CENTRE for ECONOMIC PERFORMANCE

CEP Discussion Paper No 633

May 2004

Threshold Effects and Firm Size: the Case of Firing Costs

Fabiano Schivardi and Roberto Torrini

The Queen's Anniversary Prizes
For Higher and Further Education
2002

The London School of Economics and Political Science

E·S·R·C
Economic & Social Research Council

Abstract
We study the role of employment protection legislation (EPL) in determining firm size distribution. In many countries the provisions of EPL are more stringent for firms above certain size thresholds. We construct a simple model that shows that the smooth relation between size and growth probability is interrupted in proximity of the thresholds at which EPL applies differentially. We use a comprehensive longitudinal dataset of all Italian firms, a country with an important threshold at 15 employees, to estimate the effects of EPL in terms of discouraging small firms from growing. We find that the probability of firms' growth in the proximity of the threshold is reduced by around 2 percentage points. Using the stochastic transition matrix for firm size, we compute the long-run effects of EPL on size distribution. We find that average firm size would increase by less than 1% in steady state when removing the threshold; a quantitatively modest effect.

Keywords: Firm size distribution, Employment protection, Firing costs.
JEL Classifications: J65, D21, L11
Data Used: Italian Social Security Service (INPS) database

This paper was produced as part of the Centre's Labour Markets Programme. The Centre for Economic Performance is financed by the Economic and Social Research Council.

Acknowledgements
This paper was presented at a Labour Market Seminar held at the Centre for Economic Performance, London School of Economics. We have benefited from many discussions with Andrea Brandolini. We also thank David Card, Piero Cipollone, Francis Kramarz, Marco Magnani, Marco Manacorda, Alan Manning, Barbara Petrongolo, Sandro Trento and participants at seminars at the Bank of Italy, LSE, Stanford and at the Research Conference on Microeconomic Analysis of Labor Reallocation (Kalamazoo, Michigan, August 2003) for useful comments and suggestions. Many thanks to the Italian Social Security Service (INPS) for providing us with their firm-level data. We are responsible for any mistakes. The views expressed here are our own and do not necessarily reflect those of the Bank of Italy.

Fabiano Schivardi and Roberto Torrini are economists at the Research Department of the Bank of Italy. Roberto Torrini is also a member of the Centre for Economic Performance, London School of Economics.

Fabiano Schivardi and Roberto Torrini Affiliations/Contact Details: Bank of Italy, Research Department, via Nazionale 91, 00184 Rome, Italy. Tel: ++39 06 4792 3040 Fax: ++39 06 4792 3720. Email: schivard@fas.harvard.edu ; R.Torrini@lse.ac.uk

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

ISBN 0 7530 1759 8

Threshold Effects and Firm Size: The Case of Firing Costs

Fabiano Schivardi and Roberto Torrini

Introduction 1

2. Institutional setting 5

3. A simple model of threshold effect and size structure 7

4. Estimating the threshold effect 15

4.1 Extensions 19

5. Epl and firm size in steady state 21

6. Conclusions 27

Tables 29

Figures 36

Appendix 44

1 Introduction

Economists have long been concerned with the influence of firm size on economic performance (Schumpeter 1911) and, as a consequence, with its determinants (Lucas 1978). A robust empirical finding is that average firm size varies substantially even across countries at a similar stage of development. Table 1, taken from Bartelsman, Scarpetta & Schivardi (2003), reports average firm size for a set of OECD countries for broad sectoral subdivisions. In manufacturing, the average number of employees ranges from 80.3 in the US, to 39 in Germany and 32 in France, reaching a minimum of 15.3 in Italy. These variations are confirmed by more sectorally disaggregated studies (Kumar, Rajan & Zingales 2001). In particular, cross-country differences are not simply driven by the sectoral composition of the economy: rather, countries with a large overall size tend to show the same pattern even within narrowly defined sectors (Davis & Henrekson 1999, Pagano & Schivardi 2003). This suggests that firm size distribution might have an important country specific component.

Notwithstanding the relevance of these cross-countries differences, very little is known about their causes. Cross-sectional studies relating size distribution to country characteristics are plagued by collinearity, measurement and omitted variable problems, making this line of investigation problematic.[1] This paper takes a different route. First, we consider one particular institutional feature, i.e., employment protection legislation (EPL). While the theoretical literature does not establish any uncontroversial link between EPL *per se* and average firm size,[2] one particular feature of EPL may impede firm growth: in many countries, *EPL provisions are more stringent above certain employee thresholds.* For exam-

[1] Kumar et al. (2001) undertake such an experiment for a set of European countries, confirming the difficulties in pinning down the country-level determinants of firm size.

[2] Bentolila & Bertola (1990) show that firing costs reduce employment turnover, but have only second order effects (and, in their simulations, mostly positive) on average employment.

ple, in Germany and Austria establishments with less than 6 employees are exempted from EPL, while in France firms with less then 10; in Spain, 40% of the severance payment due upon dismissal (20 days wages for each year of seniority, up to a maximum of one year) is covered by a state fund for firms with less than 25 employees; in Italy EPL is substantially less stringent for firms with less than 16 employees. The presence of such thresholds can clearly influence the size distribution, because firms might be discouraged to grow above them to avoid the more stringent EPL.

Second, we conduct a within-country analysis based on Italy, a country that presents a natural laboratory for testing the effects of EPL on size. Italy is characterized both by a more stringent regulation for firms above the 15-employee threshold and by one of the largest share of small firms in industrialized economies. Indeed, in policy debates EPL is often indicated as one of the most important factors in explaining the left skewed distribution of Italian firms.

Our aim is to quantify the effects of the threshold on steady state size distribution. To this end, we construct a simple model that, given the indivisibility of labor and Gibrat's law, predicts a smoothly increasing relation between a firm's probability of growing (as well as shrinking) and its size, and show that the threshold effect implies a drop in the probability of growing in the proximity of the threshold itself. While highly stylized, the model singles out the assumptions required for identification and offers a number of further testable predictions. In this exercise, we take the behavior of firms above the threshold as fixed, so that our exercise only identifies the threshold effect.[3]

Based on these predictions, we use a comprehensive longitudinal dataset of all Italian

[3]As noted above, the literature on firing costs does not indicate any clear-cut relationship between EPL and average firm size, suggesting that the effects above the threshold might be second order ones. The policy debate also reproduces this insight: the size effects of EPL are invariably related to a supposedly low propensity of small firms to grow.

firms between 1986 and 1998 to estimate the effects of EPL in discouraging small firms from growing. Finally, to measure the impact of the threshold effect on firm size in the long run, we compute the actual stochastic transition matrix for firm size and use our estimates to remove the threshold effects. Using the properties of Markov chains, the modified matrix can then be used to determine the steady-state firm size distribution that would emerge in the absence of the threshold.

To measure the effects of the threshold on growth propensity, we run a probit of positive employment changes on a polynomial in size and additional controls. The model fits the data remarkably well, except in the proximity of the threshold, where it overpredicts growth by approximately two percentage points, that, according to our identification procedure, is the measure of the impact effect of the threshold. We therefore conclude that, as theory predicts, the threshold effect does influence firm size. Once we compute its effect in steady state, it proves to be very modest: we estimate that, after removing the threshold, average size would increase by 0.5 per cent, a value that would narrowly reduce the gap in size of Italian firms versus those of other industrial countries (see Table 1). Extensions of this exercise along several dimensions show that the increase in average firm size would remain below 2% even under the less conservative hypotheses.

Our analysis adds to within country empirical research on the effects of employment protection legislation. Autor (2003) and Autor, Donohue & Schwab (2004*b*) exploit cross-state variation in the adoption of common law exceptions to the employment-at-will doctrine in the US, to estimate its role in explaining the spread of the temporary help supply industry (the first), and its impact on employment (the second). Acemoglu & Angrist (2001) show that the detrimental effects the Americans with Disabilities Act on the employment of disabled people are differentiated according to firm size, because its provisions do not apply to small firms. This suggests that the Act might have introduced a bias in the American size distribution similar to the one we find for Italy.[4]

Our results contrast previous work on Italian data that has been unable to find any effect of the threshold on the size distribution (Anastasia 1999). This is probably because of the relative small effect, which can only be detected with a very rich dataset like the one we use. A recent exception is Borgarello, Garibaldi & Pacelli (2002), that, in independently developed work, also finds significant but quantitatively small effects of EPL on firms' propensity to grow. Our approach differs both in the modeling and the estimation strategy; moreover, we use a more comprehensive dataset; finally, we compute the long-run effects on the steady state distribution of firms. As to other countries, Verick (2004) exploits a legislative change in Germany to measure the threshold effect of EPL, finding mixed and inclusive evidence on its relevance. Boeri & Jimeno (2003) consider the implications of the EPL threshold for dismissal probabilities in Italy and Spain.

The rest of the paper is organized as follows. Section 2 contains a brief summary of the EPL in Italy; Section 3 constructs a simple model of firm growth that illustrates our identifying assumptions and empirical predictions, while Section 4 estimates the threshold effects. Section 5 constructs the stochastic transition matrix and simulates the effects of EPL in the long run, and Section 6 concludes.

[4] Until 1999, Italian legislation had similar provisions that only applied to firms with more than 35 employees. Indeed, we have found that this threshold reduces the probability of growth of firms with 35 employees of about 2 percentage points, an effect very similar to that estimated for the 15 employee threshold. Again, the long run effects on firm size distribution are rather limited.

