NBER WORKING PAPER SERIES

THE INCREDIBLE SHRINKING PORTUGUESE FIRM

Serguey Braguinsky
Lee G. Branstetter
Andre Regateiro

Working Paper 17265
http://www.nber.org/papers/w17265

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2011

This research was supported by the Carnegie Mellon-Portugal Information and Communications Technologies Institute, the Institute's Ph.D. program in Technological Change and Entrepreneurship, and the Portuguese National Science Foundation (FCT). We thank Rui Baptista, Steven Klepper, Pedro Martins, and Lowell Taylor for helpful comments. We also thank Michael Dahl for access to information on changes in the firm size distribution in Denmark and Javier Miranda for similar information on changes in the firm size distribution in the U.S. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research, nor do they reflect the views of any branch, agency, or ministry of the Government of Portugal.

The Incredible Shrinking Portuguese Firm
Serguey Braguinsky, Lee G. Branstetter, and Andre Regateiro
NBER Working Paper No. 17265
July 2011
JEL No. J21,J58,J80,K3,L51,O12,O41,O52

ABSTRACT

Using Portugal's extensive matched employer-employee data set, this paper documents an unusual feature of the Portuguese economy. For decades, the entire Portuguese firm size distribution has been shifting to the left. We argue in this paper that Portugal's shrinking firms are linked to the country's anemic growth and low productivity. We show that the shift in the Portuguese firm size distribution is not reflected in other advanced industrial economies for which we have been able to obtain comparable data. Careful attempts to account for expanding data coverage, a structural shift from manufacturing to services, and aggressive efforts to "demonopolize" the Portuguese economy leave about half of this shift unexplained by these factors. So, what does explain the shift? We argue that Portugal's uniquely strong protections for regular workers have played an important role. Drawing upon an emerging literature that that attributes much of the productivity gap between advanced nations and developing nations to the misallocation of resources across firms in developing countries, we develop a theoretical model that shows how Portugal's labor market institutions could prevent more productive firms from reaching their optimal size, thereby constraining GDP per capita. Calibration exercises based on this model quantify the degree of labor market distortion consistent with recent shifts in the Portuguese firm size distribution. These calibration exercises suggest quite substantial growth effects could arise if the distortions were lessened or abolished altogether.

Serguey Braguinsky
Department of Social and Decision Sciences
and Heinz College,
School of Public Policy and Management
Carnegie Mellon University
Pittsburgh, PA 15213
sbrag@andrew.cmu.edu

Lee G. Branstetter
Heinz College
School of Public Policy and Management
Department of Social and Decision Sciences
Carnegie Mellon University
Pittsburgh, PA 15213
and NBER
branstet@andrew.cmu.edu

Andre Regateiro
Heinz College
School of Public Policy and Management
Carnegie Mellon University
Pittsburgh, PA 15213
AndreRegateiro@cmu.edu

1 Introduction

The Portuguese economy has been making headlines in recent months – and the news has been almost uniformly bad. After months of deteriorating economic circumstances and declining confidence in the nation's ability to make good on its rapidly expanding debts, Portugal became the third eurozone economy to request a bailout from the nations with which it shares the common currency and the IMF. The crisis led to the fall of the ruling party, an acrimonious election, and widespread pessimism on the part of Portuguese workers, managers, and investors.[1]

This paper looks beyond current headlines and macroeconomic imbalances to consider a central weakness plaguing Portugal for decades – low productivity levels. Even when compared to Western Europe's other weaker economies, Portugal's productivity record is uninspiring and has been so for years.[2] This paper suggests a link between Portugal's unusually poor productivity performance and another distinctive feature of its economic landscape – a firm size distribution that has been shifting to the left for more than 20 years. Analysis using Portugal's comprehensive and highly detailed matched employer-employee data base demonstrates the surprising extent and persistence of this shift. Although many other researchers have used these data, to our knowledge, ours is the first paper to document this surprising change.[3]

As we demonstrate, this kind of shift is not found in other advanced industrial economies where we have been able to obtain similar data, such as the U.S. or Denmark. In these countries, the tendency has been for the firm size distribution to shift modestly to the right. It might be theoretically possible for changes in Portugal's firm size distribution to be an artifact of expanding data coverage, a reflection of the shift from manufacturing to services, or a response to the efforts of Portuguese governments in the 1980s and 1990s to demonopolize sectors that had become excessively concentrated in the turbulent years of the 1970s and 1980s. However, we show that even generous allowances for all of these factors leaves most of the shift unexplained. To explain the residual, we turn to Portugal's uniquely restrictive labor market practices and their implications for the allocation of labor across firms.

We develop a theoretical model that shows how strong protections for employees could, in principle, shift the entire firm size distribution. Our model builds on the intellectual foundations of Lucas (1978), in which the firm size distribution reflects an underlying distribution of managerial ability. Better managers, by definition, run bigger firms. We argue that the impact of employment protections can be represented as an effective tax on wages. By driving a wedge between the costs firms must pay for employees and their

[1] See "Portugal and the Eurozone," Financial Times, July 6, 2011.
[2] See Blanchard (2007), among many other studies, documenting Portugal's poor productivity record.
[3] Important studies using these data include Blanchard and Portugal (2001) and Cabral and Mata (2003).

value to the firm, these protections lead firms to reduce their employment, lower demand for workers in the aggregate, and force some employees into the creation of low-productivity enterprises when these same employees would be better off working for more skilled managers. In effect, these protections distort and degrade the distribution of employees across managers of different quality. Not only is the entire firm size shifted to the left, but productivity in terms of national per capita output falls.

It turns out that even a system of labor protections that is uniformly applied across the firm size distribution has a disproportionate impact on larger, more productive enterprises. These enterprises are especially sensitive to labor protections and respond to them by reducing employment even more, in proportion to their size, than smaller, less productive enterprises. This pattern of response strengthens the (negative) impact of the labor protections on aggregate output per capita. A review of Portuguese economic history suggests that, in fact, the protections were not rigidly enforced for the smallest firms, but that the effective degree of protection was substantially higher for larger firms. We develop an extension of the model to the case of nonlinear tax on labor and show, both analytically and by means of a calibration exercise, that a policy regime that discriminates against large firms exacerbates the leftward shift in the firm size distribution.

An emerging literature in development economics finds that the largest part of the productivity gap between developed and developing countries can be attributed to the inefficient allocation of resources across firms in the latter countries.[4] Whereas well developed factor and product markets and a high level of competitive intensity ensure that the most productive factors are allocated to the most productive enterprises in developed countries, this often fails to happen to the same degree in developing countries. Our paper builds on this literature, and shows that this problem not only exists in developing Asia, Africa, or Latin America, but also in the countries of the Western European periphery.

Based on our model, we use calibration exercises to estimate the magnitude of policy distortions that are consistent with recent shifts in the Portuguese firm size distribution. We find that these distortions have serious deleterious effects on productivity in Portugal. Our calibrations suggest that the relaxation of labor market protections could yield large productivity gains. Given the difficult choices facing Portugal's new government, the message of this paper may prove to be a timely one.

The rest of the paper is organized as follows. Section 2 provides a brief overview of Portuguese economic history that lays out the essential facts and policy shifts with which our paper contends. Section 3 documents the shift in Portugal's firm size distribution, compares it to trends in other countries, and demonstrates that this shift is not an artifact of expanding data coverage or "natural causes," such as the shift from

[4]This literature is surveyed in Jones (2011). Important recent contributions include Hsieh and Klenow (2009), Restuccia and Rogerson (2008), and Chari (2011).

manufacturing to services. Sections 4 presents the theoretical model where labor protections are modeled as a uniform (linear) tax on labor and shows that it can generate the shrinkage of the firm size observed in the data and that the burden of such a tax falls disproportionately on larger firms. Section 5 presents the model with nonlinear tax to reflect the fact that labor protections have been relaxed for smaller firms but tightened for larger firms in Portugal over the past 20-25 years. The model and the calibration exercise based on it show that a large reduction in the labor protections for smaller firms can be more than undone in terms of its effects on firm size and efficiency by simultaneously introducing a relatively small bias against larger firms. Section 6 concludes.

2 Portugal's Economic Mess: Shrinking Firms and Declining Prospects

"*The road to hell is paved with good intentions*" - attributed to Saint Bernard of Clairvaux

Portugal's current economic challenges are daunting, but the underlying causes of the nation's economic woes have been evident for some time. At least five years ago, Olivier Blanchard circulated a paper that presciently warned Portugal would face real difficulty if it did not contend seriously with these underlying problems. Blanchard (2007) diagnosis of Portugal's challenges emphasized the macroeconomic imbalances that had emerged by the mid-2000s. As Portugal's former currency became more tightly linked to that of its more developed European trading partners over the course of the 1990s, and as the prospects for Portugal's early entry into a European currency union advanced, inflation and currency risk diminished. Portuguese interest rates rapidly fell from fairly high levels to much lower levels approaching those of the slower growing core European economies. Portuguese businesses and consumers responded to these rapid and substantial declines in interest rates in a predictable fashion, and booming investment and debt-fueled consumption increases drove Portuguese unemployment rates down to historically low levels while raising real wages to unsustainably high levels. Domestic savings was insufficient to finance a simultaneous consumer credit boom and an investment boom, and Portugal began running large current account deficits.

In the 2000s, Portugal's twin investment and consumption booms abruptly stopped. Dramatically slower growth and rising unemployment produced persistent fiscal deficits, as government spending sought to fill the gap left by the collapse of the boom. The financing of these growing deficits increasingly relied on foreign investors. The common currency prevented Portugal from responding to excessively high real wages by allowing the currency to depreciate. In principle, Portugal could regained competitiveness by allowing wages to fall, but wages appear to be characterized by downward rigidity in even the most flexible economies,

and rigidities in the Portuguese labor market were extreme, even by European standards, slowing downward adjustment in wages even in the presence of massive unemployment. The pain of the adjustment process could be ameliorated if Portugal could partly eliminate its large productivity gap vis-a-vis the European core economies. But this gap has proven to be large and persistent. Portuguese productivity levels remain low, and the rate of convergence with the higher productivity levels of Northern Europe has been agonizingly slow.

While Blanchard's analysis noted Portugal's poor productivity performance, his paper did not dwell at length on its causes or remedies. Our paper is more focused on this deep foundational source of Portugal's problems, and to better understand its genesis and evolution, we need to go back considerably further in time. In fact, we need to go back all the way to Portugal's institutional divergence from the rest of Western Europe in the 1930s.[5] Founded in the first decade of the 20th century, Portugal's republic was politically unstable and economically poorly managed. Inflation and sovereign debt problems prompted a military coup that brought Minister of Finance Antonio de Oliviera Salazar to power. At the nadir of the Great Depression, Portugal reconstituted itself as an authoritarian state where Salazar ruled with an iron hand. Like its Iberian neighbor, Spain, Portugal remained under this dictatorship well into the 1970s. Initially quite restrictive in its trading relationships with Western Europe, Portugal gradually opened to more extensive trade and investment ties vis-a-vis the rest of the continent, and Portuguese per capita income began to converge with that of continental Western Europe, but a large gap persisted into the 1970s.

The dictatorship collapsed with the so-called Carnation Revolution of 1974. During the long decades of authoritarian rule, the only segment of the political spectrum that had not become heavily tainted by associated with the dictator was the far left. It was therefore not surprising that the post-dictatorship political regime was dominated by politicians with this ideological bent. Seeking to defend workers' rights that had been regularly trampled on during the dictatorship, the new government enshrined high levels of worker protections in the nation's new constitution. Under the new regime, it was nearly impossible for private employers of any size to fire workers or to reduce nominal wages. In addition to aggressive intervention in the labor market, the new regime also sought to increase social spending (which led to inflation and government financing problems), and increase government ownership of the means of production. A number of sectors were effectively nationalized, and existing privately owned enterprises were combined into government-owned conglomerates.

[5]The next several paragraphs draw upon a series of wide-ranging conversations with Portuguese economists and other social scientists, including Rui Baptista (IST), Francisco Lima (IST), Nuno Limao (University of Maryland), and Pedro Martins (QMUL, now Government of Portugal). For a comprehensive history through the 1990s, see Corkill (1999).

The new regime also inherited problems that were not of its own making. At the same time that the dictatorship was collapsing at home, longstanding insurgencies and independence movements in Portugal's overseas territories intensified, the Portuguese military withdrew from Africa, and large numbers of former colonists moved back to Portugal with limited assets, income, and prospects. Students of the global macroeconomic history of the 1970s will observe that these were not terribly good times for a country to attempt to fundamentally remake itself and cope with the collapse of an overseas empire. And Portugal's prospects worsened with the severe global recession of the early 1980s.

The economic performance of the new regime was not good. Macroeconomic instability and the need for a bail-out from the IMF in the early 1980s helped prompt a shift to more centrist economic policies in the 1980s, and this shift was reinforced by efforts to accede to what was then known as the European Economic Community. Over the course of the 1980s, Portugal opened up to greater trade and investment links with the EEC and harmonized a number of its laws and economic institutions with Western European norms (as a condition for EEC accession).[6] The march toward nationalization and monopolization was reversed, with the government breaking up and privatizing in the late 1980s a number of the sectors it had nationalized and monopolized in the late 1970s and early 1980s. The growth in government spending sharply decelerated, government finances were placed on a sounder footing, and monetary policy became much less inflationary. Finally, the extremely strong protections for Portuguese workers were slightly relaxed for all enterprises, and successive Portuguese governments began granting exemptions for smaller firms from various tax and administrative rules and social policies that larger enterprises were constrained to follow.[7]

Combined with a global economic recovery, these policy shifts helped lead to much better economic outcomes. Portuguese economic growth accelerated, employment prospects improved, and growth came in tandem with a much higher level of macroeconomic stability. Portugal benefitted from its position as a relatively low cost manufacturer with privileged access to the core European markets, and manufactured exports to Western Europe grew rapidly. Portugal also benefitted from inward investment from more advanced economies, which provided better technology as well as capital. Despite inflation that was persistently higher in Portugal than in the core European economies, exchange rate movements maintained the competitiveness of Portuguese labor vis-a-vis that in the more productive and advanced core European economies.

