing small ones expand in response to the subsidy, while other establishments operate at a smaller scale than they would in an undistorted situation. The net result is that output is nearly constant across steady states. But given that accumulation of extra capital is costly, the consequence is a fall in consumption. Quantitatively, it is noteworthy that the effects created by the small policy can lead to welfare costs in excess of 1%.

Table 9: Size Dependent Subsidies

Statistic	$s = 0$	$s = 0.05$	$s = 0.10$
$\underline{k} = 1/4$ Mean Capital			
Aggr. Output	100	99.8	99.7
Output Per-Worker	100	100.4	100.8
TFP	100	98.4	96.9
Output per Establishment	100	91.1	82.3
Average Managerial Quality	100	93.7	87.8
Number Establishments	100	109.6	120.1
Mean Size	17.10	15.5	14.1
Coeff. Variation	1.62	1.70	1.78
% Distorted ($k \leq \underline{k}$)	26.3	56.7	66.7
% Distorted ($k < \underline{k}$)	26.3	23.0	19.2
Welfare Cost	-	0.89	2.80
(% increase in consumption)			
$\underline{k} = 1/3$ Mean Capital			
Aggr. Output	100	99.9	99.9
Output Per-Worker	100	100.5	101.1
TFP	100	98.5	96.9
Output per Establishment	100	91.5	84.0
Average Managerial Quality	100	94.0	88.4
Number Establishments	100	109.2	119.0
Mean Size	17.10	15.5	14.2
Coeff. Variation	1.62	1.69	1.75
% Distorted ($k \leq \underline{k}$)	41.0	65.9	73.9
% Distorted ($k < \underline{k}$)	41.0	38.9	37.0
Welfare Cost	-		
(% increase in consumption)	-	1.12	2.80

Second, note that output per-worker slightly increases as subsidies are introduced. This is not surprising as wage rates increase also slightly. But the behavior of this statistic is misleading in this case, as all other productivity measures drop. In quantitative terms, the drop in TFP, average managerial quality and output per-establishment is substantial, in line with results obtained previously.

Third, the number of establishments displays again large increases, ranging from 9.2% to 20.1%. The reason is simple: wage rates increase only slightly, but the subsidy policy, unlike all the cases studied previously, increases directly the returns to operate small establishments. It is important to notice here that the number of establishments respond relatively *more* under a low value of the threshold $\underline{k}$. The key to understand this finding is that wages also respond relatively more when $\underline{k}$ is relatively low. This phenomenon is due to the positive consequences of the subsidy policy on capital accumulation; higher (more distortionary) values of the threshold lead to higher values of the capital stock in the new steady state.

Finally, it is worth noting that dispersion in establishment size, as measured by the coefficient of variation, *increases* as the subsidies are introduced. To understand this result, note that subsidies lead to more small establishments, a "gap" in the size distribution, while the decisions of relatively large establishments are nearly unchanged across steady states. It follows that the distribution by size becomes more disperse. Note that this does not occur in the previous cases when implicit taxes restrict size, as the decisions of all establishments are affected in these cases in a non-trivial way.

8 Conclusion

In this paper we analyze government policies that target production establishments of different sizes. To this end, we develop a model economy in which agents differ in terms of their managerial ability, and sort themselves into managers and workers. Heterogeneity in managerial ability results in an endogenous size distribution: while the low ability managers operate smaller establishments, the high ability ones operate larger ones. We calibrate our benchmark economy to aggregate and cross-sectional observations from the U.S. economy. We first introduce policies that increase factor prices for larger establishments. Next, we extend our framework to a two sector model, and introduce distortions on the size of establishments in one of the sectors. We interpret one of the sector as the retail sector, with the other one being the rest of the economy, and calibrate it U.S. observations as well. Finally, we analyze two other types of policies: those that set a higher input price for all (not just the extra) units beyond a certain limits and those that subsidize small establishments.

Our parsimonious framework allows us to systematically examine the effects of size dependent policies; in terms of how they distort the allocation of productive resources across establishments of different sizes, and in terms of the consequences they have on the aggregate capital stock. We find that these policies can have potentially large effects. Our simulations show that these policies can reduce non-trivially output and welfare, while leading to significant increases in the number of small establishments and decreases in productivity. The presence of large establishments which accounts, both in the model and in the data, for a disproportionate large fraction of output, plays a key role in these results.