2 Institutional setting

In economies where "employment at will" does not apply,[5] firing costs can be thought of as the result of three main elements: the definition of fair and unfair dismissal; the cost of a no-fault dismissal and the penalty when the dismissal is ruled to be unfair; the odds for the result of a possible trial. The first defines when firing is allowed; the second assesses the costs a firm can incur; the third describes the actual enforcement of the law and the probability of winning a case for unfair dismissal.[6]

According to Italian employment protection legislation, individual and collective dismissals of workers with open-end contracts are only allowed on a just cause basis. Workers can be fired because of misbehavior (*giusta causa o giustificato motivo soggettivo*), or the firm's need to downsize or reorganize its activities (*giustificato motivo oggettivo*). A worker cannot be fired to be replaced with another if this is not justified by worker misconduct or by the need to restructure the activity. For instance, it would not be possible to fire an employee with a long tenure and a high salary just to replace her with a young worker paid the minimum contractual wage.

Workers can appeal to the court against dismissal. If the judge rules the dismissal was unfair, workers are entitled to compensation that varies according to firm size.[7] Since 1990, these general rules apply on an almost universal basis, irrespective of the employers'

[5] Strictly speaking, even in the US, whose legislation is considered one of the least stringent among the industrialized countries, employment at will does not apply anymore, as several exceptions have been introduced by the courts (Autor, Donohue & Schwab 2004*a*).

[6] This representation clearly indicates that comparing the institutional settings across countries is a very difficult task. Indeed, a close look at the most commonly used international measure of EPL, the OECD index (OECD 1999), shows that, at least in the Italian case, the measure has several problems. In particular, the TFR, a form of deferred compensation to which the worker is entitled upon separation independently of its nature (fired, quit or retired), is erroneously computed as a firing cost. We discuss these issues more in detail in the appendix.

[7] Discriminatory dismissals, such as for ethnic, religious or trade-union membership reasons are never allowed; in this case a worker always has the right to be reinstated in the work place irrespective of the firm's size.

characteristics.[8] Firing costs are nil when a dismissal is not contested or it is ruled to be fair, although firms may want to pay workers to make firing easier (this is especially true in collective dismissals, when lump-sum payments are sometimes explicitly bargained with trade unions). In cases of unfair dismissals, the workers' compensation varies substantially according to the firm's size. Firms with less than 16 employees must compensate unfairly dismissed workers with a severance payment that varies between 2.5 and 6 months of salary (*tutela obbligatoria*). As an alternative to the severance payment, firms with less than 16 employees can opt for reinstating the worker. The potential cost of an unfair dismissal is substantially higher in larger firms. Firms with more than 15 employees,[9] to which Article 18 of the "*Statuto dei lavoratori*"[10] applies, have to compensate workers for the forgone wages in the time elapsing between the dismissal and the sentence, with no upper limits. As the trial can last up to five years, the firm that loses a case for unfair dismissal will have to pay the worker a large sum of money. Moreover, firms are obliged to reinstate the unfairly dismissed worker, unless he or she opts for a further severance payment equal to 15 months of salary.

Given that the definition of fair dismissal is not particularly restrictive (OECD 1999) and that the cost is nil if a dismissal is ruled to be fair, a critical variable in determining the expected firing costs in Italy is uncertainty about the result of the trial. The actual application of a rule is always difficult to assess, as it depends critically on the courts

[8] In 1991 a special procedure was introduced for collective dismissals in firms with more than 15 workers. When a firm with more than 15 employees wants to fire five or more workers within 120 days to reorganize or to downsize its production, it has to follow a procedure that involves the trade union representatives and the public administration. Firms and unions are asked to reach an agreement on dismissals; if the administration finds that an agreement is not possible, the firm can still dismiss the workers. When choosing which workers to fire, firms are required to take into account specific criteria, such as seniority and workers' family conditions, usually explicitly stated in collective contracts.

[9] More precisely, the rule refers to establishments with more than 15 employees, firms with more than 15 workers in the same municipality or with more than 60 employees in all establishments combined.

[10] Law 300 of 1970, "Statuto dei lavoratori," was passed after the so-called "hot autumn" of 1969, when large-scale strikes were called all over the country, forcing the Parliament and the government to pass pro-labor reforms.

and on the judges' interpretation of the law. Some Italian jurists deem the discretionary power of judges to be far reaching (Ichino 1996), so that firms undergoing a trial for unfair dismissal would not be sure of the result even when the dismissal is justified by the firm's needs or the worker's behavior. In fact, the firm bears the burden of proof. The judges' discretionary power is limited when the dismissal is due to the need to reduce employment or reorganize the production process. On the contrary, when the dismissal is due to worker misconduct, the judge is asked to assess the effective behavior of the worker. In this case it could prove difficult for a firm to show a worker deserves to be fired. For large Italian firms, this uncertainty can be extremely important, as the compensation in cases of unfair dismissal depend on the duration of the trial, which can be very long. Ichino (1996) argues that the uncertainty about the result of the case, together with the potential high cost in case of loss, is a strong deterrent to initiating a dismissal procedure even when the firm might think it has the right to do so. Thus, the expected firing cost should be substantially higher for firms with more than 15 workers, to which Article 18 of the *Statuto dei lavoratori* applies.[11]

3 A simple model of threshold effects and size structure

In this section we construct a model of size evolution in the presence of the threshold effect induced by EPL. In the tradition of modern theories of firm size distribution, we assume that firms are heterogeneous in productivity, which determines optimal individual firm size

[11] The threshold of 15 workers is also relevant for the establishment of the "Rappresentanze Sindacali Aziendali". Workers of firms with more than 15 employees can elect trade union representatives at firm level, who can call general meetings, affix posters on union activities and call referendums. This represents a further effect of the 15-employee threshold, whose relevance, however, is likely to be minor, as trade union membership and activity within the firm do not depend on the presence of a "Rappresentanza Sindacale Aziendale". Moreover, collective agreements also apply to workers and firms that do not belong to unions and employers' organizations.

(see for example Lucas (1978), Hopenhayn (1992) and Jovanovic (1982)). The model has two main ingredients. First, we assume that labor is indivisible. Second, firms above a certain threshold face a higher costs of labor. This assumption formalizes the notion that EPL applies differentially to firms of different sizes. It clearly represents a shortcut with respect to modeling firing restrictions directly; however, as shown by Bentolila & Bertola (1990), firing costs can be thought of as increasing the expected cost of labor, because the firm takes into account the expected costs of firing. This assumption greatly simplifies the analysis while resulting in several general empirical predictions derived from the fact that the expected cost of labor is higher above a certain threshold. This is therefore a simple and convenient way of modeling the behavior of firms below the threshold. As we will see, the assumption is more problematic for firms above it.

Firms produce output with a decreasing return to scale Cobb-Douglas technology with labor as the only input, with a productivity or demand shock A that determines the marginal product of labor:

$$Y = Al^{\alpha} \tag{1}$$

For given wage w, optimal employment is:

$$l^{*} = (\alpha \frac{A}{w})^{\frac{1}{1-\alpha}} \tag{2}$$

In this economy, the size structure at any point in time is determined by the distribution of A, and its evolution by the stochastic evolution of A. We assume that $A = e^{\varepsilon}$ and that

ε evolves according to a random walk:

$$\varepsilon_t = \varepsilon_{t-1} + u_t \tag{3}$$

where u is and *iid* normal random variable distributed according to a $N(0, \sigma^2)$. This formulation can accommodate two features that have appealing implications for firm-size dynamics:

1. Firm productivity is highly persistent;

2. Percentage changes in productivity are independent of the productivity level itself: $\Delta \log A = u_t$.

The first feature reproduces the empirical regularity that firm size is a regular process rather than an erratic one; the second, known in the literature as Gibrat's law of independent increments, implies that absolute changes in employment depend on size.

Consider now labor adjustment. From (2), and assuming that the wage is fixed, labor adjustment will be:

$$\Delta \log l = \frac{1}{1-\alpha} \Delta \log A$$

This equation assumes that labor is perfectly divisible. Given that the relevant entity for EPL legislation is the number of employees, and given that this is exactly what we observe in our data, we want to characterize employment behavior when $l \in N_+$, the nonnegative integers. Define l =int$((\alpha \frac{A}{w})^{\frac{1}{1-\alpha}})$ as the optimal integer employment given A. Given indivisibility, employment cannot change continuously with A, so that the employment-productivity relation can be represented with a step function. Consider first the case in which $A = l^{1-\alpha}\frac{w}{\alpha}$, $l \in N_+$, i.e., the value of productivity is such that an integer employment value would be exactly optimal even without indivisibility. To determine if the firm increases employment after an increase in productivity to A', we simply need to check if profits at $l+1$ are larger than at l, given the new productivity level: in fact, if the new maximum prescribes $l' > l$, then the profits are increasing in l as log as $l < l'$, so that profits at $l+1$ are larger than at l. Therefore, the condition is:

$$\text{increase } l \text{ if } A'(l+1)^\alpha - w(l+1) > A'l^\alpha - wl$$

or

$$A' > \frac{w}{(l+1)^\alpha - l^\alpha}$$

The probability of increasing employment conditional on $A = l^{1-\alpha}\frac{w}{\alpha}$ is then:

$$\Pr\{l' > l|A\} = \Pr\{A' > \frac{w}{(l+1)^\alpha - l^\alpha}|A\} = \Pr\{u' > \ln(\frac{\alpha}{l((\frac{l+1}{l})^\alpha - 1)})\} \tag{4}$$

where we use the fact that $A' = Ae^{u'}$ and $A = l^{1-\alpha}\frac{w}{\alpha}$,. The right hand side of the inequality is decreasing in l ; moreover, it is a smooth function of l. These two properties imply that the probability of increasing employment is a smoothly increasing function of employment itself: in fact, it reaches a minimum of $\Pr\{u' > \ln\frac{\alpha}{2^\alpha - 1}\}$ for $l = 1$, where $\ln\frac{\alpha}{2^\alpha-1}$ is strictly larger than zero, and converges to $\Pr\{u' > 0\} = \frac{1}{2}$ for $l \to \infty$. A similar argument applies to the probability of decreasing employment, which is also an increasing and smooth function of initial employment. As we will see, this property, which derives from indivisible labor and Gibrat's law, is very much in line with the empirical evidence. Note also that the probability of adjusting employment is independent of the wage, which influences the level of employment but not its changes.