But as the 1990s wore on, some of these favorable circumstances began to shift in less favorable directions. In the early 1990s, Portugal, like other Western European countries, effectively pegged its currency to the

[6] SeeHandley and Limão (2010).

[7] See Martins (2009) for an excellent description and detailed analysis of the impact of this relaxation of labor regulations for small firms.

German Deutschemark, as part of preparation for an eventual common currency. The de facto loss of currency flexibility undermined Portuguese competitiveness (and this is reflected in the trade statistics).[8] The collapse of Leninism in Eastern Europe and the rise of China brought a new set of competitors into the relatively low-tech industries in which Portugal had been a successful exporter and this, too, is reflected in the trade statistics. The expansion of the EU in an eastward direction opened up a whole new range of attractive options for Western European multinationals seeking to engage in FDI at the European periphery, and we see this, too, reflected in the data. In the mid-to-late 1990s, as all of these adverse phenomena intensified, their macroeconomic effects were masked for a while by the twin investment and consumption booms that were the focus of Blanchard's prescient diagnosis. When the booms ended, the impact of Portugal's worsening relative competitiveness became far too obvious.

This overview provides a useful context in which to consider the chief empirical contribution of this paper, which is the documentation of the pronounced leftward shift in the Portuguese firm size distribution. Our data window opens in the mid-1980s, as the policy regime was shifting in a more market friendly direction. Greater trade openness might have led to greater competition for larger manufacturing firms. Demonopolization of the industries that had been nationalized could plausibly lead to shrinkage of the largest firms in these industries. Like nearly all industrialized nations, Portugal has witnessed a shift in labor from manufacturing, where firms have traditionally been larger, to services, where they have traditionally been smaller. Successive Portuguese governments made concerted efforts to bring small firms in the "informal economy" into the formal sector, and coverage of small firms in the official databases expanded over time. All of these factors could affect the firm size distribution, and we need to first confirm that the leftward shift in the firms size distribution does not simply arise from these "natural causes."

At the same time, there are ample reasons to believe that government interventions in the labor market continue to distort the allocation of labor across firms. Even after the partial labor market reforms of the late 1980s, it remains very difficult for enterprises – especially those with over 20 employees – to fire workers for cause or to lay-off workers even in difficult economic circumstances. It remains all but impossible for firms to reduce employees' nominal wages, even when the firms face very adverse circumstances. Legally mandated severance payments are quite high, even by European standards, and Portuguese courts have been consistently characterized by a pro-worker orientation. Portuguese firms are required to provide a range of services to employees. OECD rankings of member states on the basis of labor market protections consistently placed Portugal at the very top through the mid 1990s. At that point, it was ranked second after Turkey,

[8]The issues in this paragraph are noted in Blanchard (2007).

and Turkey's macroeconomic performance in the 1990s and 2000s has also been quite uneven.

Another dimension of distortion revolves around the increasing extent to which the Portuguese legal, tax, and administrative regime discriminates against larger enterprises. Appendix B lists a large number of policies which only apply to firms above a certain size. These policies span virtually the entire spectrum of public regulation of enterprise from compliance with accounting rules, to minimum wage requirements, to tax policy. It is common for social democratic European countries with elaborate labor laws and protections to exempt the smallest firms from many policy requirements and mandates. In other countries, these exemptions are often granted to all enterprises below a certain threshold, and this tends to be associated with a "bulge" in the firm size distribution just below the common threshold at which many of these requirements hold.[9] In Portugal, we find no "bulge" in the firm size distribution, probably because there is no common threshold but rather a very large number of different thresholds that are connected to different policies. However, it is clear that, as Portuguese enterprises grow in size, they confront a steadily growing set of rules, regulations, and mandates that increasingly drive a wedge between the value of employees to the firm and the cost of employing workers while maintaining compliance with all relevant laws. The absence of a single clear threshold does not eliminate the possibility that firm growth is deterred by a gradual accretion of increasing mandates and costs.

In Section 4, we introduce a theoretical model that reflects both these dimensions of distortion. We first illustrate how strong labor market protections can function as a tax on wages and, in turn, how that can lead to a leftward shift to a firm size distribution. Even when there is a uniform tax that does not apply with greater incidence against large firms, we find that the reductions in employment relative to the no-distortion benchmark are greatest for the larger firms. It is straightforward to show that workers are shifted into less productive enterprises and aggregate per capita output falls as the firm size distribution shifts to the left.

To reflect the more recent pattern of exemptions for small firms, but requirements for larger firms, in Section 5 we replace our uniform tax with a nonlinear tax, and show that a large decrease in the uniform component of the tax, if accompanied by introducing an relatively modest rate of increase of such a tax with firm size, can actually lead to an even bigger leftward shift of the firm size distribution and efficiency loss than a large *increase* in the uniform tax. It thus appears that more recent attempts by the Portuguese government to relax labor protections for smaller firms while also "tilting" the playing field against larger firms have only exacerbated the negative effects in terms of the shift in the firm size distribution and efficiency.

Before we develop this model and apply it to the Portuguese economy, though, we must first document

[9]See Garicano et al. (2011), who find evidence of such a bulge in the French firm size distribution.

the shift in Portugal's firm size distribution and demonstrate that it is not fully attributable to "natural causes." And that is the focus of our next section.

3 Firm Size Matters: Shifts in the Portuguese Firm Size Distribution, 1986-2009

Table 1 shows the evolution of firm size, measured by the total number of workers, of the Portuguese entire economy, by quartile, from the opening of our data window in 1986 through the most recent year for which we have complete data, 2009. The shift in the entire firm size distribution is immediately apparent. It also appears if we measure firm size by revenues rather than workers. If we plot data by decile, we see that firm size is declining at every decile, save the lowest.

What is also interesting is that we do not see a shift like this in other advanced industrial countries for which comparable data are easily available. The Business Dynamics Statistics database maintained by the U.S. Census Bureau allows users to examine changes in the distribution of U.S. firms by employment size category[10] of the U.S. Census Bureau. While the on-line database does not allow us to produce a table that looks exactly like Table 1, it is clear from the histogram one can produce with these data that the U.S. firm size distribution has modestly shifted to the right. Between the late 1970s and 2009, the number of firms in the smallest categories declined slightly, and the number of firms in most of the largest categories increased slightly. This looks nothing like the shift we see in Portugal.

Figure 1 illustrates the shift in the U.S. firm size distribution. Of course, the United States is not necessarily an ideal comparator for Portugal. Instead, one might want to look at another comparable European economy. Fortunately, similar data are also available for Denmark. In fact, the data for Denmark are more detailed and more comparable to that the Portuguese data than is the case for the U.S., allowing us to construct a table that is easily comparable to the one we created for Portugal.

Table 2 shows that the average firm size in Denmark has actually grown in the last 30 years. Not only that but all other percentiles of the data have either grown or remained constant. As in the U.S., it seems the firm size distribution in Denmark has shifted somewhat to the right. But even if there is a shift in the measured Portuguese firm size distribution that is not evident in the data for other industrial countries, it is still possible that the shift could be an artifact of the data or it could arise for reasons other than distortionary government policies.

[10] `http://www.ces.census.gov/index.php/bds`

3.1 Is the Shift an Artifact of Increasing Data Coverage?

An increase in database coverage could have caused an apparent shift in the Portuguese firm size distribution. Small firms could have been previously operating "under the radar" and not reporting their existence in order to escape paying taxes and social security contributions. As these, mostly small, firms move into the formal economy a decrease in the firm size distribution could appear in the data, even though the underling real FSD remained unchanged. Dell'Anno (2007) claims the informal economy has indeed decreased in Portugal, as depicted in Table 3 transcribed from that study.

To see how much of the leftward shift in the firm size distribution may be attributable to the decrease in the informal economy, we make use of the regulation that requires firms to disclose how long they have been operating, and the tenure of their employees at the time of their first formal registration. Table 4 reports the percentage of new firms (firms that are in the database for the first time) that report tenures of at least 3 years for at least one worker. It seems from these data that the database is indeed becoming more inclusive. Once we have identified using this procedure firms that had been operating in the informal economy before they became formally registered, we use a simple regression approach to correct our firm size distribution for the effects of increasing data coverage.

Specifically, we estimate recursively the following regression for firms identified as having entered from the informal economy:

$$E_{t-1} = E_t + \beta_1 FirmAge + \beta_2 IndustryControl.$$

The regression is estimated recursively for the previous 5 years or the maximum workers' tenure reported, whichever is smaller. The resulting coefficients are then employed to infer the size in the previous year, given the size in the current year, firm age, and industry.

Table 5 compares the original and corrected average firm size. Table 6 shows the decile decomposition of the corrected firm size. Figure 2 compares the 1987 original and corrected firm size density. Figure 3 compares the 2007 original and corrected firm size density.

In line with the story that the size of the informal economy in Portugal has been getting smaller over the years (Dell'Anno (2007)), the correction procedure above seems to have a much greater impact in the early that in later years. It turns out that of our original 8.6 drop in average firm size 1.95 or 22% can be explained by increased database coverage. If we consider the entire firm size distribution rather than a single moment, such as the mean, the impact on our measured shift appears limited, as the figures indicate.

3.2 Demonopolization in the 1980s

As mentioned in the introductory section, the opening of our data window broadly corresponds to the period in which Portuguese economic policy was shifting to the center, and earlier efforts to nationalize and monopolize certain critical sectors were reversed. This "denationalization" and "demonopolization" policy was concentrated in sectors such as electricity generation/distribution, railway management/operation, cable and DSL based telecom companies, gas and water distribution (with the establishment of regional monopolies), and regional transport, where earlier nationalization and monopolization efforts had been concentrated. Forcing the breakup of large companies into several smaller ones could, in principle, drive the measured firm size distribution to the left.

Unfortunately, our data, which have replaced firm names with identifier codes to maintain anonymity, do not allow us to easily identify exactly which enterprises were subject to this policy. However, we can show that even if we control for all significant firm breakups in our data over our sample period, this is insufficient to explain the shifts we see in the data. The procedure we follow below is to identify firm breakups through worker movements, which we can track quite easily. We identify any firm whose initial workforce is composed of over 50% of workers that worked together in another firm in the previous year as being created as a result of a breakup or divestiture. Obviously, this procedure captures not only government forced breakups but also voluntary ones. The procedure is applied to all firms with more than 50 workers, even though the conventional wisdom regarding the demonopolization and denationalization policies of the 1980s suggests that they were concentrated on much larger enterprises. Our procedure will thus capture many other kinds of breakups, including spinoffs that contained a high degree of worker movement from the parent to the new firm.

As a result of the procedure described above, we have identified 982 firms with more than 50 workers as having been created out of some kind of divestiture or breakup procedure. To measure the impact of firm breakups in the change in average firm size we can compare the current situation with a hypothetical world where these firms never went through a breakup. To do so we consider that only the parent firm survives and that its size is the sum of the sizes of all of its offspring.

Table 7 shows the results. Out of the remaining 5.6 average firm size reduction (after the correction for increased database coverage), breakups only explain 0.001 difference in average firm size or close to 0.002%. Other moments of the firm size distribution remain broadly unaffected as well. This particular aspect of recent Portuguese policy history does not explain the leftward shift in the firm size distribution.

3.3 The Switch to Services

Another factor contributing to decreases in firm size is the change in the structure of the Portuguese economy. Like all other advanced industrial economies, Portugal has seen a decline in the employment share of manufacturing, and a corresponding rise in the employment share of the service sector over our sample period.

Table 8 shows this change. Firms in the service sector have historically been considerably smaller than firms in manufacturing as can be seen in Table 9. So the switch in economic fabric is yet another factor contributing to the decrease in firm size. To measure the impact of the change in the economic fabric of Portugal on the firm size distribution we compare the observed decrease in size with the counterfactual of what would have happened if the change in employment shares had not occurred. To do so we compute the expected firm average size in 2007 if the aggregate sector weights were the same ones as in 1987.

This calculation yields an expected firm size in 2007 of 11.36 workers. The unexplained remaining gap of 15.67 to 9.11, or about 6.57, can then be decomposed into the change of size within sectors from 15.67 to 11. 13 and the change in sector composition from 11.36 to 9.11. The change in industry composition explains 2.25 out of the initial 8.6 difference, or about 26%. Although we do not report these results here, one can undertake a similar exercise for other moments of the distribution. The clear conclusion is that, while the shift to services explains part of the shift in the firm size distribution, it explains only part of the shift. Even within the service sector, we see a decline in average firm size and a decline at every size decile. We also remind the reader that, while other countries like the United States and Denmark have also undergone a shift toward greater employment in services, they have not experienced the same leftward shift in the entire firm size distribution that we have seen in Portugal.

Several interesting conclusions emerge from this section. First, the entire firm size distribution in Portugal has shifted significantly to the left. Second, we do not see similar shifts in other Western countries for which we have comparable data. Third, the Portuguese shift cannot be plausibly ascribed to expanding data coverage or other "natural causes." While expanding data coverage and other factors can explain part of the shift that we observe, a great deal remains unexplained. To account for this large residual, we turn now to the consideration of a category of economic policies that Portugal has pursued to an extreme degree in the post-Salazar era: employment protections for workers.

4 Labor Protection

Labor Protection is notoriously high in Portugal. The OECD index of Strictness of Overall Employment Protection[11] has listed Portugal as the country having the most protective labor laws in the entire sample from 1985 to 1996. Since 1996, it has ranked second overall (after Turkey), but it is the highest ranked Western European country by a considerable margin. In 2007 Denmark placed 20th and the US 29th out of the 29 OECD countries.