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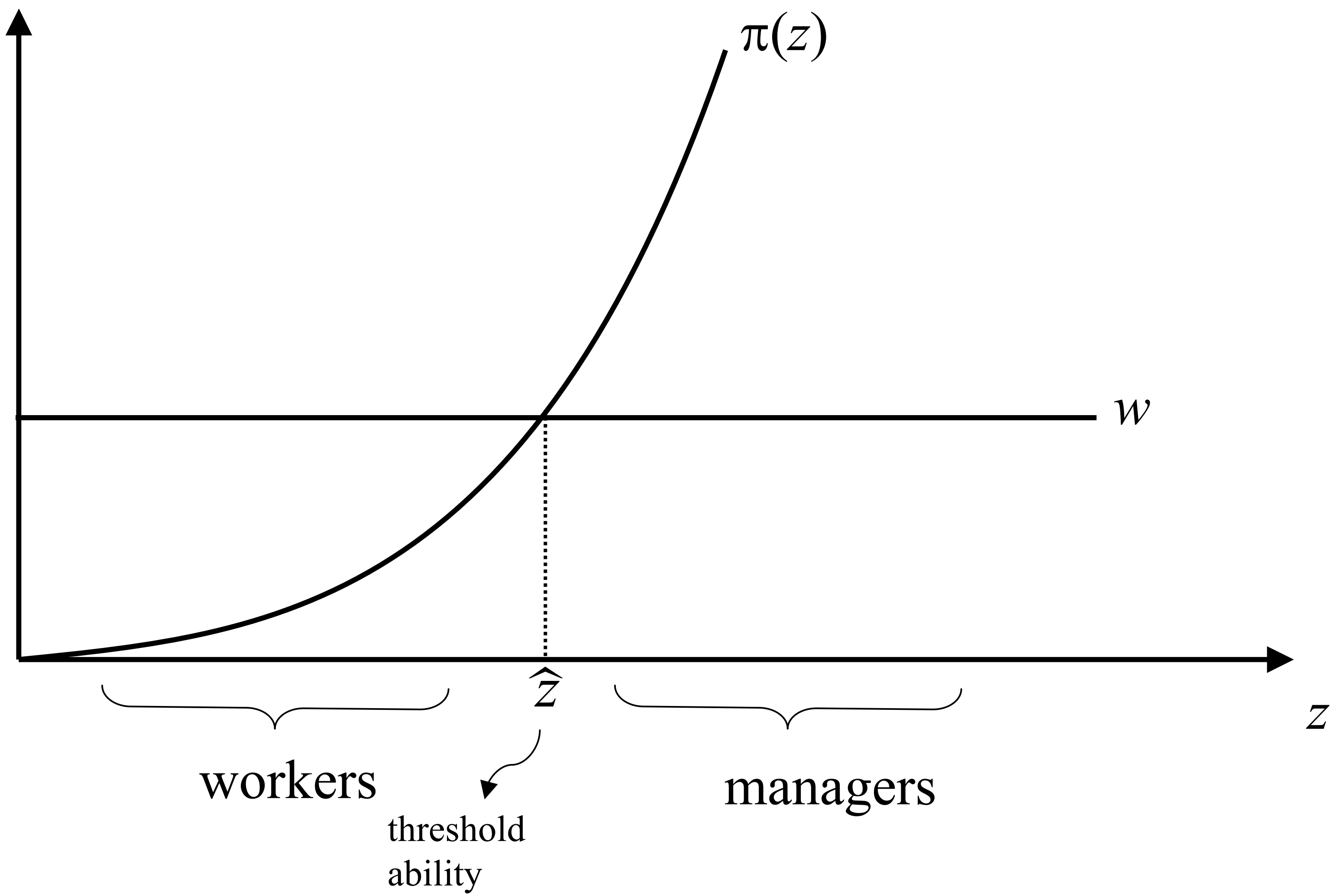
Figure 1--- Occupational Choice