We have derived the result under the assumption that $A = l^{1-\alpha}\frac{w}{\alpha}$ for l integer. In general, firms with employment level l will have productivity levels A in range around $l^{1-\alpha}\frac{w}{\alpha}$, i.e. the range for which l is preferable to both $l-1$ and $l+1$. Call this set $\mathbf{A}_l$. To determine the probability of increasing employment conditional on l, one needs to integrate over this set: $\Pr\{l' > l|l\} = \int_{\mathbf{A}_l} \Pr\{l' > l|A\}dG(A)$, where $G(A)$ is the CDF of the productivity level over $\mathbf{A}_l$. As shown by the literature on Ss policy rules (Caplin & Spulber 1987), the behavior of the "representative firm" considered above is sufficient to characterize to a first degree approximation the average probability of adjustment, because the higher probability of increasing employment of firms in the upper part of $\mathbf{A}_l$ will be compensated by the lower ones of those in the lower range of $\mathbf{A}_l$.

We now turn to the threshold effect. We assume that firms above the relevant employment threshold $\tilde{l}$ pay a wage $w_H = \lambda w$, with $\lambda > 1$.[12] We temporarily put aside the integer problem, which, for this part of the argument, is inconsequential and would only make notation substantially more involved.

If we define $\Pi(A)$ as the maximized value of profits for a firm with productivity level A, we find:

$$\Pi(A) = (\frac{1-\alpha}{\alpha})(\frac{\alpha A}{w^{\alpha}})^{\frac{1}{1-\alpha}}. \tag{5}$$

Clearly, $\Pi'(A) > 0$: the higher the productivity level, the higher the profits. The problem of the firm in the presence of a threshold above which the EPL imposes additional costs

[12] Another possibility is to assume that firms that pass the threshold pay an additional fixed cost c. This assumption is less realistic and, in any case, leads to very similar predictions.

can be formulated as follows:

$$\max_{l}\{Al^{\alpha} - [wI_{\{l\leq\tilde{l}\}} + \lambda w(1 - I_{\{l\leq\tilde{l}\}})]l\} \tag{6}$$

where $I_{\{l\leq\tilde{l}\}}$ is the indicator function taking the value of 1 if $l \leq \tilde{l}$ and zero otherwise. Define $\tilde{A} = \frac{w\tilde{l}^{1-\alpha}}{\alpha}$ as the minimum productivity level at which optimal employment is $\tilde{l}$. Clearly, optimal employment will be equal to $(\frac{\alpha A}{w})^{\frac{1}{1-\alpha}}$ for $A \leq \tilde{A}$. Moreover, if $A > \tilde{A}$ and the firm optimally chooses not to pass the threshold, the employment level which maximizes profits is $\tilde{l}$, because profits are increasing in l for $l < \tilde{l}$. For $A > \tilde{A}$, we therefore need to compare profits at $\tilde{l}$ with those at the optimized value of employment given $w_H = \lambda w$

$$A\tilde{l}^{\alpha} - w\tilde{l} \lesseqgtr (\frac{1-\alpha}{\alpha})(\frac{\alpha A}{(\lambda w)^{\alpha}})^{\frac{1}{1-\alpha}}. \tag{7}$$

By construction, evaluated at $\tilde{A}$, the left-hand side of (7) is larger than the right-hand side; moreover, the former increases linearly with A, while the latter exponentially. This implies that there exist one and only one $\bar{A}$ at which (7) is satisfied as an equality, and above which it is optimal to pass the employment threshold. It is easy to show that the size of the productivity range in which $\tilde{l}$ is the preferred employment level increases with λ. We can therefore characterize optimal employment as follows:

$$l^{*} = \begin{cases} (\frac{\alpha A}{w})^{\frac{1}{1-\alpha}} & \text{if } A < \tilde{A} \\ \tilde{l} & \text{if } \tilde{A} \leq A < \bar{A} \\ (\frac{\alpha A}{\lambda w})^{\frac{1}{1-\alpha}} & \text{if } A \geq \bar{A} \end{cases}$$

The same conditions hold for the indivisible labor case. The difference is that the profits in (5) will not generally be attainable, so that profits will be lower than in the unconstrained case. This implies that $\bar{A}$ must be adjusted to compensate for this, so that the minimum value of A that prescribes adjustment will generally be larger. However, the reduction in profits because of indivisibility is rather modest, so that this constitutes a second order effect with respect to the impact of the increase in labor costs.[13]

Define $\tilde{A}_{+1}$ as the minimum value of A which, in the absence of EPL, would induce a firm which experiences a productivity gain from $\tilde{A}$ to $\tilde{A}_{+1}$ to increase employment from $\tilde{l}$ to $\tilde{l}+1$. If the costs of EPL are nontrivial, then $\tilde{A}_{+1} < \bar{A}$, the more so the larger λ. Then, we have that:

$$\Pr\{l' > \tilde{l}|\tilde{A}\} = \Pr\{A' \geq \bar{A}|\tilde{A}\} < \Pr\{A' \geq \tilde{A}_{+1}|\tilde{A}\} \tag{8}$$

if and only if $\bar{A} > \tilde{A}_{+1}$, where we use the notation $\Pr\{A'|z\} \equiv \Pr\{A|A_t = z\}$ The inequality in (8) formalizes the notion that EPL makes employment growth less attractive for firms within the proximity of the threshold. This implies that, with respect to a situation without the differential effect of the EPL, we should observe:

1. An increase in the share of firms within the proximity of the threshold;

2. A drop in the probability of growth for firms at the threshold.

These predictions, coupled with the smoothness of the relation between firm size and the probability of inaction implied by (4), offer an identification strategy to estimate the impact of EPL on the growth choices of firms below the threshold: if we observe that the probability of growth follows a smooth pattern, interrupted in the proximity of the threshold, than we can speculate that the deviation from this smooth relation is attributable to the

[13]For example, fixing α to 2/3, $\tilde{l}$ to 15, w to $\frac{\alpha}{15^{1-\alpha}}$ (so that A at $l = 15$ is 1) and λ to 1.05, we find that $\bar{A}$ =1.1141, and the corresponding value for $\bar{l}$ is 20.75. At $\bar{l} = 21$, the minimum value of A that makes adjustment optimal would rise to 1.1145, an increase of less that .04%.

effects of the EPL. Moreover, given that the difference between $\bar{A}$ and $\tilde{A}_{+1}$ increases with λ, the size of this deviation is an indirect measure of the costs of EPL itself.

This model has several additional predictions that can be empirically tested. First, by following a similar argument, it can be shown that, with respect to a situation with no threshold, firms that have employment level $\tilde{l} - j, , 1 \leq j < \tilde{l}$ should show a lower probability of increasing employment by j or more, because this would imply their passing the threshold. Second, define $\bar{l}$ =int$(\frac{\alpha\bar{A}}{\lambda w})^{\frac{1}{1-\alpha}}$, i.e., as the minimum value of l chosen by a firm that passes the threshold. Then, by using the implicit function theorem, one can show that $\frac{\partial \bar{l}}{\partial \lambda} > 0$. This in turn implies that, if the cost of passing the threshold is sufficiently large, the range of employment values $[\tilde{l} + 1, \bar{l} - 1]$ would not be chosen by an expanding firm.[14]

The simple way EPL is modeled is more problematic when considering the behavior of firms above the threshold. Here, employment adjustment will be influenced by EPL itself, arguably reducing the propensity to hire and fire with respect to an unregulated world (Bentolila & Bertola 1990). Indeed, our within country analysis would hardly identify the overall effects of EPL; in our simulations we will therefore keep the behavior of firms above the threshold fixed. This implies that we can only identify the size effect deriving from the reduction in the propensity to grow of firms below the threshold. While this is clearly an important limitation, theoretical models of EPL do not identify any clear cut effect of EPL *per se* on average firm size, because it should reduce both hirings and firings, with second order effects on average employment.[15] It is therefore arguable that our analysis captures the most important channel through which EPL influences firm size, a conjecture that will

[14]Numerical analysis shows that $\bar{l}$ is very sensitive to λ: fixing as before α to 2/3 and $\tilde{l}$ to 15 and w to $\frac{\alpha}{15^{\frac{1}{1-\alpha}}}$ (so that A at $l = 15$ is 1), at $\lambda = 1.01$ the jump point is 19, and at $\lambda = 1.1$ it is 29.

[15]See Schivardi (2000) for a simple model that formalizes this notion and for a survey of the available evidence.

require further work to be verified.

4 Estimating the threshold effect

We use data on firms collected in the period 1986-1998 by the Italian Social Security Administration (Inps),[16] which covers the entire population of private firms with at least one employee (about 1.1 million firms per year). We use information collected in January of each year so that the size of each firm is defined as the stock of employees registered in the Inps' archive in this month.[17] Figure 1 reports the share of firms and of employment by size class for the whole economy in the entire sample period 1986-98. The main features of the pictures are by now well known:[18]

- Small firms constitute the vast majority of the population: more than 75% of them have less than 5 employees, and only 0.3% more than 250.
- The picture is dramatically different in terms of employment: firms with less than 5 employees account for around 15% of employment, those with at least 250 employees for 35%.