Various aspects of Portugal's employment protection regime have been discussed in detail elsewhere (e.g., Blanchard and Portugal (2001) and Martins (2009)). For now, we note that Portugal's regime makes it very difficult for all but the smallest firms to fire workers for cause, to lay off workers in a downturn, and to reduce nominal wages. In addition to the law itself, many sectors in Portugal remain highly unionized, and union contracts introduce additional protections that go above and beyond the (very high) minimum required by law. With strong employment protection, we would expect firms to be especially cautious when hiring workers, due to the difficulties involved in firing them later. Firms facing a tumultuous market might put off hiring workers that would be useful in the present but that would become costly to let go if conditions deteriorated. These fears might lead to biases and mis-allocations of workers across firms.

Most of the theoretical literature on the economics of such labor laws states they they have a dampening effect on worker mobility: firms do not hire as much when conditions are good and do not fire as much when conditions deteriorate. However as noted by Lazear (1990), if labor protection costs can be undone by efficient markets, then the only outcome of stricter labor protection is the reduction in wages and there are no further repercussions in terms of protective labor laws in terms of employment effects or efficiency. For example, if the total costs of firing a worker are given to that worker in the form of severance pay then both the firm and the worker will consider that severance costs plus wages are the workers total cost or revenue. Thus in a frictionless world, the same workers will work for the same companies, the only difference being that their wages will be reduced to take into account a final balloon payment.

As Lazear (1990) also notes, this analysis holds only if wages are completely flexible. Particularly in the presence of minimum wages or other sources of downward wage rigidity, firms' ability to lower wages in response to employment protections is limited. There is a strong correlation across countries between high levels of employment protections and the presence of high (and binding) minimum wages. In addition, in countries with elaborate employment protections, wages are often decided by collective agreements negotiated with labor unions. This setting further compromises the ability of firms to offset the effects of labor protection

[11] `www.oecd.org/employment/protection`

through lower wages. And a realistic degree of risk aversion on the part of workers coupled with a realistic degree of bankruptcy risk on the part of a firm can limit even further the trade-off between severance payments and regular wages. We believe that, in the Portuguese context, the various frictions Lazear keeps in the background of his model are a sufficiently important part of the economic landscape that employment protections almost surely have significant effects on the working of the labor market. But is it reasonable to think that these protections could also impact the firm size distribution and aggregate productivity?

In order to guide our thinking on these issues, we present a variation of the celebrated Lucas "span-of-control" model (Lucas (1978)), which describes the firm size distribution of an economy taking into consideration also the occupational choice. Labor protection costs are modeled as a tax on labor. We view this as a simplification of a far more complex interaction between workers and firms in which greater labor protections transfer bargaining power to workers. The work of Grout (1984) and Grossman and Hart (1986), among others, suggests that standard Nash bargaining outcomes will lead to an effect that operates much like the simple tax we use in the model below. [12]

4.1 Modeling the Firm Size Distribution in the Presence of Labor Protection

Following Murphy et al. (1991) variation of the Lucas model, we assume that there is a distribution of ability x in the workforce, with the support of $[1, x_{max}]$ and the strictly positive density function $g(x)$. There is only one good in the economy which is produced by many firms. If a firm is organized by an entrepreneur with ability x, its profits are given by

$$\pi(x; w, T) = xh^{\alpha} - wTh,$$

where h is the aggregate human capital (ability) of all the workers employed by this entrepreneur, $0 < \alpha < 1$ is the parameter of the production function, w is the workers' wage, the price of good is normalized to be 1, and $T \geq 1$ is the gross tax on labor.

The first order condition determines the optimal size of the firm given the ability of the entrepreneur, the wage and the gross tax rates per efficiency units of labor employed:

$$h(x; w, T) = \left(\frac{x\alpha}{wT}\right)^{\frac{1}{1-\alpha}}. \tag{1}$$

Abler entrepreneurs obviously run larger firms and since there are increasing returns to ability in en-

[12] As we were developing this model, we came across Garicano et al. (2011) who take a similar approach with their own study of employment protections in France.

trepreneurship, optimal firm size is actually a convex function of x and so are entrepreneurial profits:

$$\pi(x; w, T) = x^{\frac{1}{1-\alpha}} (wT)^{-\frac{\alpha}{1-\alpha}} c,$$

where $c = \alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}} > 0$.

Note also that given w, an increase in T lowers the optimal sizes of all firms. Of course, an increase in tax will not leave wages unchanged, so we now turn to market equilibrium.

An individual becomes an entrepreneur when

$$\pi(x) > wx,$$

and a worker otherwise. The abler people become entrepreneurs in equilibrium, and the less able ones become workers. The ability (human capital) level that defines the cutoff between entrepreneurs and workers is denoted by z and is given by the indifference condition:

$$wz = z^{\frac{1}{1-\alpha}} (wT)^{-\frac{\alpha}{1-\alpha}} c,$$

or equivalently by:

$$z = \left(\frac{w}{c^{1-\alpha}}\right)^{\frac{1}{\alpha}} T. \tag{2}$$

The demand for workers by entrepreneurs must equal the supply of workers:

$$\int_1^z x\, g(x)\, \mathrm{d}x = \int_z^{x_{max}} h(x)\, g(x)\, \mathrm{d}x. \tag{3}$$

The existence and uniqueness of the equilibrium pair (z, w) is a standard result in the Lucas "span-of-control" model and it is not affected by the presence of the labor tax, so we do not present it here. Figure 4 illustrates the occupational choice.

A rise in labor protections (an increase in labor tax) will have repercussions for both the equilibrium wage rate w and for the cutoff ability z. It might seem at first sight that since a higher tax reduces profits, this will induce marginal firms to exit, raising the cutoff ability required to be an entrepreneur. Such a conclusion, however, does not take into account the effect of the equilibrium adjustment of the wage rate. As it turns out, in equilibrium a higher T not only leads to smaller sizes of all existing firms, but also induces *entry* by entrepreneurs with ability below the z that prevailed in the previous equilibrium. More formally, we have

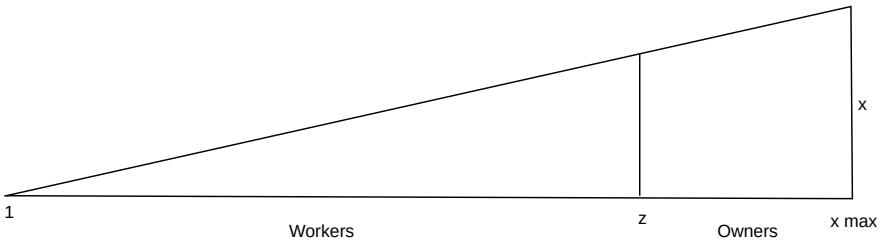


Figure 4: Occupational Choice

Proposition 1: *An increase in labor protections reduces equilibrium wage and optimal sizes of all incumbent firms. It also induces new entry of firms run by entrepreneurs in the lower tail of the entrepreneurial ability distribution.*

Proof: From the indifference condition (2) we have

$$(wT)^{-\frac{1}{1-\alpha}} = z^{-\frac{\alpha}{1-\alpha}} T^{-1} c^{-1}.$$

Substituting for the optimal size of the firm (1) in the equilibrium equation (3) and using the expression immediately above we obtain

$$cT \int_1^z x\, g(x)\, \mathrm{d}x = \alpha^{\frac{1}{1-\alpha}} z^{-\frac{\alpha}{1-\alpha}} \int_z^{x_{max}} x^{\frac{1}{1-\alpha}}\, g(x)\, \mathrm{d}x, \tag{4}$$

which implicitly determines equilibrium z as a function of T (and the parameters of the model). Straightforward differentiation shows that $\frac{dz}{dT} < 0$.

Next, rearranging and differentiating the indifference condition (2) we obtain that

$$w'(T) = c^{-\frac{(1-\alpha)}{\alpha}} [-\alpha T^{-\alpha-1} z^{\alpha} + \alpha z^{\alpha-1} T^{-\alpha} \frac{dz}{dT}] < 0,$$

because $\frac{dz}{dT} < 0$.

Finally, using equation (1) we can see that optimal firm size is inversely proportional to the gross of tax wage rate wT for any x, hence all optimal sizes of incumbent firms will change in the same direction in response to an increase in taxes. Suppose, by way of contradiction, that optimal sizes of incumbent firms increase or at least do not decrease in response to a higher tax on labor (in principle, this could happen if the incidence of tax falls more than 100 percent on the workers, so that $\frac{d(wT)}{dT} < 0$). If that were the

case, however, labor demand from incumbent firms will increase or at least stay constant as compared to the previous equilibrium situation (before the increase in tax), while new entry will definitely increase overall labor demand. Labor supply, on the other hand, has to go down because z shifts to the left as shown above. Thus the new situation where all incumbent firms expand or at least do not decrease their optimal sizes cannot be an equilibrium, meaning that we must have $\frac{\partial h(x;T)}{\partial T} < 0$ for any x. □

The preceding argument also shows that the equilibrium gross of tax wage wT will be increasing in T. The incidence of tax is always shared between firms and workers in the model.

Why does an increase in labor tax lead to entry by more marginal firms? Intuitively, this happens because wage earnings for the marginal worker/entrepreneur go down by more than his/her profits as an entrepreneur. Thus, the worker with ability z who was indifferent between working for wage or running his/her own firm before the tax increase now strictly prefers to run his/her own firm. To see this even more clearly, suppose that after an increase in taxes the wage was such that the worker with ability z in the previous equilibrium was still indifferent between working for pay and being an entrepreneur. This would imply that the supply of labor has not changed from the previous equilibrium (with a lower tax). But with a higher tax all existing firms now have lower profits and smaller optimal sizes, so the demand for labor is definitely lower than it was before the tax increase. Thus, the wage has to come down further and that induces the marginal worker to switch to entrepreneurship. An increase in labor protection, somewhat unexpectedly, pushes more workers into starting their own firms, and these newly created firms are less efficient than incumbent firms.

The effect of an increase in employment protection on firm size distribution follows in a straightforward fashion from Proposition 1:

Corollary: *An increase in labor protections produces a leftward shift of the firm size distribution.*

Proof: Proposition 1 implies that all incumbent firms decrease in size, while there is entry by even smaller firms due to a decrease in the ability of the marginal entrepreneur z. The claim follows immediately. □

4.1.1 Welfare, Output, and Productivity

Welfare in the model is given by economy-wide output:

$$Y = \int_{z(T)}^{x_{max}} x h(x;T)^{\alpha} g(x)\,\mathrm{d}x.$$

Totally differentiating with respect to T, we obtain

$$\frac{dY}{dT} = \alpha \int_{z}^{x_{max}} x h^{\alpha-1} \frac{\partial h}{\partial T} g(x)\,\mathrm{d}x - z h(z;T)^{\alpha} g(z) \frac{dz}{dT}. \tag{5}$$

Equation (5) shows that the effect of the tax on labor can be decomposed in two parts. The first part is the decrease in output of incumbent firms, which are now producing at less than their optimal levels without tax. The second part is the additional output produced by former employees who now find it relatively more attractive to start their own firms. Total output and welfare decline because workers that leave employment to become entrepreneurs do not have the same level of ability as their previous employers and so are unable to compensate for the production loss taking place in the firms they left.

In our model, higher taxes will lower aggregate output. Since we assume that population is fixed, this means that output per capita falls. We therefore use per capita output as our measure of the economy's aggregate productivity. This particular measure of productivity is helpful in linking our analysis to considerations of national welfare. References elsewhere in the text to the implications of our analysis for the "productivity" of the Portuguese economy are, therefore, meant to indicate per capita output. Our modeling assumptions – especially the assumption of diminishing returns to labor within firms – imply that the marginal product of labor within firms actually increases as taxes force firms to decrease employment. But, at the aggregate level, the ability of the economy to produce output with its labor endowment clearly declines, because labor is shifted out of productive enterprises and into less productive ones.

4.1.2 Non-linear Effect of a Linear Tax

Even though we have so far assumed that the marginal tax rate on labor is constant and independent of firm size, it is important to note that the effect of increasing such a tax results in a disproportional decrease in the sizes of the largest, that is, most efficient firms. Formally, from the expression for the optimal size of the firm (1) we have

$$-\frac{\partial h}{\partial (wT)} \frac{wT}{h} = \frac{1}{1-\alpha} > 1,$$

so that the elasticity of the optimal firm size with respect to gross of tax wage is greater than 1. This, of course, is a consequence of increasing returns to entrepreneurial ability and it shows that labor protection has a disproportionately large impact on the size and output produced by the most efficient firms in the economy.