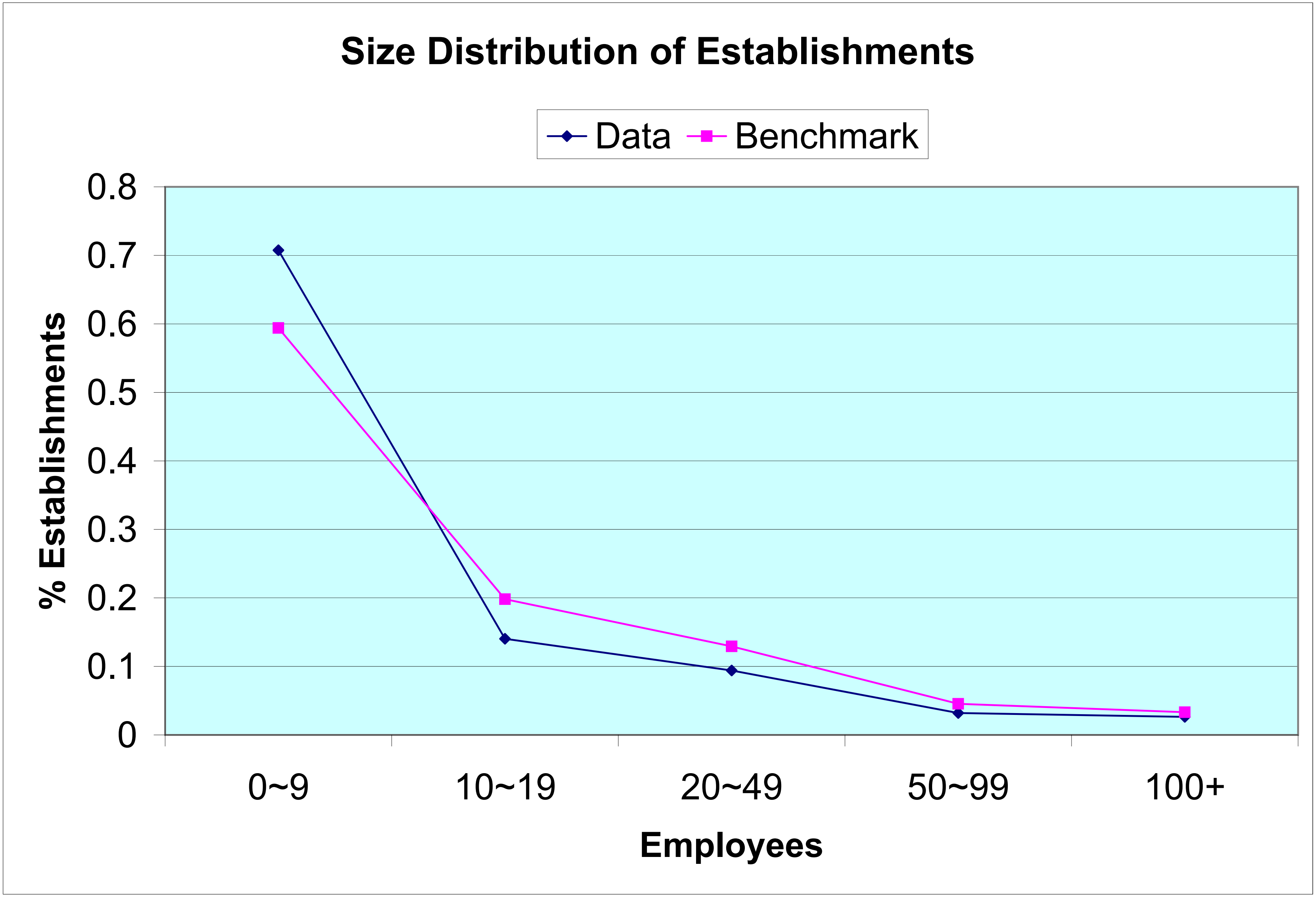

Size Distribution of Establishments
Data
Benchmark
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
% Establishments
0~9
10~19
20~49
50~99
100+
Employees

Figure 3 --- The Effects of Restrictions on Size