The density function declines smoothly with size. To get a closer picture of the distribution in the neighborhood of the threshold, Figure 2 reports the annual average number of firms by firm size in the 8-25 employment interval. Similar to Istat (2002), which uses

[16] A comprehensive description of Inps' archives can be found in Contini (2002).

[17] The employment concept of the "Statuto dei lavoratori" relevant to determine the 15-employee threshold excludes workers with an apprenticeship contract; moreover, case-law allows firms to weight part time workers according to the hours actually worked and refers to the usual employment level. While this will introduce some noise in our estimates it does not seem to be very relevant. In fact, Borgarello et al. (2002), using a richer data set for the province of Turin, that accounts for such factors, do not find major differences comparing the inaction probability of firms around the threshold computed according to two different concepts of employment, the first identical to the one we use, the other more similar to the one to which the law refers.

[18] The analysis is conducted on the whole private sector. Manufacturing and services repeat the same patterns, with the distribution shifted to the right for the first and to the left for the second, arguably because of technological factors.

data on 1999 from the Statistical Archive on Active Firms, the number of firms regularly declines until 12-13 employees; it still declines, but at a slower pace, at 14 and 15, and drops at 16, after which the number of firms starts to decrease again at a regular pace. This weak disturbance in the relation between the number of firms and their size is a sign that some threshold effect is probably at work, even if its impact on the size distribution appears to be limited.

We turn to the predictions of the model in terms of growth probability. For each employment level we compute this probability as the share of firms that increase the number of employees from one year to the next. Figure 3 plots this probability against size in the 5-25 employment range; the probability of growth increases regularly with size, as predicted by the model. Moreover, a clear downward spike emerges at 14-15 employees, just at the EPL threshold. Similar patterns are observed when separately analyzing services and manufacturing, the main difference being that small firms in the service sector have a lower probability of growth (Figure 4).[19]

Consistent with the model, the inertia probability shows an upward spike at 15 (Figure 5). The probability of reducing the number of employees is somewhat more irregular than the inertia and the growth probability (Figure 6), so that it is difficult to single out any clear threshold effect.

[19] We have also checked that this probability is stable over time. The share of firms that increase employment from one year to the next for four size classes around the 15 threshold (5-10, 11-15, 16-20, 21-25) shows a clear cyclical pattern and a slightly negative trend. This, however, seems to mirror the differences in macroeconomic conditions between the first and second half of the period rather than a structural change in the firm size dynamics. Moreover, the four groups of firms share the same tendencies, so that it seems fair to say that the probability of growing net of cyclical factors has remained quite stable in the size range we consider.

To quantify this effect, we estimate a probit model at the firm-year level of the form:

$$y_{it} = \alpha + \sum_{j=1}^{4} \beta_j l_{it-1}^{j} + \sum_{k=1}^{n} \gamma_k D(16-k)_{it-1} + X_{it} + \epsilon_{it} \tag{9}$$

where $y_{it} = 1$ if $l_{it} > l_{it-1}$ and 0 otherwise. This binary variable is regressed on a fourth degree polynomial in size, and a set of dummies $D(16-k)_{it-1}$ that are equal to 1 if $l_{it-1} = 16-k, k = 1, 2, ...$; X_{it} are additional controls. In particular, we always include the age of the firm (quadratic form), 2 digit sector, year and 20 regional dummies. The estimates of γ_k should capture the threshold effect due to EPL, given that the fourth degree polynomial in size should account for the smooth relation between size and the probability of growing. All our results are robust to alternative specification.[20]

Table 2 reports the results of the estimates and Figure 7 plots the actual probability of growth and the predicted values by size. As the figure shows, the model fits the actual probabilities quite well, and the dummy at size 15 is approximately -1.5 percentage points and significant, while at 14 it drops to -.35 percentage points, and it is not statistically different from zero at 13. Borgarello et al. (2002) obtain remarkably similar results from a relatively small sample using annual averages instead of microdata, without controlling for age, industry and location of firms.

We run several robustness checks. We have repeated this exercise for the service and manufacturing sectors in order to assess whether the apparently different relation between probability and size we saw above has any significant impact on the estimate of the threshold effect.[21] Table 2, column 2, reports the estimates and Figure 8 plots actual and predicted

[20] Our results do not change substantially if we include dummies for firms whose size is just above the threshold or extend the sample to firms with less than 5 or more than 25 employees, or restrict ourselves to firms belonging to specific age groups, such as young firms.

[21] Note that these two sectors are not exhaustive, as construction and mining are not included therein.

probabilities for manufacturing, while column 3 and Figure 9 do so for services. Once we split the sample, the threshold effect seems to be slightly higher (-1.78 in manufacturing and -1.76 in the service sector).[22]

Given that we consider the probability of growth, irrespective of by how much, the dummy at 14 is harder to interpret, as a firm with 14 employees could still hire one worker without passing the threshold. Our estimates of the threshold effect could therefore be downward biased for this size class. More generally, as argued in the model of the previous section, we should expect that the threshold effect reduces the probability of passing it for any employment level below it. To visualize this effect, Figure 10 reports in each sub-panel the probability of growing by 1 or more, 2 or more and so on. The effect is very apparent for employment levels not far from the threshold, while it tends to disappear as we move further away from it. This is due to the fact that the probability of experiencing a shock that prompts a sufficiently large size increase to cross the threshold diminishes as we move away from the threshold itself: in fact, the smooth expansion pattern implied by Gibrat's law makes large increases less likely. The same pattern is observed looking at the probability of growing by exactly 1, 2, 3, etc., as reported in Figure 11. In this case, the drop is more clearly apparent, in line with the theoretical prediction that firms that pass the threshold should record relatively larger employment increases, so that moving just above the threshold is a less likely event.

Table 3 reports the estimates of the dummy 15 for the probability of growing by one or more, of the dummy 14 for the probability of growing by two or more, of the dummy 13 for that of growing by 3 or more and so forth, obtained by probit models separately estimated for each size increase. We used a fourth-degree polynomial in size for rows 1

[22] We have also produced annual estimates of the threshold effect, without observing any clear trend in their magnitude.

and 2, a third-degree polynomial for row 3 and a second-degree polynomial in size in the other probits to accommodate the fact that the relation becomes progressively more linear, as is apparent in Fig. 10. As can be seen, the impact of the threshold moving away from 15 rapidly becomes very low: we estimate that for a firm with 12 workers the threshold prompts a reduction in the probability of growing by 4 or more of 0.36 percentage points; for a firm with 10 workers the reduction in the probability of growing by 6 or more is to 0.1 points and for firms with 8 workers the drop in the probability of growth by 8 or more is only 0.06 percentage points. The effects are negligible afterward.

We have tested other predictions of our model. As suggested by the model, conditional on increasing employment, we observe a higher than expected size of the upward adjustment for firms at the threshold; however the magnitude of this effect is very small and not precisely estimated. As to the probability of a size decrease, the pattern is much noisier than that observed for the probability of an increase, and we could not pin down any sizable threshold effect.

4.1 Extensions

It has been argued (Ichino, Polo & Rettore 2003) that local labor market conditions could affect courts' decisions, in that in a tighter labor market, judges would be more inclined to allow a dismissal than when the unemployment rate is high and the possibility of finding a new job low. Ichino et al. (2003) seem to find some supporting evidence for this argument by analyzing the personnel data of a large bank with branches throughout Italy. According to this hypothesis, the actual application of EPL and the cost of crossing the 15-employee threshold should differ according to the local labor market conditions. As in the South the unemployment rate is much higher than in the North (in 1993, the first year of the new labor force survey, unemployment was about 17 per cent in the South and 6 per cent in the North), we should observe a stricter application of EPL and therefore a greater incentive to remain under the threshold in southern regions. We test this hypothesis by repeating our exercise and computing the threshold effect by area. In columns 4 to 7 of Table 2 we report the estimates by area. Our evidence does not support the hypothesis. Contrary to what one would expect, the effect seems to be weaker in the South than elsewhere (0.9 percentage points, against 2.4 in the Center, 2.0 in the North west and 1.5 in the North east).[23].

Saint-Paul (2002) claims that EPL should be more relevant for firms in innovative sectors, as they would face a rapidly changing environment and therefore would require a higher workers' turnover rate. To test this assumption, we have repeated our basic exercise for two broad manufacturing sectors that should differ as to the incidence of innovative activities: the traditional products sector (textile, leather and wood) and the machinery and equipment sector. The estimate of the threshold effect is somewhat larger for the machinery sector, as predicted by the theory (1.6 vis-a-vis 1.2), but the difference between the two sectors is not statistically significant.

Labor laws introduce multiple thresholds relevant to different aspects of the employment relation (Baffi & Baffi 1999). To check for the presence of other significant thresholds, Figure 12 reports the inaction probability[24] by firm size in the range from 5 to 55 workers; in addition to the one at 15, another clear hump appears at 35. In fact, firms with more than 35 employees were requested, until the reform of 1999,[25] to hire 15 per cent of

[23] The hypothesis that a high unemployment rate is associated with a more lenient application of EPL is not supported by a time series analysis either. In fact, considering litigation from 1975 to 1999 we observe that the rate of success of workers is lower in the mid-1990s, when the number of judgments was very large due to the early 90s' recession that sharply increased the unemployment rate.

[24] We use the inaction probability because that of growth becomes somehow more erratic for larger values of employment.