4.2 The Self Employment Option

A salient feature of the Portuguese economy in the last several decades has been not just the leftward shift in the overall firm size distribution, but an especially sharp increase in the number of firms that have no employed workers (self employment). Table 10 shows that the fraction of self employed businesses in the total increased from a little over 1 percent in the late 1980s to 3.5 percent in the late 1990s and eventually exceeded 10 percent by the late 2000s. The self employment choice can be incorporated into the model presented in the previous subsection. Self employment, in contrast to being a worker, entails an extra non-pecuniary benefit of "being your own boss". Past research has shown that such non-pecuniary benefits are pervasive and quite large (see, e.g., Hamilton (2000), Moskowitz and Vissing-Jorgensen (2002)). Thus, total return for the self employed individual is given by $x+B$, where B is the utility component.[13] The individual is self employed if $x + B > wX$ and a worker otherwise. Let the equilibrium wage and cutoff ability that solve the system of equations (2) and (3) in the previous subsection be given by (w^*, z^*). We have

Lemma 1: *In the presence of the self employment option, either $w^* \geq 1 + B$ and there are no self employed in the economy, or $w^* < 1 + B$ and there is a second cutoff ability z_{min} such that all individuals with $x < z_{min}$ are self employed while all individuals with $x \geq z_{min}$ are either paid workers or owners of entrepreneurial firms. In this latter case, there is a pair $(\hat{w}, \hat{z})$ with $\hat{w} > 1 + B > w^*$ and $\hat{z} > z^*$ such that $(\hat{w}, \hat{z})$ are the equilibrium wage and the cutoff ability, respectively, of the "truncated" labor market, where the pool of potential workers and entrepreneurs has the support $[z_{min}, x_{max}]$.*

Proof: The first part of the claim is trivial. Assume therefore that the equilibrium wage without self employment $w^* < 1 + B$ and let $u > 1$ be defined as the solution of the equation $w^*x = x + B$ if such a solution belongs to the interval $(1,\ x_{max})$, otherwise, let $u = x_{max}$. By construction, all individuals with $x \leq u$ prefer to be self employed rather than work in firms, so the supply of labor will be given by $\int_u^z x\, g(x)\, \mathrm{d}x < \int_1^z x\, g(x)\, \mathrm{d}x$, while the demand for labor remains unchanged. The resulting excess demand for labor will tend to increase the wage rate above w^* leading, in its turn, to a decrease in the demand for labor by incumbent entrepreneurial firms and also a rightward shift of the cutoff ability z (because the increase in the wage rate makes working for pay more attractive than running an entrepreneurial firm for the individual with the cutoff ability z^* in the previous equilibrium). The process will continue until the new equilibrium is attained; in this new equilibrium we must have $\hat{w} > 1 + B > w^*$ and $\hat{z} > z^*$. □

Thus, the equilibrium with self employment is characterized by the triple $(\hat{w}, z_{min}, \hat{z})$ which jointly solves

[13] Equivalently, we may assume that there is a legal minimum wage $\bar{W}$ which has to be paid to a worker regardless of his/her efficiency units of labor endowment. The analysis below goes through with this alternative assumption.

the following three conditions:

$$z_{min} + B = \hat{w} z_{min}, \tag{6}$$

$$\hat{z} = \left(\frac{\hat{w}}{c^{1-\alpha}} \right)^{\frac{1}{\alpha}} T, \tag{7}$$

and

$$\int_{z_{min}}^{\hat{z}} x\, g(x)\, \mathrm{d}x = \int_{\hat{z}}^{x_{max}} h(x)\, g(x)\, \mathrm{d}x. \tag{8}$$

Figure 5 illustrates the resulting occupational choice.

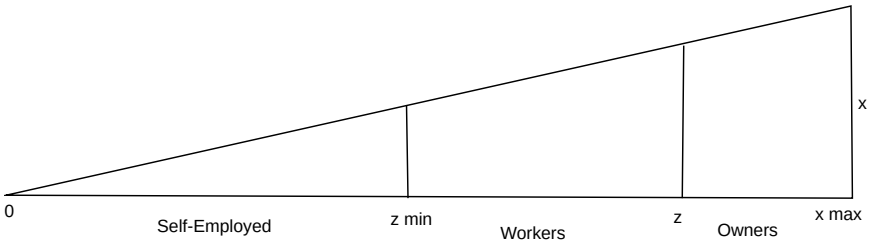


Figure 5: Occupational Choice

An increase in labor protections (the tax on labor) in the equilibrium with self employment has similar effects on the equilibrium wage $\hat{w}$ and the equilibrium cutoff ability between workers and entrepreneurs $\hat{z}$ as before, although the decline in equilibrium wage and the decrease in $\hat{z}$ are less in magnitude. In addition, an increase in labor protections increases the fraction of the labor force that chooses to be self employed. Formally, we have

Proposition 2: *In the presence of self employment, an increase in labor protections reduces equilibrium wage and optimal sizes of all incumbent firms. It also induces new entry of firms run by entrepreneurs in the lower tail of the entrepreneurial ability distribution as well as transition of former workers in the lower tail of workers ability distribution into self employment.*

Proof: Since the proof of the first three claims is almost identical to the proof of Proposition 1 we do not repeat it here. To prove the last claim just observe that from (6) $\frac{\partial z_{min}}{\partial \hat{w}} = -\frac{1}{\hat{w}-1} < 0$, so that the cutoff ability between the self employed and the paid workers will increase as the wage decreases in response to a

higher tax on hired labor. □

Both the corollary to Proposition 1 and the welfare implications from the previous subsection remain valid and are actually reinforced by self employment. In particular, the firm size distribution will shift to the left not just because of the decrease in the sizes of incumbent firms and additional entry by marginal entrepreneurial firms, but also because of an increase in entry by the smallest firms, those with no employees. Total output will also go down because of decreased production of existing firms that is not compensated by the production of the new marginal entrants and because the new self employed do not benefit from the production boost of their previous managers.[14]

4.3 Calibrating the Model

We saw in the previous two subsections that the model, especially the model with the self employment option captures the qualitative features of the evolution of the firm size distribution in Portugal over the past quarter century. The question remains, however, whether it can capture the quantitative features of this evolution for some reasonable parameter values.

To answer this latter question we conduct our first simple calibration exercise (see also the next section). We choose the standard value of the parameter of the production function $\alpha = 0.67$, and we assume that ability (human capital) is distributed uniformly on the interval [1,10]. With these model parameters, the equilibrium average firm size with no labor protections would be 22.59 employees, while the size of the firm at the 90th percentile would be 27 employees (see the first column in Table 11).

The second column of Table 11 shows that in order to match the average firm size in the Portuguese data in 1986 without introducing the self employment option, the net tax rate on wages should be 50 percent ($T = 1.5$). With this tax rate, the size of the firm at the 90th percentile of the firm size distribution is 20 employees, somewhat lower than the actual number (23 employees in Table 1). The 50 percent tax rate on wages also results in the reduction of the equilibrium wage by 27 percent as compared to the no tax equilibrium. The impact on gross total output is small (it declines by just over 1 percent) but net of tax output declines by 14 percent.

The third column in Table 11 shows that in order to match the decline of the average firm size similar to the one observed in the Portuguese data from 1986 to the late 2000s, the tax on labor must be increased to 200 percent ($T = 3$). The corresponding decline in equilibrium wage is more than 50 percent compared to

[14]The new self employed do receive non-pecuniary benefits from exercising their self-employment option, so that their actual utility loss is lower than the loss in output. Still, those individuals chose to work for wage before the tax increase, so they are worse off overall in the new situation, although not by as much as they would be without the self employment option.

the no-tax case and net of tax output is also reduced by almost one half. A simple linear tax model without self employment requires somewhat unrealistically high tax rates and wage declines in order to produce firm size patterns observed in the data.

Including the self employment option makes the situation look much more reasonable. Table 12 shows the results of the calibration with the same parameters as before, while also assuming that the utility component of being self employed $B = 1$, so that being self employed doubles the total return to human capital of the least able worker. Under this parametrization, the equilibrium wage without tax on labor is 2.21, so the self employment option is not exercised in the no-tax equilibrium, which thus looks exactly the same as the no-tax equilibrium in the previous case (Table 11).

Introducing the tax on hired labor now has the additional effect of pushing some workers into self employment. This effect is actually quite significant quantitatively, as the average firm size (inclusive of self-employed firms) declines much faster with an increase in tax than before. As can be seen from column 2 of Table 12, a 30 percent net tax on labor ($T = 1.3$) is now sufficient to generate the average firm size matching the actual average firm size observed in Portugal in 1986. The fraction of the self employed is 2 percent, which is also fairly close to the actual data (see Table 10). Moreover, in order to match the subsequent decline of the average firm size we now need to assume that T has to be increased to just 1.8 (rather than 3). The fraction of the self employed under this tax rate is 15 percent, which is somewhat higher than in the data, but as a result of this, the decline in the wage is limited to 36 percent (rather than 57 percent without the self employment option) and net of tax output also goes down by 24 percent rather than by 49 percent as without self employment.

Figure 6 shows the distribution of firm sizes under the no-tax, $T = 1.3$ and $T = 1.8$ scenarios above. In the next section we will see that the actual dynamics of labor protections in Portugal were heavily biased against larger firms. This can be incorporated into the model by assuming a nonlinear tax on labor. Calibration exercises based on the nonlinear tax produce an even more realistic picture of the effects of increasing labor protections, especially in the presence of self employment (see subsection 5.3).

5 Biases against Large Firms in Portugal

Portugal is known for having strong government support systems for small firms. Small firms are typically viewed as important economic drivers and worthy of stronger support then larger firms. These incentives to be a small firm might hamper firm growth and exacerbate biases and mis-allocations of workers across firms.

A particular aspect of government systems to promote small businesses is that they commonly contain several provisions favoring firms under various specific size thresholds. Hence, such laws might create incentives for firms to remain below a certain size threshold and so decrease the average firm size. The impact of these types of thresholds has already been the subject of several past studies.

For example, in Portugal the impact of the threshold created by the DL 64-A/1989 law was studied by Martins (2009). The study found that the threshold did not create a significant distortion in the worker flows of firms above and bellow the threshold. The study did find, however, that firms under the threshold gained sizable increases in relative performance. A similar law with a 15 worker threshold in Italy was analyzed by Schivardi and Torrini (2008). The authors found that the law created a concentration of firms under the threshold and that firms just bellow the same had a 2% lower probability of growth. Garibaldi et al. (2003) and Boeri and Jimeno (2005) found a similar effect when analyzing the same law.

Our analysis indicates that at least In Portugal, government support system for small firms has not created a concentration of firms under any particular threshold. This may reflect the fact that there many different laws have been introduced over the past few decades, with many different thresholds (see Appendix B for the list of relevant laws and their brief description). Figure 7 shows the number of firms for each size category from 5 to 60 workers. The 10, 20 and 50 thresholds are highlighted by a vertical line, as each of these thresholds occurs in more than one Portuguese law. As the reader can see, there is litte indication that firms prefer to stay below any of them.

To test this more formally, we follow the methodology proposed by Schivardi and Torrini (2008) to see if firms change their growth behavior close to the thresholds. Specifically, we estimate a probit model of the form:

$$Y_{it} = \alpha + E_{t-1} + E_{t-1}^2 + E_{t-1}^3 + E_{t-1}^4 + Age_{t-1} + Age_{t-1}^2 + Ind_{t-1} + \sum_{k=5}^{60} D(E_{t-1} = k)$$

Where Y is an indicator stating if the firm grew from the last period to the current one, E is employment, Age is firm age, Ind is a set of industry dummies and D is a set of dummy variables that equals one if the firm was of that specific size in the previous period. The idea is test whether, after controlling for firm size, the specific size thresholds still retain some effect. The resulting threshold coefficients are plotted in figure 8. All of them were statistically significant but they do not point to a strong clustering at any of the thresholds. Even when considering year to year changes (by interacting the threshold controls with year controls) there is no discernible pattern around the patterns identified by the laws. The same pattern emerges when running the probit on a variable indicating that the firm shrank.

5.1 Threshold Crossing Probability

Another way to check if the thresholds introduced by the laws are influencing firm size is to see if the probability that some thresholds will be crossed varies around those specified thresholds. Figure 9 plots the probability of crossing size thresholds between 5 and 60. Firms can either grow above the threshold of shrink below it. The picture looks quite smooth, with no kinks at any particular thresholds.

One way in which firms could be responding to the laws is by changing the composition of their work force. Firms could for example hire more temporary workers above the thresholds to be able to maintain a flexible work force. To see if this pattern can indeed be found in the data we have examined the percentage of temporary workers in total number of workers below and above various firm size thresholds and did not detect any major changes in contract types. The same holds for part-time contracts. Wages and firm survival probabilities also do not seem to change significantly at the thresholds. Overall there is no strong evidence that the thresholds identified by the laws impact firm size in any significant manner.

Our interpretation of these results is straightforward. The absence of "threshold effects" does not mean that the bias against larger firms has no effect. It instead stems from the wide range of different thresholds at which the various policies begin to bind. As productive firms in Portugal grow, they do not run into a solid wall of greater employment protection costs at some particular size. Instead, the growth momentum may be undermined by a gradual accumulation of costs that are individually small but collectively amount to a significant disincentive to growth. We model such a situation theoretically in the next subsection by introducing a degree of nonlinearity into the model with labor tax from the previous section.

While measures to support small firms have been added over the past 20 years, the situation with accumulating barriers to firm growth appears to have worsened over time as laws that effectively discriminate against larger enterprises proliferated. Some telling evidence of the effects of such increased bias against larger firms can be seen in Figures 10 and 11. These two Figures show the change in the probabilities of growing above a certain threshold or shrinking bellow it, respectively, for firms of different sizes that occurred over these 20 years. We can see that the probability of growing to the next level has diminished fairly substantially at all firm sizes. Portugal's firm size distribution has shifted to the left, in part, because enterprises do not have the same propensity to grow larger in the latter part of our time period that they had at the outset. We also see that the probability of a firm shrinking in the next period compared to the previous period has increased over time, and this increase is concentrated in the smaller size ranges. This could reflect the fact that the labor market costs of reducing workforce size tend to be much higher for larger firms.

5.2 Equilibrium With a Nonlinear Tax

Given the reality of a labor protection regime that hits larger firms more intensely, we redefine the equilibrium in this section with a nonlinear labor tax. Let the profit of the firm run by entrepreneur of ability x be given by

$$\pi(x; w, T(h)) = xh^{\alpha} - whT(h),$$

where $T(h)$ is assumed to be an increasing function of the firm size h. For simplicity, we will assume that $T(h)$ has constant elasticity $\delta > 0$ with respect to h, $T(h) = \mu h^{\delta}$. Let $\beta \equiv \delta + 1$, then the profit function can be written as

$$\pi(x; w, \mu, \beta)) = xh^{\alpha} - w\mu h^{\beta}$$

.

The parameter $\mu > 1$ is the linear component of the gross tax on labor corresponding to T in the previous section, while $\beta > 1$ reflects the convexity of the overall cost of hiring extra workers under the non-linear tax on labor. Taking the first-order condition, we can solve for the optimal firm size as before:

$$h(x; w, \mu, \beta) = \left(\frac{\alpha x}{\beta w \mu}\right)^{\frac{1}{\beta-\alpha}} \tag{9}$$

Clearly, *ceteris paribus* the optimal firm size is decreasing in both the linear and non-linear parameters of the tax.