[25] The reform of March 1999 changed the rule in the following way: firms with 15 to 35 workers have to hire a worker from the protected categories; firms with 35 to 50 employees have to hire two workers; and firms with more than 50 employees have to hire 7 per cent of their workforce from these categories. This

their workers from the list of the so-called "protected categories", namely disabled people, refugees, orphans and widows of persons who died in war or in the workplace. This rule substantially restricted firms' freedom to choose their employees. To quantify its effects, we run the same specification as before, with two dummies for firms with 34 and 35 employees. Even if the relation between the probability of growth and size is not as smooth as in the range from 5 to 25 employees, the relation is stable enough to single out a drop in the probability just around the threshold (Table 4): the probability of growth is reduced between 1 and 2 percentage points, again in this case a significant but rather limited amount.

All in all, these results indicate that the effects of EPL on firm growth are in line with the theoretical predictions, but that their extent appear to be rather limited.

5 EPL and firm size in steady state

The analysis of the previous section suggests that the impact effect of the threshold might be modest. However, we lack a precise metric to determine its long-run effect: in fact, it could be that an apparently small effect on the year-to-year probability of growing is compounded in the long run and has a sizable impact on the steady-state distribution. To assess the long-run consequences of EPL on the size distribution, we use a representation of firms' dynamics based on a stochastic transition matrix (STM). An STM is a matrix P whose entries $p_{i,j}$ represent the probability of a firm moving from size class j to size class i from one year to the next, for any size class subdivision. Given that our dataset comprises the firms' population, we can calculate the exact probabilities of transition for any size class subdivision. This can be seen as a non-parametric representation of the

has made the 35-employee threshold less relevant, by decreasing the share of "protected" workers and by spreading it more evenly across firms of different sizes. The recent changes in the rules do not affect our sample, as it includes data from 1986 to 1998.

transition probability of firm size that exploits the Markov property of the productivity shocks assumed in (3).

Define X^t as the n-dimensional vector $\{x_1^t, ..., x_{n+1}^t\}$, where x_i^t is the share of firms in size class i and $n+1$ represents exit.[26] Then, the evolution of X is governed by the system of difference equations:

$$X^{t+1} = PX^t \tag{10}$$

The theory of Markov chains establishes that, under regularity conditions,[27] each STM is associated with a unique steady-state distribution, irrespective of any initial distribution X^0; the long-run distribution is obtained by solving the system of equations $X = PX$, in addition to the condition $\Sigma_j x_j = 1$. Our strategy is to calculate the steady state distribution associated with the actual STM and to modify the STM by removing the threshold effects according to the findings of the previous section. The corresponding steady state distribution can then be interpreted as the one that would emerge in the absence of the threshold effect, thus obtaining a well-defined measure of the long-run impact of EPL on firm size.

Table 5 reports the STM, constructed as an average of the yearly matrices for the period 1986-98. We take the average over the period to minimize the possibility that business cycle factors influence the long-run analysis. A preliminary inspection of the matrix revels that the assumptions of the model are in line with the data. The persistence of the size at the

[26] To accommodate entry and exit we use the following convention: the last row of the matrix represents exit and the last column entry; x_{n+1}^t is the share of entrants between the beginning and the end of period t, so that $p_{n+1,i}x_{n+1}^t$ is the contribution of entry to x_i^{t+1}; $x_{n+1}^{t+1} = \sum_j p_{n+1,j}x_j^t$ is the share of exit between t and $t+1$. This implies that x_{n+1}^t represents exits during the previous period at the beginning of the period and entry during the current period at the end of it. This convention agrees perfectly with the steady state, where entry and exit are necessarily the same.

[27] A STM P is said to be regular if, when raised to some power k, it has the property that all its elements are strictly positive. In this case, there exists a unique long-run limiting distribution (Karlin & Taylor 1975)

individual level clearly emerges from the diagonal, whose entries are always the largest in the column.[28] Moreover, the matrix confirms that firm size tends to evolve smoothly: in fact, entries in the cells adjacent to the diagonal are always larger than those farther away from it, indicating that big jumps are less likely than small ones. Entry occurs mostly at the small end of the size distribution, and the probability of death decreases with firm size.

One potential problem with this approach is that the actual size distribution might be very different from the steady state one. In this case, projecting ahead the evolution of the size distribution might be a dangerous exercise, because any temporary trend might be inflated in steady-state. Table 6 reports the actual distribution (calculated as the average over the period 1986-98) and the steady-state distribution. The table shows that the movements in the size distribution seem to imply a slightly larger share of firms in the intermediate classes, with a very small decrease of the share of those in the largest class. The last column reports the actual average size within class μ_j;[29] using this, we can compute the implied average steady state size as $\mu^{ss} = \sum_j x_j^{ss} \mu_j$. It turns out that the increase in the share of firms in the intermediate size classes more than compensate for the decrease in the largest: in fact, the steady state mean size is 9.24, compared with 9.0 for the actual size. The increase is small, indicating that for the period 1986-98 there seems to be no disruptive trend in firm size distribution.

Having checked the reliability of the steady-state analysis, we now proceed to compute the long-run effect of the threshold. Our first experiment restricts the threshold effect to influencing only the growth probability of firms in the proximity of the threshold itself.

[28] The persistence probability depends on the range of employment that each cell covers, with persistence increasing with the size of the range. This explains for example why the diagonal entry for the 16-20 class is larger than that for the 13-15 class. As we show below, our results are very robust to changes in the size-class subdivision.

[29] It is reasonable to assume that the average size within class μ_i is fixed. This is an obvious identity for size classes defined only on one employment level. It is also a reasonable assumption in this context, where we look at changes in the distribution between classes and not within them.

Our probit estimates show that the threshold effect reduces the probability of growth by approximately 2 percentage points for firms in the 9^{th} size class, which corresponds to the 13-15 employment interval. We therefore reduce the persistence probability for that class by reducing the entry in the diagonal; correspondingly, we increase the probability of growing using two different assumptions about the way firms would grow in the absence of the threshold: first, we redistribute the probability to the size class just above the threshold; second, we redistribute it to all size classes above the threshold, in proportion to the actual probability of moving to each class (excluding the exit class).[30] Formally, if the reduction in the persistence probability is δ, then we modify the entries in the matrix as follows:

$$\tilde{p}_{9,9} = p_{9,9} - \delta \tag{11}$$

$$\tilde{p}_{10,9} = p_{10,9} + \delta \tag{12}$$

$$\tilde{p}_{i,9} = p_{i,9} + \delta \frac{p_{i,9}}{\sum_{l=10}^{n} p_{l,9}}, \quad i = 10,..,n \tag{13}$$

where a tilde indicates values that would prevail in the absence of EPL and (12) and (13) formalize the two redistribution assumptions. We then compute a new steady state distribution $\tilde{X}$ and, using the within-class average size, the average size that would prevail in the absence of the EPL: $\tilde{\mu} = \sum_{\iota=1}^{n} \tilde{x}_i \mu_i$. We also compute the change in the share of firms above 15 employees.

Table 7 reports the results of these experiments. The first column reports the size classes modified in the experiment; the second the size of the probability redistribution; the

[30] The first redistribution assumption is more in line with the model, as it assumes that firms that do not grow are those that have received shocks not large enough to make it worthwhile to cross the threshold. The second can be seen as an upper bound of the effect of removing the threshold.

last four columns report the change in average size and in the share of firms above 15 for the two redistribution methods. The first line reports the results of the basic experiments, in which only the 13-15 size class is modified. We find that an increase of two percentage points in the growth probability of firms in this size class (an overestimate, given that we are also attributing the larger decrease of firms with 15 employees to firms with 14 and 13 employees) would bring about an increase of 0.5% in the average firm size (from 9.24 to 9.28) using the first redistribution assumption (equation 12) and of 0.7% using the second (equation 13). Moreover, the share of firms above the 15 threshold increases by small amounts, always well below 1 percentage point. These are clearly small effects, in particular in the light of the "Italian anomaly", i.e. that firm size in Italy is approximately half that of the average for the European Union (Pagano & Schivardi 2003).

A first possible explanation of such low effects is that we have only considered the size class just below the threshold, while in the previous section we have seen that in the other classes there is also a clear decline in the probability of growing above the threshold. We therefore modify the probability for the previous size classes according to the estimate reported in Table 3. The next two lines report the results when we modify, in addition to the 9^{th}, the entries in columns 8 (by .36 percentage points) and 7 (by .1 percentage points), corresponding to the 10-12 and 8-9 size classes. In line with the theoretical analysis, our assumption is that firms that are discouraged from passing the threshold stop right before it. Correspondingly, we subtract probability from the 9^{th} row, corresponding to the 13-15 size class, and redistribute it to the cells of larger size classes. We find that the effects are only marginally greater, increasing average firm size by 0.65 and 1.2 per cent for the two redistribution methods respectively.

We have seen that estimating the reduction in the probability of growth for the size classes further away from the threshold is rather problematic. As an alternative approach to determining such probabilities we assume that, for $j = 1, 2, ..., 8$, the increase in the probability of moving to the size class just below the threshold, $p_{9,j}$, and the symmetric reduction in that of passing the threshold itself, is proportional to that estimated for the size class 9, where this reduction was around 2 percentage points against a persistence probability of 34%, so that the increase in persistence is in the order of 1/17. Formally,

$$\delta_j = \frac{1}{17} p_{9,j}, \; j = 1, 2, ...8 \tag{14}$$

so that

$$\tilde{p}_{9,j} = p_{9,j} - \delta_j \tag{15}$$

$$\tilde{p}_{10,j} = p_{10,j} + \delta_j \tag{16}$$

$$\tilde{p}_{i,j} = p_{i,j} + \delta_j \frac{p_{i,j}}{\sum_{l=10}^{n} p_{l,j}}, \; i = 10, .., n \tag{17}$$

Results are reported in lines 4-9 of Table 7. The second column reports the size of the probability reallocation calculated according to equation (14). The probability reallocation is slightly higher than estimated, and so is the increase in the average size. However, as we add in more classes away from the threshold the additional effect becomes increasingly smaller, because the probability of moving just below the threshold becomes smaller and smaller. In practice, most of the change is accounted for by the classes with 8 employees and above. When all classes are included, the average firm size increase is 0.86% in the first reallocation method and 1.8 in the second. This analysis therefore suggests that most of the effect of the threshold takes place in its proximity, while that stemming from smaller firms is likely to be very small.

We have performed several robustness checks. We have experimented with different values of δ, the threshold effects. We found that the increase in average size grows less than proportionally with it: for example, a $\delta = 4$ percentage points in the baseline experiment brings about an increase in average size of 0.9%, against the 0.5 of the basic experiment with $\delta = 2$. This implies that, even if we had substantially underestimated the threshold effect, the size increase is bound to remain modest. We have also controlled that the particular size class subdivision chosen does not influence results. We have repeated the experiment for a finer class subdivision, designed so that each size class contains approximately 3% of total employment (the approximate share of size classes defined over one employee) and composed of 32 classes, obtaining slightly smaller effects.

We have seen that another empirically relevant threshold occurs at 35. We perform the experiment of removing that threshold, again using the two redistributive assumptions above and, from the estimates in the previous section, taking 2 percentage points as the reduction in the growth probability induced by the threshold. Again, we find that the increase in the long-run average firm size is below 1%, a further indication that the threshold effects induced by EPL explain very little of the Italian left-skewed distribution of firm size.

6 Conclusions

This paper has analyzed the role on EPL in determining firm size distribution. We have exploited the fact that EPL applies differentially to firms of different size, which has some clear-cut implications for firm dynamics. Our empirical analysis was based on Italy, where there is both a clear-cut increase in the stringency of EPL regulation for firms above the 15-employee threshold and a large population of small firms, making it an ideal candidate to find such effects. Our results show that EPL does influence firm dynamics, but that its effects are quantitatively modest: in most of our experiments, average firm size would increase by less than 1% in steady state when removing the effect of EPL. We take this finding as indicating that the sources of cross-country differences in firms size distribution are not likely to be explained substantially by differences in labor market regulation.

Our results also have implications for the overall relevance of EPL. While we do not directly measure the costs of EPL, the threshold effect is clearly a function of the perceived costs of passing it. Given that we find that the discouragement effect is modest, one can infer that the overall additional costs of the stricter legislation are not very large, an important input in the debate on the role of labor market regulation for economic performance.

This observation leads to our final point. Our model has the advantage of capturing threshold effects in a simple setting. For further policy evaluation, however, it would be important to set up a model that explicitly incorporates firing restrictions. While greatly increasing the complexity of the analysis, particularly on the empirical side, this would allow to directly recover a measure of firing costs, a policy relevant issue. We plan to pursue this task in future work.

Table 1: Average number of employees per firm in broad sectors of OECD countries, 1989-94

	Total economy	Non-agric. business sector	Manufacturing	Business services
United States	26.4	25.6	80.3	21.4
western Germany	17.0	17.7	39.1	11.5
France	33.5	33.2	32.1	35.7
Italy	10.5	10.0	15.3	6.8
United Kingdom			40.7	
Canada	12.7	15.2	40.5	12.0
Denmark	13.3	15.2	30.4	12.7
Finland	13.0	13.0	27.8	9.9
Netherlands	6.5	5.8	18.3	5.3
Portugal	16.8	17.4	31.0	11.4

Source: Bartelsman et al. (2003).

Table 2: Probit model. Probability of growth, by sector and area

	Total	Man.	Serv.	N-W	N-E	C	S
Size	4.89***	4.12***	6.20***	4.93***	1.58	4.70***	6.28***
	(0.34)	(0.54)	(0.53)	(0.90)	(1.03)	(1.21)	(1.33)
Size^2	−0.37***	−0.26***	−0.52***	−0.36***	0.09	−0.35***	−0.58***
	(0.04)	(0.07)	(0.06)	(0.11)	(0.12)	(0.15)	(0.17)
Size^3	0.01***	0.01*	0.02***	0.01**	−0.013**	0.01	0.02***
	(0.02)	(0.00)	(0.00)	(0.01)	(0.01)	(0.1)	(0.01)
Size^4	−0.00***	−0.00***	−0.00***	0.00	0.00***	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	−0.78***	−0.97***	−0.74***	−0.92***	−1.05***	−0.86***	−0.96***
	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)
Age^2	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Du13	0.07	0.06	0.11	0.14	−0.44	0.57	−0.07
	(0.14)	(0.22)	(0.24)	(0.38)	(0.41)	(0.49)	(0.56)
Du14	−0.35**	0.22	−0.96***	−0.45	0.35	−0.04	0.39
	(0.15)	(.23)	(0.25)	(0.38)	(0.43)	(0.53)	(0.60)
Du15	−1.51***	−1.78***	−1.76***	−1.98***	−1.51***	−2.42***	−0.91
	(0.16)	(0.24)	(0.27)	(0.39)	(0.44)	(0.53)	(0.63)
Pseudo Rsq	1.64	1.89	1.54	2.08	1.9	1.54	1.64
N. obs	3,263,287	1,397,795	1,362,775	508,064	397,976	276,271	215,484

Note: Probit estimates. The table reports the change in probability for an infinitesimal change in each independent, continuous variable and the discrete change in the probability for dummy variables. Sector, year and regional dummies included in the model.
Firms in the range 5 - 25 workers. *** indicates significance at 1%, ** at 5% and *10%. Standard errors in brackets.

Table 3: Size dummy estimates

Probability of increasing by:	Size dummy	Parameter dy/dx
1 or more	15	-1.51^{***} (0.16)
2 or more	14	-0.79^{***} (0.13)
3 or more	13	-0.39^{***} (0.09)
4 or more	12	-0.36^{***} (0.06)
5 or more	11	-0.24^{***} (0.05)
6 or more	10	-0.11^{***} (0.04)
7 or more	9	-0.10^{***} (0.02)
8 or more	4	-0.06^{***} (0.02)

Note: Each row refers to a different probit model. The first reports the estimate of the dummy at 15 for the probability of growing by one or more, the second the estimate of dummy 14 for the probability of growing by 2 or more etc. The table reports the discrete change in probability due to these dummies. Age of the firm (quadratic form) and sector, year and regional dummies included in the models. *** indicates significance at 1%, ** at 5% and * 10%. Standard errors in brackets. We used a fourth-degree polynomial in size for rows 1 and 2, a third-degree polynomial for row 3 and a second-degree polynomial in size in the other probits, to accommodate the different relationships between these probabilities and size, which is apparent in Fig. 10 .

Table 4: Probit model. Probability of growth

Variables	Parameter dy/dx
Size	2.51^{***} (0.43)
Size^2	0.07^{***} (0.01)
Size^3	0.00^{***} (0.00)
Age	0.44^{***} (0.02)
Age^2	0.00^{***} (0.00)
Du34	-0.96^{**} (0.39)
Du35	-1.86^{***} (0.41)

Note: The table reports the change in probability for an infinitesimal change in each independent, continuous variable and the discrete change in the probability for dummy variables. Year, sector and regional dummies included in the model. *** indicates significance at 1%, ** at 5% and * 10%. Standard errors in brackets. Firms in the range 20-50 workers. Number of observations: 539,191; Pseudo Rsq=1.71

Table 4: Transition matrix

	1	2	3	4	5	7	9	12	15	20	24	29	35	49	99	249	499	500+	entry
1	**74,5**	20,5	7,8	4,4	3,1	2,5	2,0	1,7	1,4	1,2	1,1	1,1	1,0	1,2	1,3	0,7	0,7	1,0	60,3
2	8,8	**52,6**	18,6	6,8	3,3	1,8	1,0	0,7	0,5	0,4	0,3	0,3	0,2	0,3	0,3	0,1	0,1	0,0	15,6
3	2,0	12,4	**44,7**	18,7	7,4	3,1	1,4	0,8	0,5	0,4	0,3	0,3	0,2	0,2	0,2	0,1	0,1	0,0	7,4
4	0,7	3,2	13,8	**39,3**	18,4	6,1	2,1	1,0	0,6	0,4	0,3	0,2	0,2	0,2	0,2	0,1	0,1	0,0	4,1
5	0,3	1,1	4,2	14,6	**35,1**	13,6	3,4	1,4	0,7	0,4	0,3	0,2	0,2	0,2	0,1	0,1	0,0	0,0	2,6
7	0,3	0,7	2,3	7,3	21,1	**46,6**	19,5	5,2	2,0	1,1	0,6	0,5	0,4	0,3	0,2	0,1	0,1	0,1	3,1
9	0,1	0,3	0,7	1,5	3,8	15,1	**41,7**	16,0	3,7	1,6	0,8	0,5	0,4	0,3	0,2	0,1	0,1	0,0	1,8
12	0,1	0,2	0,3	0,7	1,4	4,3	19,1	**47,8**	19,1	4,7	1,9	1,1	0,7	0,5	0,3	0,1	0,1	0,0	1,7
15	0,1	0,1	0,1	0,2	0,4	1,0	3,1	15,8	**45,5**	15,4	3,4	1,7	1,0	0,6	0,3	0,1	0,0	0,0	1,0
20	0,0	0,0	0,1	0,1	0,2	0,5	1,2	3,8	18,3	**52,5**	20,8	5,6	2,3	1,3	0,5	0,2	0,1	0,0	0,9
24	0,0	0,0	0,0	0,0	0,1	0,1	0,3	0,6	2,0	12,6	**42,3**	16,5	3,8	1,5	0,4	0,1	0,1	0,0	0,4
29	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,3	0,8	3,1	17,7	**45,0**	15,9	3,2	0,7	0,1	0,1	0,0	0,3
35	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,2	0,4	1,0	3,9	17,8	**49,4**	12,6	1,3	0,2	0,1	0,0	0,2
49	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,3	0,6	1,6	4,4	18,9	**60,7**	8,4	0,5	0,2	0,1	0,3
99	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,3	0,6	1,0	2,1	13,6	**77,4**	7,8	0,4	0,2	0,3
249	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,2	0,3	5,3	**83,3**	8,3	0,5	0,1
499	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	3,1	**81,6**	4,2	0,0
500+	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	4,6	**90,0**	0,0
exit	12,9	8,8	7,1	6,1	5,6	5,2	4,8	4,5	4,2	4,2	3,8	3,6	3,2	3,1	2,8	2,8	3,2	3,6	**0,0**

Each entry represents the probability of moving from the size class of the column to that of the row. Size classes are identified with the upper limit of the class, so that, for example, the class 20 is constituted by firms in the size intervale 16-20. Boldface entries represent the persistance probability. Average values for the 1986-98 period.