The optimized profit is given by:

$$\pi(x; w, \mu, \beta) = x^{\frac{\beta}{\beta-\alpha}} (w\mu)^{-\frac{\alpha}{\beta-\alpha}} \left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{\beta-\alpha}} (1 - \frac{\alpha}{\beta})$$

As in the previous section, the cutoff ability of the marginal entrepreneur is determined by the indifference condition similar to equation (2), from which we obtain, after some manipulations,

$$z = (w\beta)^{\frac{\beta}{\alpha}} \frac{\mu}{\alpha} (\beta - \alpha)^{-\frac{\beta-\alpha}{\alpha}} \tag{10}$$

Finally, in equilibrium the demand and supply of labor should once again be equal to each other implying that

$$\int_1^z x\, g(x)\, \mathrm{d}x = \int_z^{x_{max}} h(x)\, g(x)\, \mathrm{d}x. \tag{11}$$

We first establish

Lemma 2: *For any positive and finite μ and β there exists a unique market equilibrium with the nonlinear tax, that is, there is a unique pair (w^*, z^*) such that all individuals with ability below or equal to z^* choose to work in firms and receive wage w^*, all individuals with ability above z^* choose to run entrepreneurial firms and the equilibrium condition of the demand and supply of labor* (11) *is satisfied.*

Proof: The indifference condition (10) together with increasing returns to ability in entrepreneurship establish the first part of the claim. Solving equation (10) for w in terms of z and substituting the resulting expression as well as the expression for the optimal size of the firm (9) into the market equilibrium condition (11), we obtain

$$\int_1^z x\, g(x)\, \mathrm{d}x = \left(\frac{\alpha}{\mu(\beta-\alpha)}\right)^{\frac{1}{\beta}} z^{-\frac{\alpha}{\beta(\beta-\alpha)}} \int_z^{x_{max}} x^{\frac{1}{\beta-\alpha}}\, g(x)\, \mathrm{d}x. \tag{12}$$

The left-hand side of the equation (12) is equal to zero when z tends to 1 and is monotonically increasing in z. The right-hand side is positive and finite when z tends to 1 and is monotonically decreasing in z, converging to zero as z tends to x_{max}. Thus, there must exist one and only one z that satisfies equation (12). This is the z^* the existence of which is claimed in the Lemma. The existence of the corresponding unique w^* follows from equation (10). □

The equilibrium with the nonlinear tax has the same qualitative properties as the equilibrium with the linear tax studied in the previous section. More formally, we have

Proposition 3: *Assume that*

$$\beta < \frac{\alpha(1+\mu)}{\mu}. \tag{13}$$

Then an increase in either the linear component of the tax μ, or the nonlinear component β (provided the above constraint is still met) reduces equilibrium wage and optimal sizes of all incumbent firms. It also induces new entry of firms run by entrepreneurs in the lower tail of the entrepreneurial ability distribution.

Proof: See Appendix.

Note that the parametric restriction (13) is only a sufficient but not a necessary condition and it is likely to be easily satisfied for reasonable parameter values.

Provided that (13) holds, all other results we obtained in the previous section also continue to hold. In particular, an increase in μ and/or β shifts the firm size distribution to the left and reduces total output

and efficiency. The extension to the equilibrium with self employment is also straightforward.

5.3 Calibration of the Nonlinear Tax Model

While the qualitative features of the modes with linear and nonlinear tax can be seen to be very similar, the nonlinear tax case is important because it shows how labor protection reforms that reduce the degree of this protection for smaller firms but are biased against larger firms can in fact lead to very big distortions and efficiency losses, comparable to those from a much higher linear tax.

Columns 4 in Table 11 and Table 12 show that the same decline in the average size of the firm and very similar declines in the firm size at the 90th percentile as observed in the Portuguese data from 1986 to 2009 can result from a 100 percent *decrease* in the linear component of the net tax rate on labor (from 50 percent to 25 percent in Table 11 without the self employment option and from 30 percent to 15 percent in Table 12 which does allow for self employment), accompanied by introducing a relatively modest degree of nonlinearity (the elasticity of the tax with respect to firm size of 0.16 in Table 11 and 0.12 in Table 12). As can be seen by comparing columns 3 and 4, "tilting" the playing field in favor of smaller firms and against larger firms like this is comparable in terms of its effects on the decrease in the average firm size, the decrease in the size of the 90th percentile firm and the increase in the fraction of self employed (in Table 12) to the effects of increasing the linear net tax rate on labor from 50 percent to 200 percent in Table 11 and from 30 percent to 80 percent in Table 12. In other words, even a relatively small bias against large firms in the labor protections policy can completely undo any positive effects on firm size and efficiency of a reduction in labor protections for smaller firms and is actually equivalent to a sharp *increase* in the labor protection if applied equally to all firms.

Figure 12 shows the comparative effects of the nonlinear tax with a low linear component $\mu = 1.15$ and $\beta = 1.12$ and a much higher linear tax (with $T = 1.8$) on the overall distribution of entrepreneurial firms. With the nonlinear tax, the optimal sizes of the firms run by entrepreneurs at the high end of the ability distribution are markedly lower than under a much higher linear tax. There are also many more entrepreneurial firms run by individuals towards the lower end of the part of the ability distribution from which entrepreneurial talent is drawn.

6 Conclusion

This paper documents an important, unusual, and heretofore undocumented feature of the Portuguese economy. For at least two decades, the Portuguese firm size distribution has been shifting to the left. This shift is quite pronounced, does not appear to exist in other advanced industrial countries, and cannot be fully ascribed to expanding data coverage or other "natural causes."

We believe Portugal's unusual and distinctive shifts in the firm size distribution reflect its unusual and distinctive labor market regime. As many observers and official indices have attested, Portugal's policy commitment to employment protections for regular workers in the formal sector is extreme, even by Western European standards. We present a model in which high levels of employment protection effectively operate as a tax on wages, and can produce a shift in the firm size distribution, relative to the distortion-free benchmark, that reflects, in some ways, what we have seen in Portugal.

An immediate implication of our model is that the same policy regime that shrinks firms also lowers aggregate productivity. Even a uniform tax tends to hit the most productive enterprises disproportionately hard, causing a degradation of the allocation of resources across enterprises. More resources are tied up in smaller, less protective enterprises and fewer resources are allocated to the most productive firms, relative to what we would see in a distortion-free economy. To the extent that the tax hits larger (and more productive) enterprises harder – a reasonable belief given the realities of Portugal's labor regime – the negative impact of resource allocation is exacerbated, the firm size distribution is driven even further to the left, and aggregate productivity declines even more.

We engage in some simple calibration exercises to quantify the level of policy distortion that is consistent with the shifts in the firm size distribution we observe in the data, then seek to measure the level of aggregate productivity gains that might result if these distortions were partly or completely eliminated. Our results strongly suggest that Portugal could achieve first-order productivity gains by moving to a less distorted labor market.

References

O. Blanchard. Adjustment within the euro. The difficult case of Portugal. *Portuguese Economic Journal*, 6 (1), pp. 1–21, 2007.

O. Blanchard and P. Portugal. What hides behind an unemployment rate: Comparing Portuguese and US labor markets. *American Economic Review*, 91(1), pp. 187–207, 2001.

T. Boeri and J.F. Jimeno. The effects of employment protection: Learning from variable enforcement. *European Economic Review*, 49(8), pp. 2057–2077, 2005.

L.M.B. Cabral and J. Mata. On the evolution of the firm size distribution: Facts and theory. *American Economic Review*, 93(4), pp. 1075–1090, 2003.

A.V. Chari. Identifying the aggregate productivity effects of entry and output restrictions: An empirical analysis of license reform in india. *American Economic Journal: Economic Policy*, 3(2), pp. 66–96, 2011.

D. Corkill. *The development of the Portuguese economy: a case of Europeanization*. Psychology Press, 1999.

R. Dell'Anno. The shadow economy in Portugal: An analysis with the MIMIC approach. *Journal of Applied Economics*, 10(2), pp. 253–277, 2007.

P. Garibaldi, L. Pacelli, and A. Borgarello. Employment protection legislation and the size of firms. *IZA Discussion Papers*, 2003.

L. Garicano, C. LeLarge, and J. Van Reenen. Firm size distortions and the productivity distribution: Evidence from France. Working Paper, London School of Economics, 2011.

S.J. Grossman and O.D. Hart. The costs and benefits of ownership: A theory of vertical and lateral integration. *The Journal of Political Economy*, 94(4), pp. 691–719, 1986.

P.A. Grout. Investment and wages in the absence of binding contracts: A Nash bargaining approach. *Econometrica: Journal of the Econometric Society*, 52(2), pp. 449–460, 1984.

B.H. Hamilton. Does entrepreneurship pay? An empirical analysis of the returns of self-employment. *Journal of Political Economy*, 108(3), pp. 604–631, 2000.

K. Handley and N. Limão. Trade and investment under policy uncertainty: Theory and firm evidence. Technical report, Mimeo, University of Maryland, 2010.

C.T. Hsieh and P.J. Klenow. Misallocation and manufacturing TFP in China and India. *Quarterly Journal of Economics*, 124(4), pp. 1403–1448, 2009.

C.I. Jones. Misallocation, economic growth, and input-output economics. Technical report, National Bureau of Economic Research, 2011.

E.P. Lazear. Job security provisions and employment. *The Quarterly Journal of Economics*, 105(3), pp. 699–726, 1990.

R.E. Lucas. On the size distribution of business firms. *The Bell Journal of Economics*, 9(2), pp. 508–523, 1978.

P.S. Martins. Dismissals for cause: The difference that just eight paragraphs can make. *Journal of Labor Economics*, 27(2), pp. 257–279, 2009.

T.J. Moskowitz and A. Vissing-Jorgensen. The returns to entrepreneurial investment: A private equity premium puzzle? *The American Economic Review*, 92(4), pp. 745–778, 2002.

K.M. Murphy, A. Shleifer, and R.W. Vishny. The allocation of talent: implications for growth. *The Quarterly Journal of Economics*, 106(2), pp. 503–530, 1991.

D. Restuccia and R. Rogerson. Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic Dynamics*, 11(4), pp. 707–720, 2008.

F. Schivardi and R. Torrini. Identifying the effects of firing restrictions through size-contingent differences in regulation. *Labour Economics*, 15(3), pp. 482–511, 2008.

A Proof of Proposition 3

Note that the equilibrium equation (12) in the main text can also be written as

$$\int_1^z x\, g(x)\, \mathrm{d}x = \left(\frac{\alpha}{\mu(\beta-\alpha)}\right)^{\frac{1}{\beta}} z^{\frac{1}{\beta}} \int_z^{x_{max}} \left(\frac{x}{z}\right)^{\frac{1}{\beta-\alpha}} g(x)\, \mathrm{d}x.$$

Totally differentiating (12) yields

$$\frac{dz}{d\mu} = -\frac{\frac{1}{\mu\beta}\Omega}{zg(z)\left(\Gamma z\right)^{-\frac{1}{\beta}} + \frac{\alpha}{\beta(\beta-\alpha)} z^{-1}\Omega + g(z)}, \tag{14}$$

$$\frac{dz}{d\beta} = -\frac{\frac{1}{\beta^2}\Omega \ln z + \frac{1}{(\beta-\alpha)^2}\Xi + \frac{1}{\beta(\beta-\alpha)}\Omega + \frac{1}{\beta^2}\Omega \ln \Gamma}{zg(z)\left(\Gamma z\right)^{-\frac{1}{\beta}} + \frac{\alpha}{\beta(\beta-\alpha)} z^{-1}\Omega + g(z)}, \tag{15}$$

where $\Omega \equiv \int_z^{x_{max}} \left(\frac{x}{z}\right)^{\frac{1}{\beta-\alpha}} g(x)\, \mathrm{d}x$, $\Xi \equiv \int_z^{x_{max}} \left(\frac{x}{z}\right)^{\frac{1}{\beta-\alpha}} \ln(\frac{x}{z})\, g(x)\, \mathrm{d}x$, and $\Gamma \equiv \frac{\alpha}{\mu(\beta-\alpha)}$.

Both the numerator and the denominator in the expression (14) contain only positive terms, hence, $\frac{dz}{d\mu}$ is always negative. The denominator in the expression (15) is the same; as for the numerator, all terms except the last one are positive. If $\ln \frac{\alpha}{\mu(\beta-\alpha)} > 0$ the the last term is also positive. Hence, the condition (13) in the main text is a sufficient (but not necessary) condition for $\frac{dz}{d\beta}$ to also be negative.

Next, taking the natural log of the equation (10) in the main text, we obtain

$$\ln w = \frac{\alpha}{\beta} \ln z + \frac{\alpha}{\beta} \ln \frac{\alpha}{\mu} + \frac{\beta-\alpha}{\beta} \ln(\beta-\alpha) - \ln \beta.$$

Obviously, w will be decreasing in μ and/or β if and only if $\ln w$ is so. Since z is decreasing in μ, the equilibrium wage is clearly a decreasing function of μ. Differentiating the expression above with respect to β we obtain, after some manipulations

$$\frac{d\ln w}{d\beta} = -\frac{\alpha}{\beta^2} \ln z + \frac{\alpha}{\beta} \frac{1}{z} \frac{dz}{d\beta} - \frac{\alpha}{\beta^2} \ln \frac{\alpha}{\mu(\beta-\alpha)}.$$

Under the condition (13) both the second and the third terms on the right-hand side of the expression above are negative, so that $\frac{d\ln w}{d\beta} < 0$.