Table 6: Firm size distribution (actual and steady state) and average size within each class

Size class	Actual sh.	Ss sh.	Difference	μ_j
1	41.00	39.62	1.38	0.85
2	15.90	15.61	0.29	2.00
3	9.46	9.37	0.09	3.00
4	6.17	6.18	-0.01	4.00
5	4.34	4.40	-0.06	5.00
7	5.77	5.92	-0.15	6.44
9	3.72	3.85	-0.13	8.45
12	3.64	3.83	-0.18	10.89
15	2.39	2.56	-0.18	13.91
20	2.19	2.43	-0.24	17.74
24	1.02	1.16	-0.14	22.37
29	0.86	0.99	-0.13	26.86
35	0.76	0.88	-0.12	32.34
49	0.87	1.03	-0.16	41.59
99	1.06	1.25	-0.19	68.51
249	0.54	0.61	-0.08	150.60
499	0.16	0.17	-0.00	346.49
500+	0.14	0.13	0.01	1800.77

The first column is the size class, the second the share calculated from the data, the third the implied steady-state share, the fourth the difference between the two, and the last the average firm size within class.

Table 7: Percentage increase in average firm size and in the share of firms above the 15-employee threshold in steady state

Experiment	Outcome by reallocation method				
		Next		Proportional	
Classes	δ	Mean	% >15	Mean	%. >15
Baseline case: size class 13-15					
13+	2	.5	.16	.7	.18
Other classes: experiment A (actual estimates)					
10+	.36	.62	.21	1.1	.24
8+	.10	.65	.22	1.2	.26
Other classes: experiment B (proportional changes)					
10+	.72	.75	.25	1.3	.3
8+	.14	.80	.27	1.5	.32
6+	.05	.82	.28	1.6	.34
5+	.02	.83	.28	1.6	.34
4+	.01	.84	.28	1.7	.35
1+	.003	.86	.29	1.8	.36

Note: Jump is the decrease in the probability of inaction; Next cell means that the reduction in inaction is compensated by an identical increase in the probability of moving to the next size class, Proportional by an increase in all superior size classes, in proportion to the actual probability of moving to each of them; the outcome columns report the percentage increase in steady-state average size and the percentage points increase in share of firms above 15 and 35 employees.

Figure 1: Firm and employment shares by size class (Average values over the 1986-98 period)

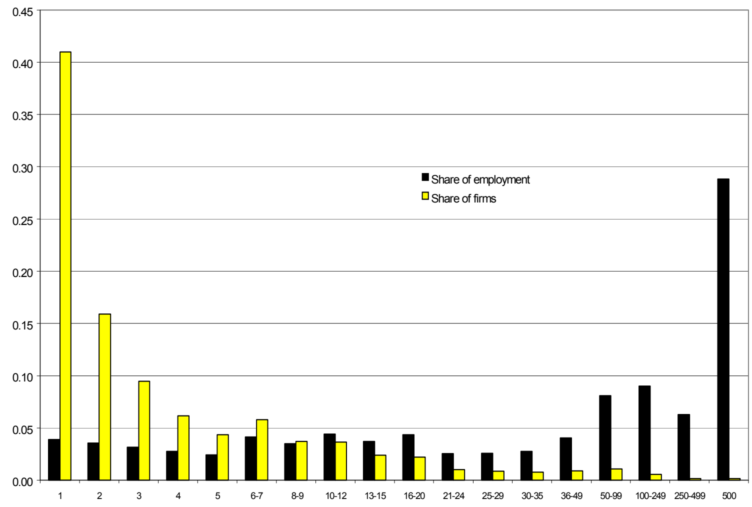


Figure 2: Number of firms by size class, average 1986-1998 (thousands)

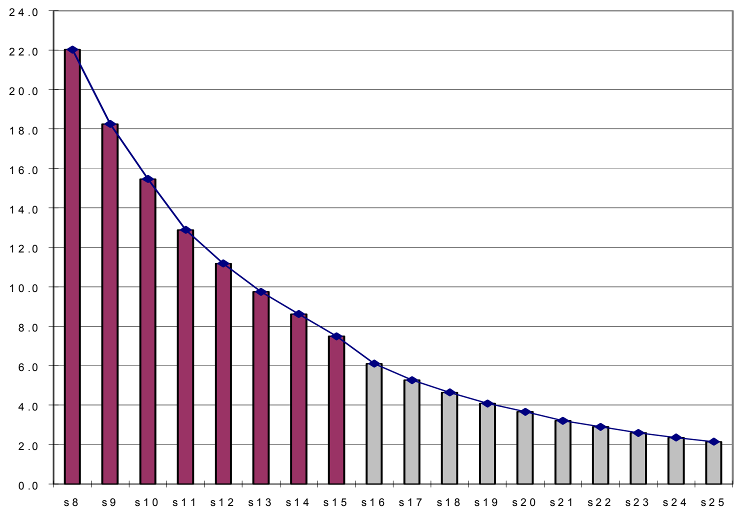


Figure 3: Probability of growth by size class, average 1986-1997

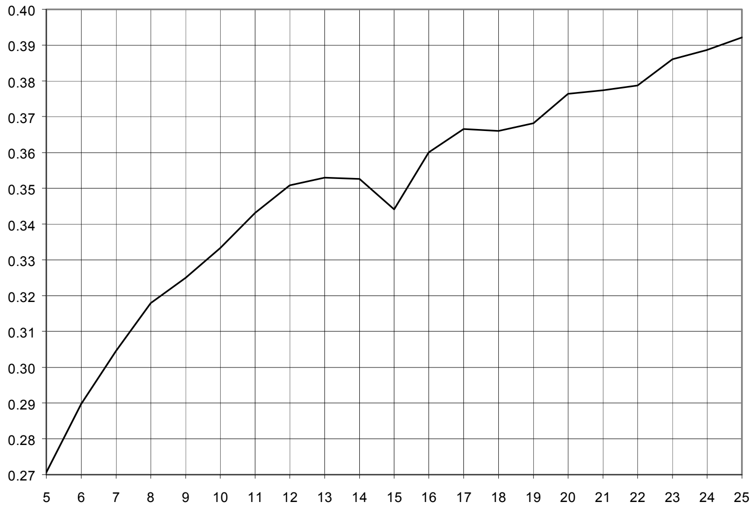


Figure 4: Probability of growth by size class in the service and manufacturing sectors