The arguments that under the condition (13) the optimal sizes of all incumbent firms are decreasing in μ and β and that an increase in either μ or β shifts the firm size distribution to the left and reduces total output are exactly the same as in the proofs of Propositions 1 and the Corollary in the main text. □

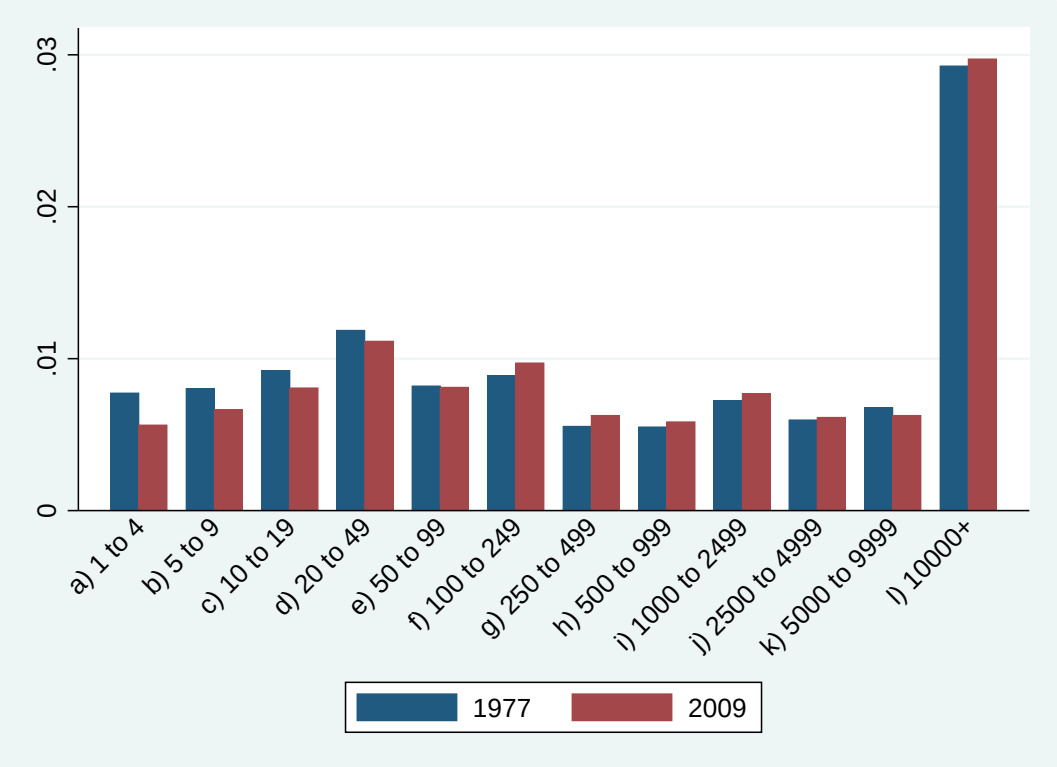
B List of Laws Supporting small firms

- DL 132/1983 - Tax incentives for investment in firms under 50 workers.
- DL 141/1985, DL 9/1992 - Firms over 100, (50 after 1992) workers have to present a monthly social balance.
- DL 69-A/1987 - Firms under 6 workers are allowed to pay bellow minimum wage. (in effect until 2003)
- DL 69-A/1987 - Firms under 50 workers are allowed to pay up to 50% bellow minimum wage under certain conditions. (in effect until 2003)
- DL 64-A/1989 - Firms under 20 workers are allowed to go through a less bureaucratic process for dismissal for cause. (in effect until 2003)
- DL 298/1992, DL 211/1998, DL 171/1999 - A line of credit for firms under 250 workers is created.
- DL 26/1994, DL 109/2000 - Firms over 50 workers must maintain an internal Worker Health Protection system.
- DL 30-B/1994, DL 160/9195 - Firms under 20 workers are entitled to a 95% collectable income tax deduction. (in effect until 1997)
- DL 121/1995, DL 200/1996, DL 42/1998 - Firms under 20 workers are entitled to deduct several operational costs. (in effect until 2001)
- DL 34/1996 - Firms under 50 workers have a access to subsidized young workers.
- DL 116/1999 - Progressive fines for labor law breach established at the 5, 50, and 200 thresholds.
- DL 12-A/2000 - Priority is given to firms under 50 workers on the use of European Structural Funds for worker training.
- DL 106/2001 - Firms over 10 workers have to report monthly the wage bill.
- DL 255/2002 - Firms under 50 workers receive support for hiring workers.
- DL 99/2003 - Firms under 50 are not required to inform union leaders of several firm related information.

- DL 99/2003 - Firms under 10 workers are allowed to go through a less bureaucratic process to let go of workers.
- DL 99/2003 - Several small advantages for firms under 10 workers: changes in information presentation deadlines, mandatory days off and vacation time.
- DL 99/2003 - Firms under 50 are allowed to deny leave of absence under certain conditions.
- DL 99/2003 - Firms under 50 and 10 have progressively higher limits on overtime.
- DL 40/2005 - Firms under 250 workers are allowed to tax deduct patent request and maintenance costs.

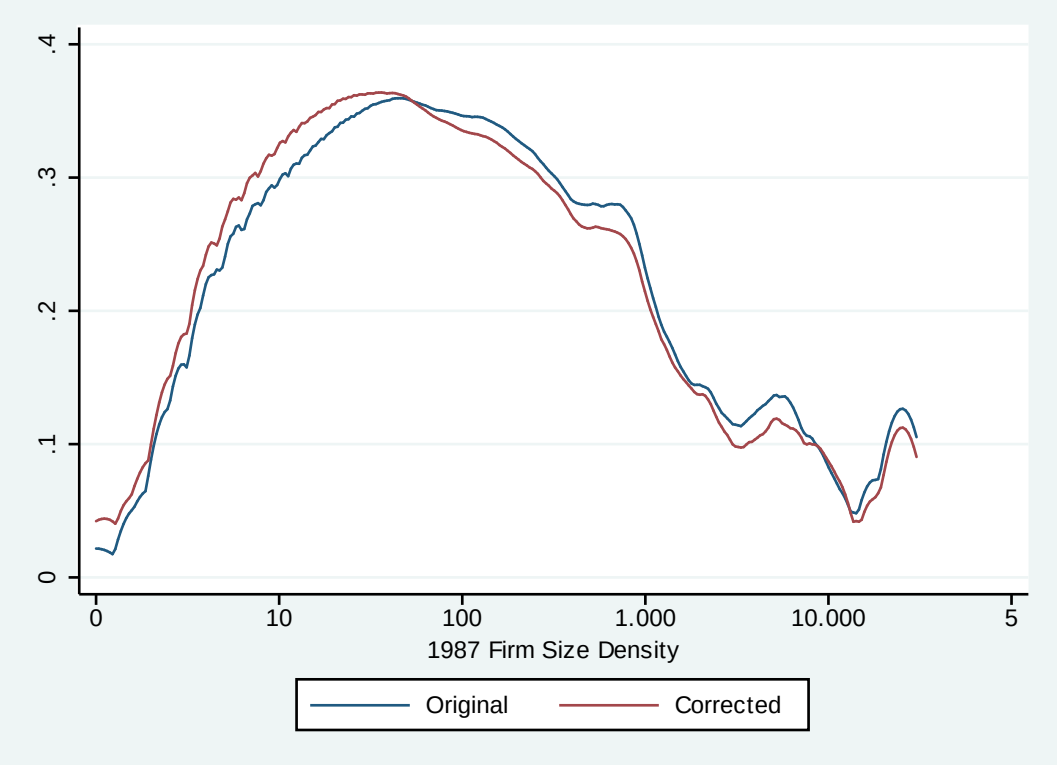
C Figures

Figure 1: Changes in the US Firm Size Distribution, 1977-2009



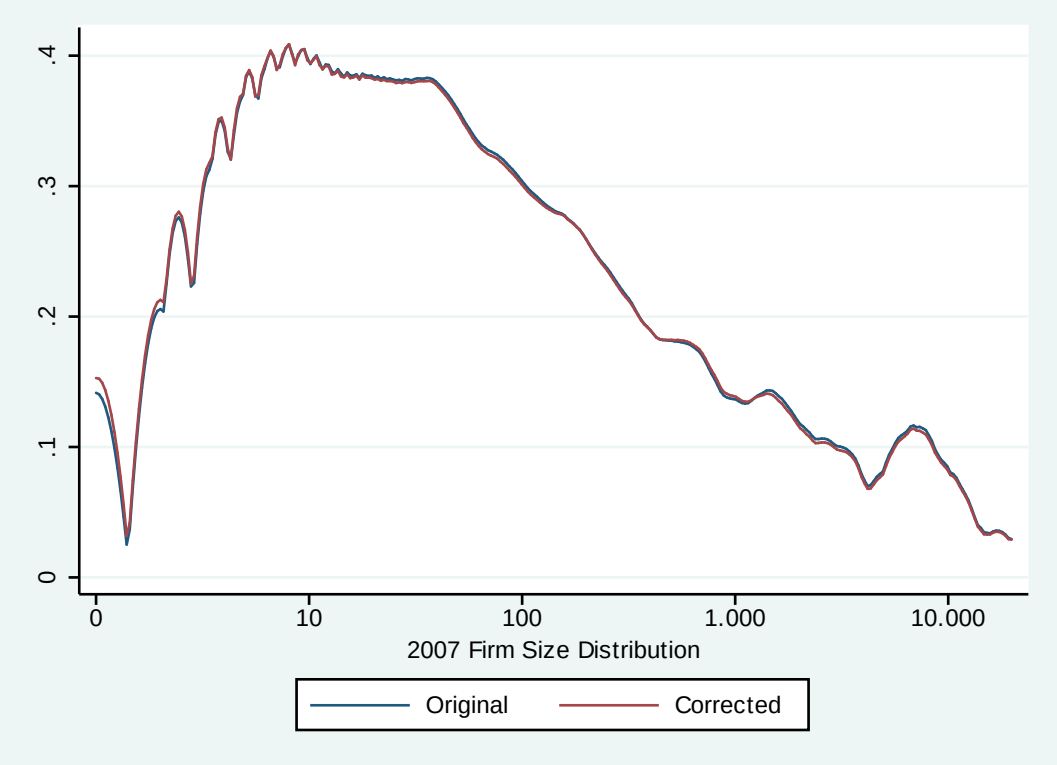
Source: U.S. Census Bureau

Figure 2: 1987 original and corrected FSD
The firm size distribution in Portugal:
Original data and the data corrected for the increase in data coverage, 1987.



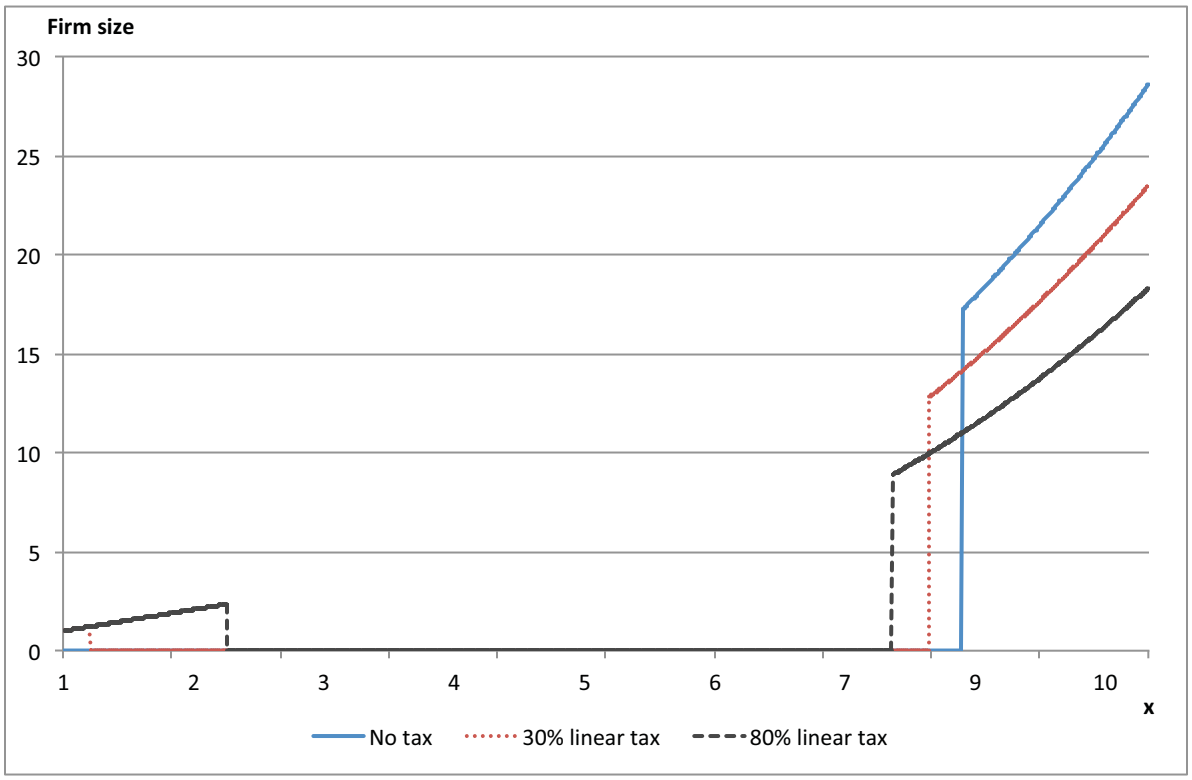
Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 3: 2007 original and corrected FSD
The firm size distribution in Portugal:
Original data and the data corrected for the increase in data coverage, 2007.



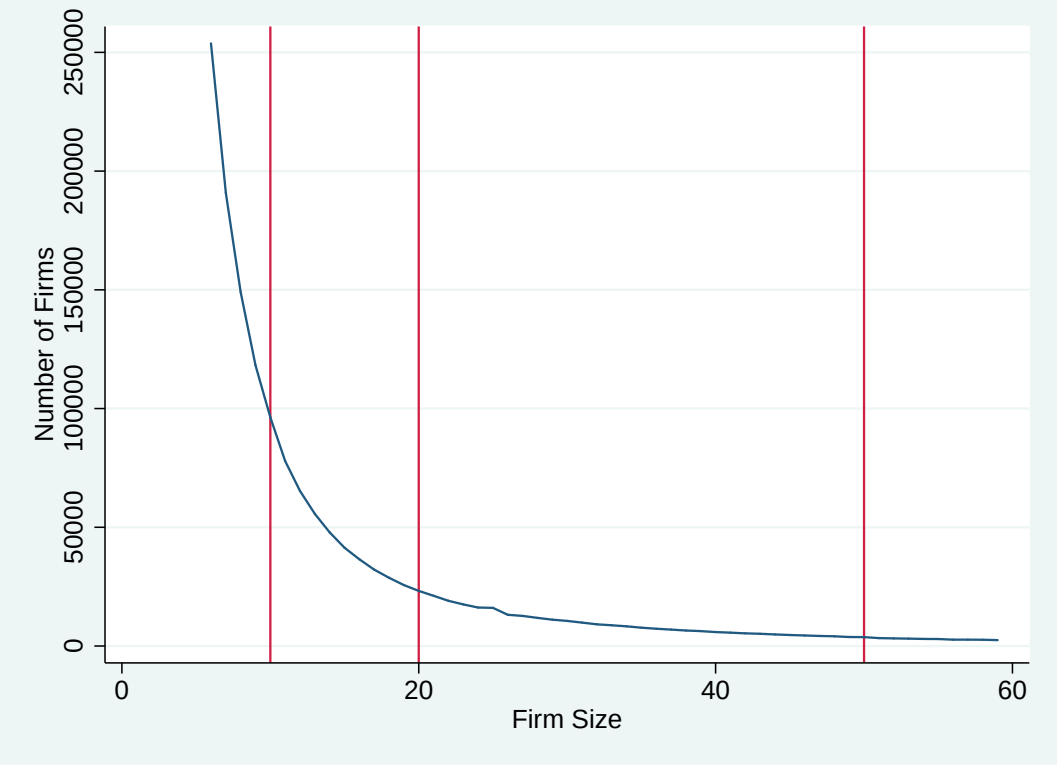
Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 6: Calibration with Linear Tax



Firm sizes with no tax, $T = 1.3$, and $T = 1.8$. Including the self employment option.
The parameter of the production function $\alpha = 0.67$, utility component of self employment $B = 1$,
x distributed uniformly on the interval $[1, 10]$.

Figure 7: Number of firms by firm size 1986-2007
Number of firms in different size categories. Some thresholds affected by labor protection laws and government support for small firms highlighted in red.



Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 8: Threshold Coefficients
Probit regression coefficients for threshold size dummies.

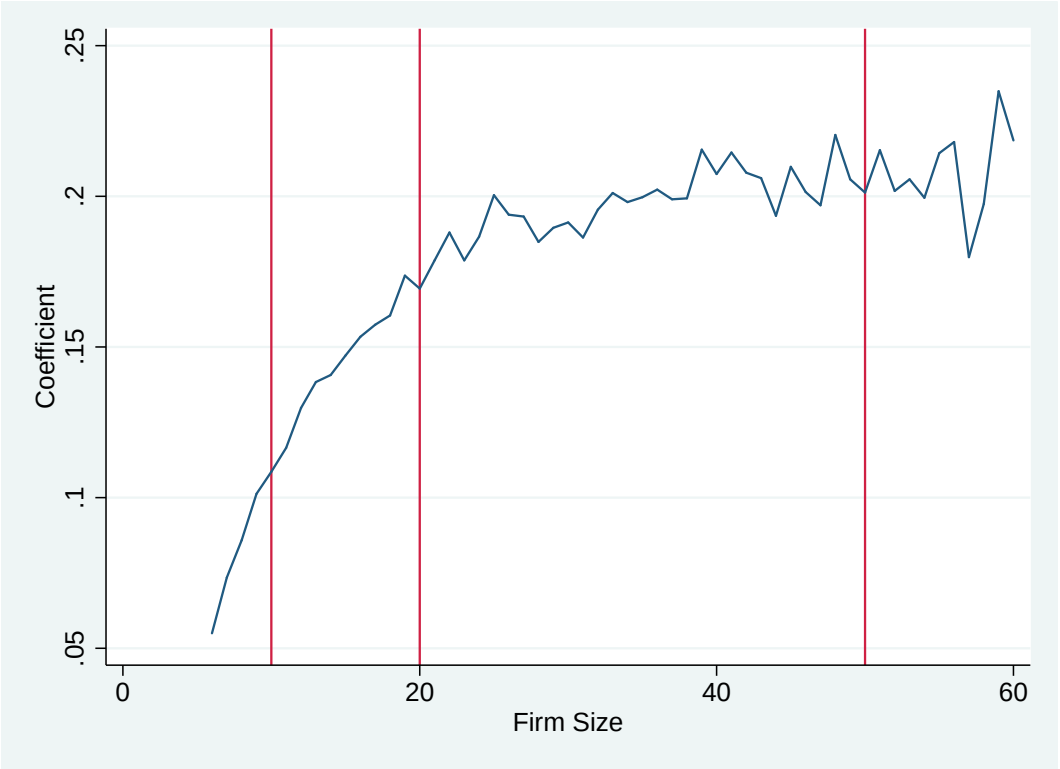
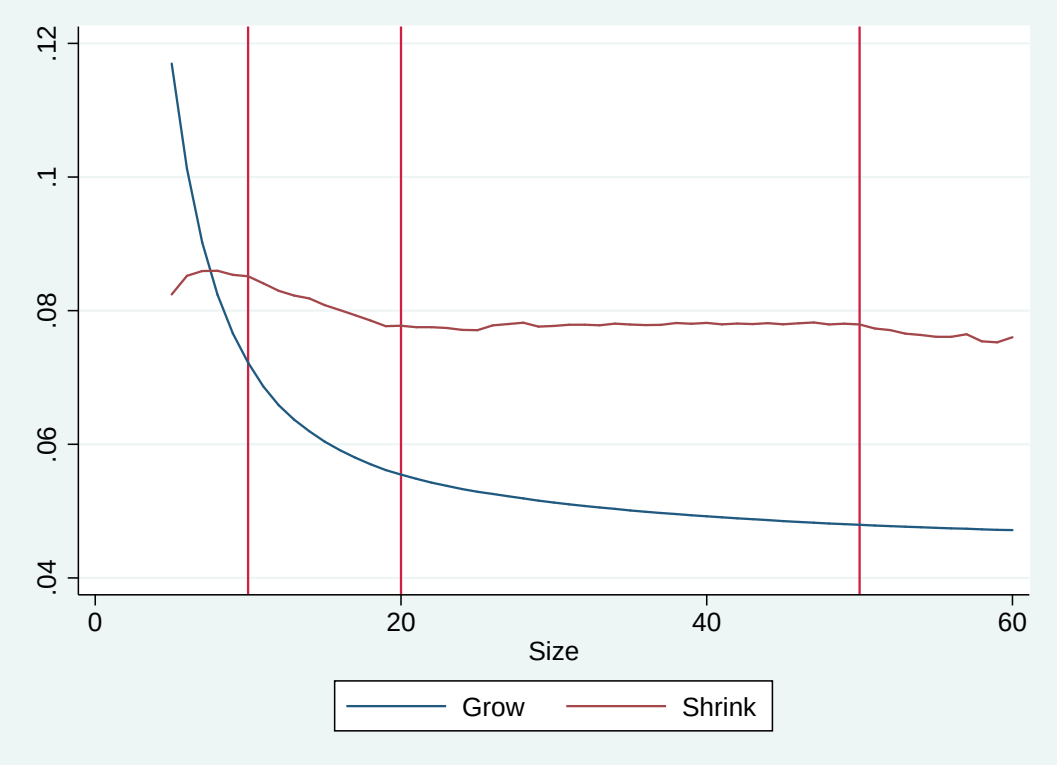
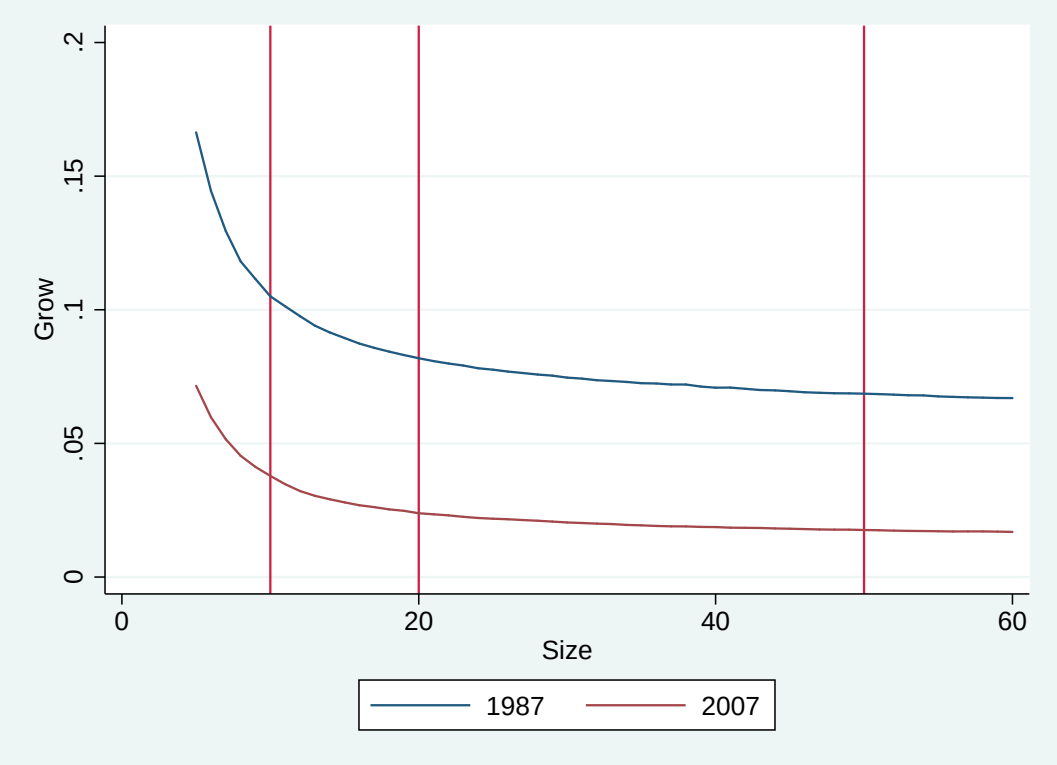


Figure 9: Threshold Crossing Probabilities
The probabilities of crossing size thresholds (either grow above or shrink below)
for firm sizes between sizes 5 and 60.



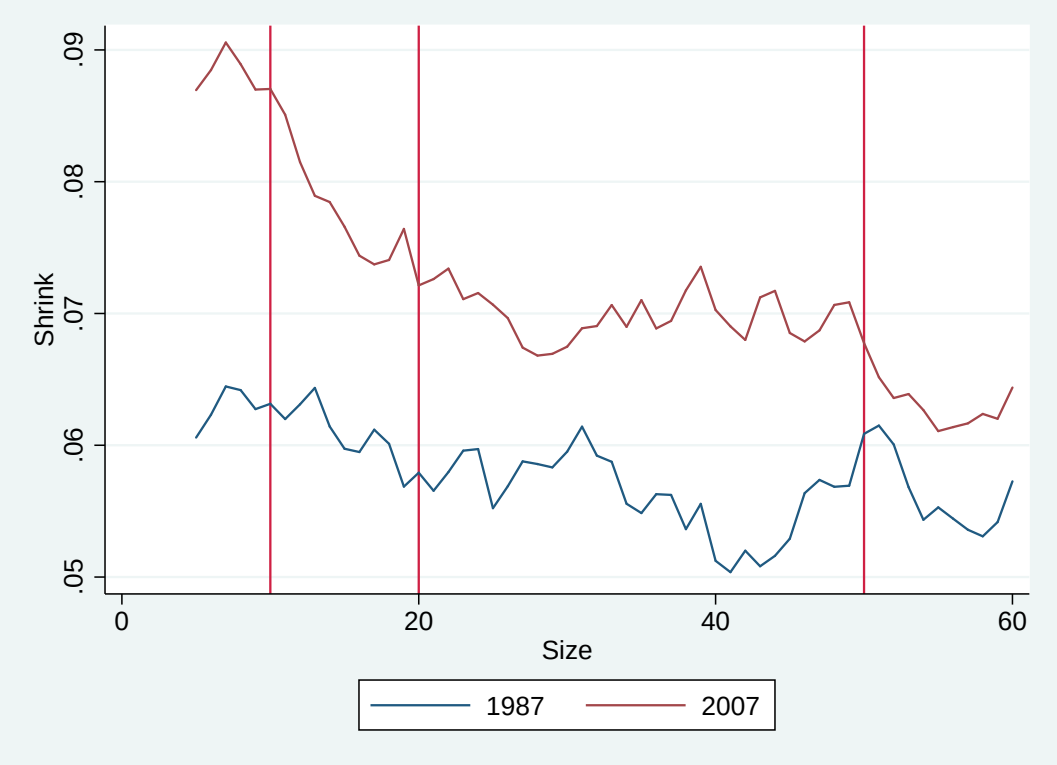
Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 10: The probability of a firm growing above a given threshold, 1987 and 2007.



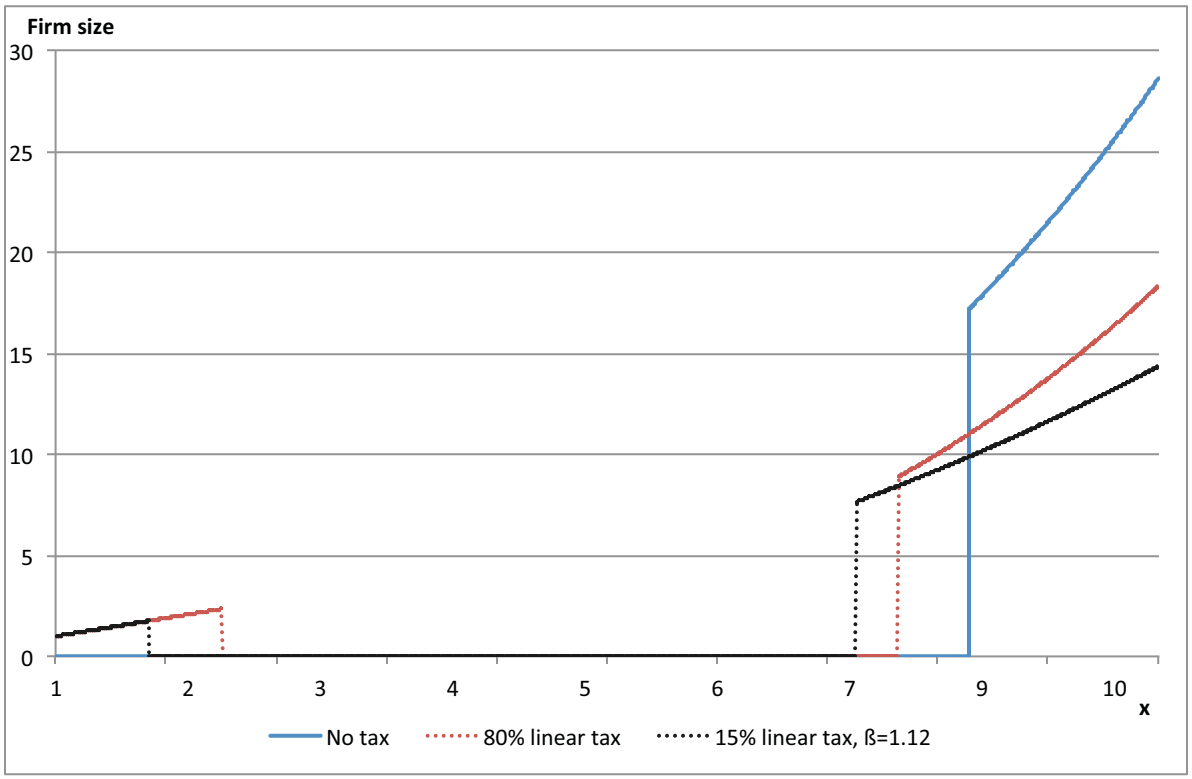
Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 11: The probability of a firm shrinking below a given threshold, 1987 and 2007.



Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Figure 12: Calibration with Nonlinear Tax



Firm sizes with no tax, $T = 1.3$, and $\mu = 1.8, \beta = 1.12$. Including the self employment option. The parameter of the production function $\alpha = 0.67$, utility component of self employment $B = 1$, x distributed uniformly on the interval $[1, 10]$

D Tables

Table 1: Portuguese Firm Size

Average firm size and firm sizes at various percentiles of the firm size distribution, 1986-2009.

Year	Mean	P10	P25	P50	P75	P90
1986	17.72	1	2	4	10	26
1987	17.44	1	2	4	10	26
1988	16.27	1	2	4	10	25
1989	15.87	1	2	4	9	24
1990	15.75	1	2	4	9	24
1991	15.07	1	2	4	9	24
1992	14.27	1	2	4	9	23
1993	13.36	1	2	4	8	21
1994	12.02	1	2	4	8	19
1995	11.63	1	2	4	7	18
1996	11.31	1	2	3	7	17
1997	11.00	1	2	3	7	17
1998	10.78	1	2	3	7	16
1999	10.56	1	2	3	7	16
2000	10.05	1	2	3	7	15
2001	10.04	1	2	3	7	15
2002	9.41	1	2	3	7	15
2003	9.29	1	2	3	6	14
2004	9.26	1	2	3	6	14
2005	9.01	1	1	3	6	14
2006	9.01	1	1	3	6	14
2007	9.03	1	1	3	6	14
2008	9.11	1	1	3	6	14
2009	8.89	1	1	3	6	13

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 2: The Danish Firm Size Distribution

Average firm size and firm sizes at various percentiles of the firm size distribution, 1980-2007.

Year	Mean	P10	P25	P50	P75	P90
1980	11.03	1	1	3	7	16
1981	10.90	1	1	3	7	16
1982	11.35	1	1	3	7	16
1983	11.39	1	1	3	7	16
1984	11.60	1	1	3	7	17
1985	12.43	1	1	3	7	18
1986	13.08	1	1	3	8	19
1987	13.11	1	1	3	8	19
1988	13.07	1	1	3	8	19
1989	13.20	1	1	3	8	19
1990	13.21	1	1	3	8	19
1991	13.44	1	1	3	8	19
1992	13.32	1	1	3	8	19
1993	12.91	1	1	3	8	19
1994	13.49	1	1	3	8	20
1995	14.12	1	1	3	8	20
1996	13.83	1	2	3	9	20
1997	14.26	1	2	4	9	21
1998	14.66	1	2	4	9	21
1999	14.69	1	2	4	9	21
2000	14.78	1	2	4	9	21
2001	14.76	1	2	4	9	21
2002	14.66	1	2	4	9	21
2003	14.26	1	2	3	9	21
2004	14.01	1	2	3	9	20
2005	13.84	1	2	3	9	20
2006	13.90	1	2	3	9	21
2007	13.70	1	2	3	9	21

Source: Summary statistics from the Danish matched employer-employee database were kindly provided by Michael Dahl.

Table 3: Shadow Economy estimated by MIMIC model.

Years	77/79	80/82	83/85	86/88	89/91	92/94	95/97	98/00	01/03	04
	28.8%	26.4%	27.7%	24/6%	20.2%	21.9%	21.4%	18.5%	17.9%	17.6%

Source: Dell'Anno (2007)

Table 4: The fraction of new firms reporting at least 3 year tenures

Year	Mean
1987	0.35
1988	0.27
1989	0.23
1991	0.24
1992	0.24
1993	0.22
1994	0.24
1995	0.19
1996	0.17
1997	0.16
1998	0.15
1999	0.14
2000	0.18
2002	0.16
2003	0.15
2004	0.15
2005	0.24
2006	0.14
2007	0.11
2008	0.09

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 5: Average firm size after correcting for data coverage

Year	Original Size	Corrected Size
1986	17.72	15.67
1987	17.44	15.23
1988	16.27	14.92
1989	15.87	15.15
1990	15.75	13.94
1991	15.07	13.38
1992	14.27	12.65
1993	13.36	11.95
1994	12.02	11.05
1995	11.63	10.72
1996	11.31	10.45
1997	11.00	10.27
1998	10.78	10.06
1999	10.56	9.84
2000	10.05	9.60
2001	10.04	9.27
2002	9.41	9.03
2003	9.29	8.81
2004	9.26	8.73
2005	9.01	8.61
2006	9.01	8.67
2007	9.03	8.81
2008	9.11	9.11
Total	11.06	10.43

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 6: Corrected Firm Size

Firm sizes at various percentiles of the firm size distribution corrected for the increase in data coverage.

Year	P10	P25	P50	P75	P90
1986	1	2	4	9	23
1987	1	2	4	9	22
1988	1	2	4	9	22
1989	1	2	4	9	22
1990	1	2	4	9	22
1991	1	2	4	8	20
1992	1	2	3	8	19
1993	1	2	3	7	18
1994	1	2	3	7	17
1995	1	2	3	7	16
1996	1	2	3	7	16
1997	1	2	3	7	15
1998	1	2	3	6	15
1999	1	2	3	6	15
2000	1	2	3	6	14
2001	1	1	3	7	15
2002	1	1	3	6	14
2003	1	1	3	6	14
2004	1	1	3	6	13
2005	1	1	3	6	13
2006	1	1	3	6	13
2007	1	1	3	6	13
Total	1	2	3	7	16

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 7: Average firm size after correcting for "denationalization" and "demonopolization"

	Firm Size	Corrected
1986	15.671	15.671
1987	15.226	15.226
1988	14.915	14.915
1989	15.148	15.148
1990	13.942	13.942
1991	13.379	13.379
1992	12.654	12.654
1993	11.949	11.949
1994	11.050	11.051
1995	10.715	10.715
1996	10.445	10.445
1997	10.275	10.275
1998	10.063	10.063
1999	9.841	9.841
2000	9.595	9.595
2001	9.267	9.267
2002	9.031	9.031
2003	8.813	8.813
2004	8.726	8.726
2005	8.606	8.606
2006	8.675	8.675
2007	8.807	8.807
2008	9.114	9.117

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 8: Employment shares by industry in Portugal, 1986-2008

Year	Agriculture, Forestry Fishing	Manufacturing	Retail Wholesale	Construction	Transport, Electric, Gas	Services
1986	2.8	40.3	7.3	17.9	8.0	23.7
1987	2.6	39.9	7.1	17.9	7.8	24.6
1988	2.7	38.8	7.2	18.1	7.4	25.7
1989	2.8	39.2	7.7	18.7	7.3	24.3
1990	2.7	37.3	7.5	18.1	6.8	27.6
1991	2.5	36.6	7.9	18.6	6.9	27.5
1992	2.5	35.8	8.1	19.6	6.8	27.3
1993	2.4	34.5	8.2	20.2	6.6	28.1
1994	2.4	34.1	8.6	22.4	6.4	26.2
1995	2.3	33.3	8.5	17.8	6.2	32.0
1996	2.3	31.8	8.6	17.7	6.0	33.6
1997	2.3	31.0	9.0	17.9	5.8	33.9
1998	2.3	30.2	9.2	17.8	5.8	34.6
1999	2.2	29.6	9.3	18.3	5.8	34.7
2000	2.2	28.5	10.2	18.6	5.8	34.7
2001	2.1	26.3	11.5	17.9	5.6	36.5
2002	2.2	24.7	11.8	18.1	5.5	37.7
2003	2.1	24.5	11.4	18.4	5.5	38.2
2004	2.1	24.3	11.6	18.6	5.4	37.9
2005	2.5	24.1	12.1	19.2	5.6	36.5
2006	2.5	23.3	12.2	19.3	5.6	37.1
2007	2.4	22.4	12.6	19.5	5.5	37.7
2008	2.4	22.2	12.6	19.9	5.7	37.3

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 9: Average Firm Size by industry, 1986-2008

Year	Agriculture, Forestry Fishing	Manufacturing	Retail Wholesale	Construction	Transport, Electric, Gas	Services
1986	11.4	33.6	17.0	8.7	60.2	10.2
1987	11.1	33.0	16.9	8.5	58.3	10.0
1988	10.1	30.8	15.6	8.1	51.7	11.0
1989	9.8	30.1	15.0	8.0	48.3	12.1
1990	9.6	29.8	14.6	8.1	47.3	10.0
1991	8.9	28.5	13.7	7.9	44.4	9.8
1992	8.3	26.9	12.6	7.7	40.4	9.3
1993	7.8	25.3	11.9	7.4	36.1	9.1
1994	7.1	22.7	10.9	6.9	30.0	8.8
1995	6.7	22.1	10.5	6.7	27.8	8.4
1996	6.6	21.7	10.4	6.6	25.7	8.3
1997	6.4	20.6	10.0	6.7	24.4	8.4
1998	6.4	20.1	9.2	6.6	22.8	8.4
1999	6.2	19.6	8.6	6.7	21.4	8.2
2000	5.9	18.7	8.1	6.6	18.1	8.4
2001	6.0	18.3	8.6	6.6	16.5	7.9
2002	5.7	17.2	8.2	6.4	13.9	8.1
2003	5.6	16.9	7.9	6.3	12.9	8.0
2004	5.4	16.9	8.1	6.3	12.4	7.8
2005	4.1	16.5	8.1	6.2	12.1	8.0
2006	4.2	16.2	8.2	6.2	11.8	8.2
2007	4.3	16.4	8.3	6.3	11.6	8.5
2008	4.4	16.5	8.2	6.4	11.8	9.2
Average	6.3	21.6	9.5	6.9	20.9	8.7

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 10: Fraction of self employed in the workforce, 1986-2008

Year	%
1986	0.011
1987	0.010
1988	0.013
1989	0.015
1991	0.015
1992	0.019
1993	0.023
1994	0.030
1995	0.034
1996	0.034
1997	0.035
1998	0.035
1999	0.035
2000	0.065
2002	0.088
2003	0.085
2004	0.086
2005	0.088
2006	0.096
2007	0.107
2008	0.110

Source: Authors' calculations based on *Quadros de Pessoal* (Portuguese matched employer-employee dataset).

Table 11: Calibrating the model (no self employment option)

Parameters: $\alpha = 0.67, supp(x) = [1, 10]$

	No tax	T=1.5	T=3	μ =1.25, β=1.16
Average firm size	22.59	15.69	8.66	8.64
Firm size at 90th percentile	27	20	12	11
Equilibrium wage	2.21	1.63	0.95	1.38
Wage index (no tax=1)	1.00	0.73	0.43	0.62
Total output index (no tax=1)	1.00	0.99	0.91	0.91
Tax revenue	0	15	47	26
Net of taxes output index (no tax=1)	1.00	0.86	0.51	0.68

Table 12: Calibrating the model (with self employment option)

Parameters: $\alpha = 0.67, B = 1, supp(x) = [1, 10]$

	No tax	T=1.3	T=1.8	μ =1.15, β=1.12
Average firm size	22.59	15.97	8.73	8.59
Fraction of self employed	0.00	0.02	0.15	0.09
Firm size at 90th percentile	27	22	17	14
Equilibrium wage	2.21	1.82	1.43	1.57
Wage (no tax=1)	1.00	0.82	0.64	0.71
Total output (no tax=1)	1.00	0.99	0.95	0.93
Tax revenue	0	9	22	17
Net of taxes output index (no tax=1)	1.00	0.91	0.76	0.79