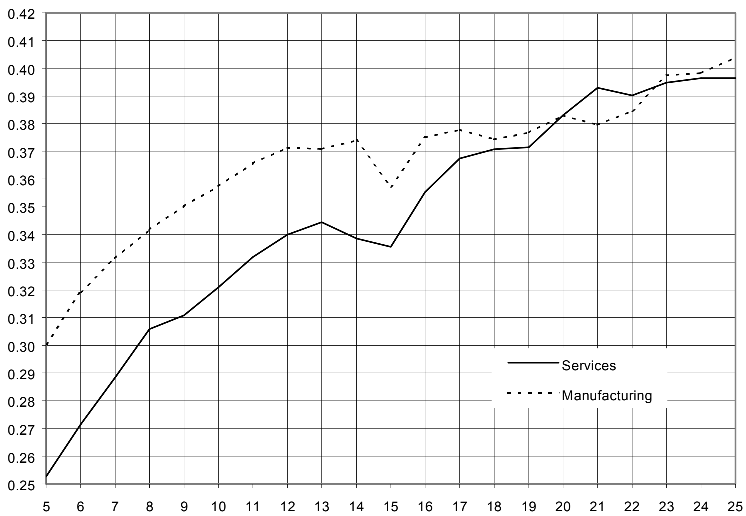


Figure 5: Inertia probability by size class, average 1986-1997

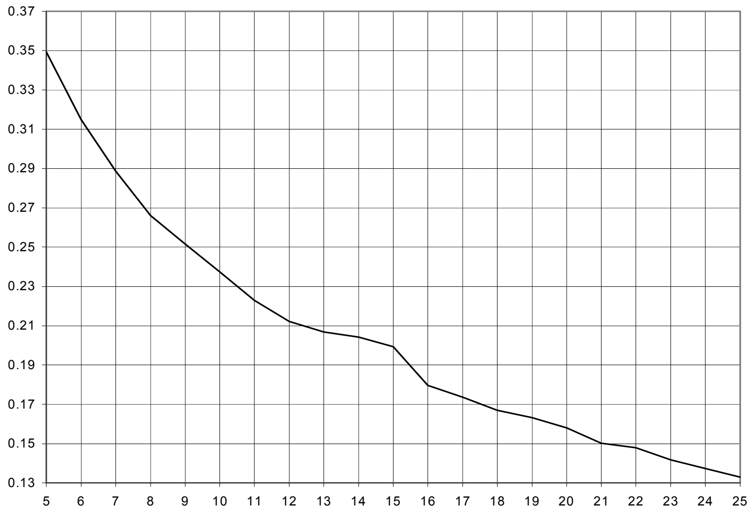


Figure 6: Probability of reducing firm sise by size class, average 1986-1997

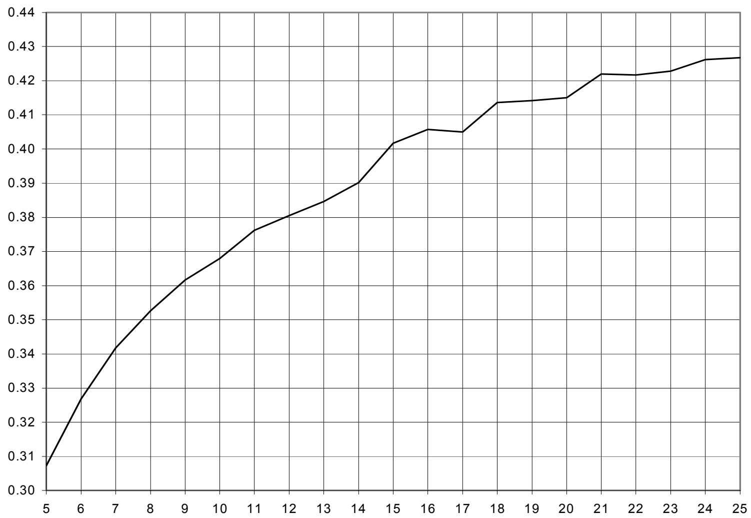


Figure 7: Probability of growth and predicted probabilities, all sectors

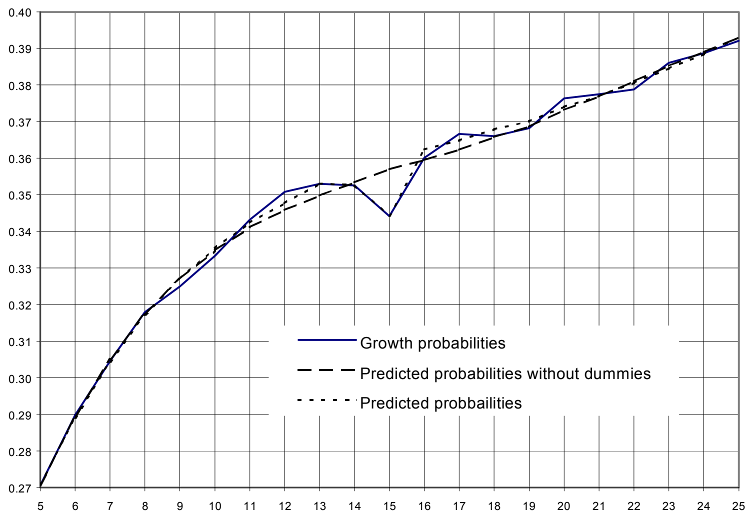


Figure 8: Probability of growth and predicted probability, manufacturing

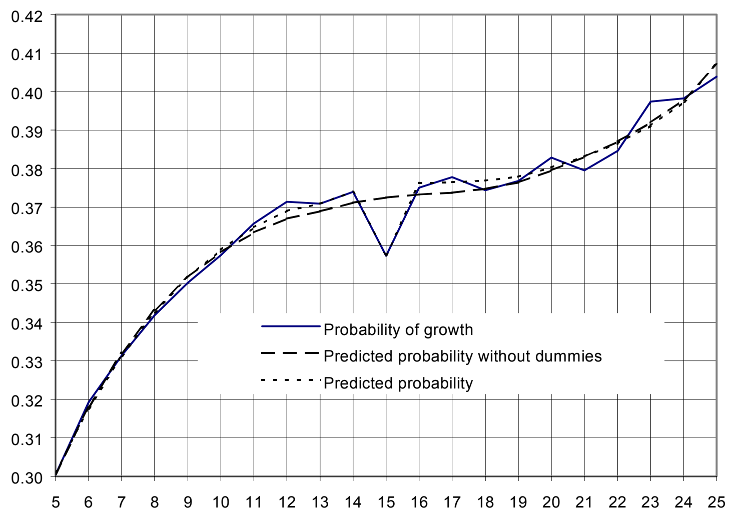


Figure 9: Probability of growth and predicted probability, services

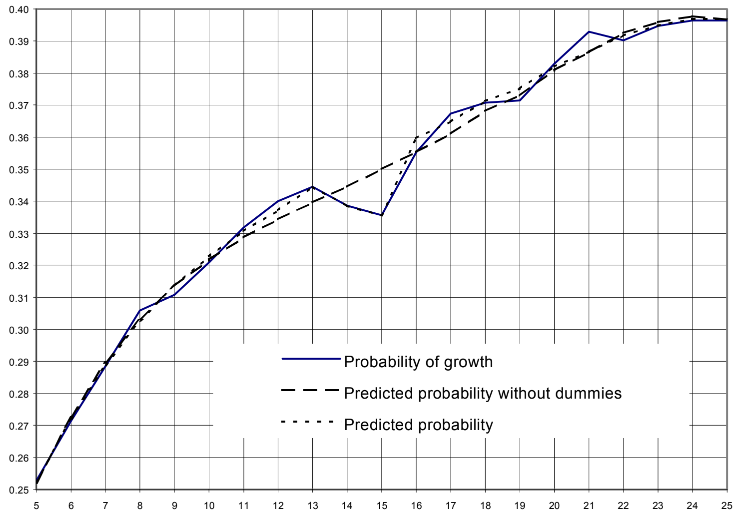


Figure 10: Probability of growing by size of the increase (1 or more, 2 or more, etc.) and firm size

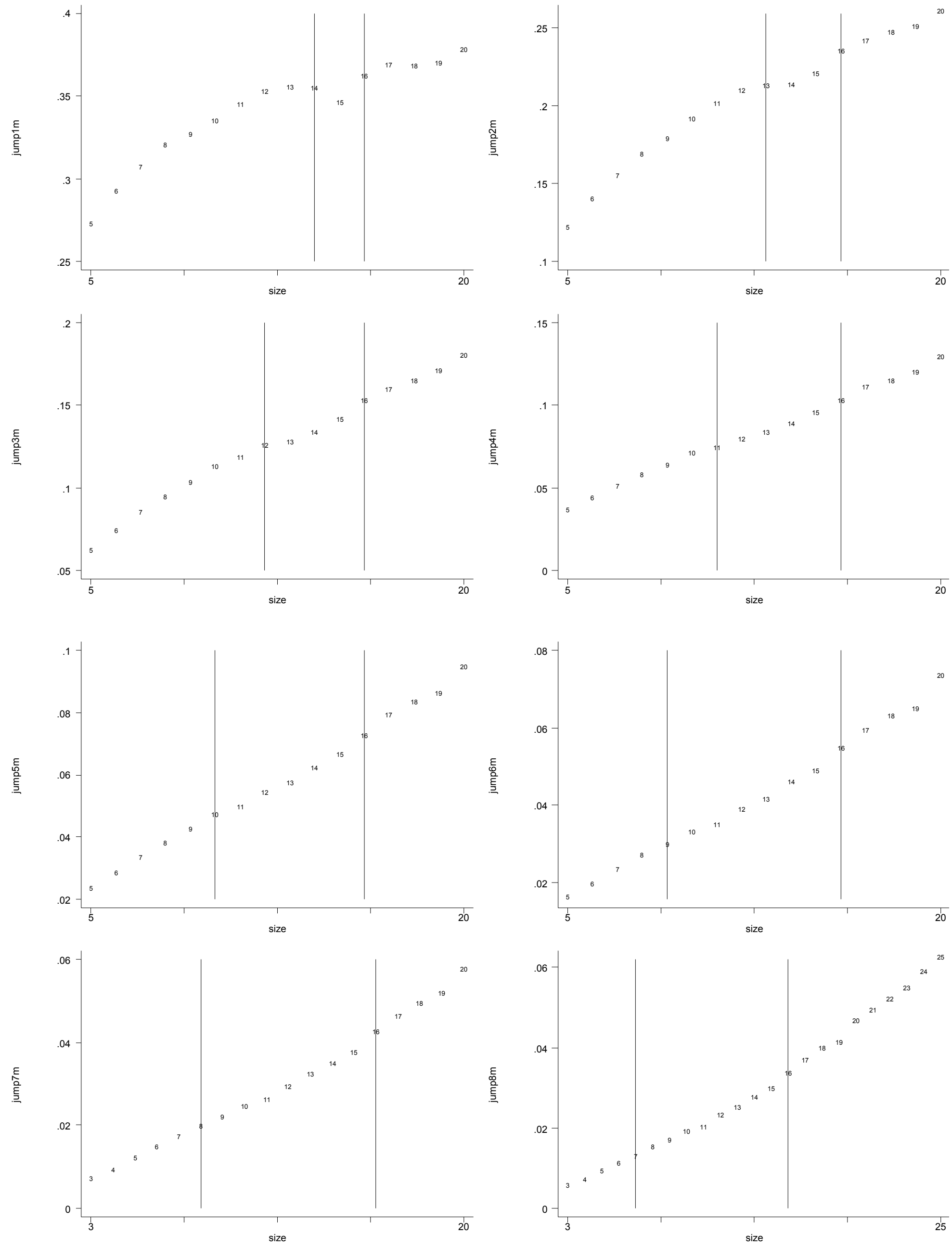


Figure 11: Probability of growing by size of the increase and firm size

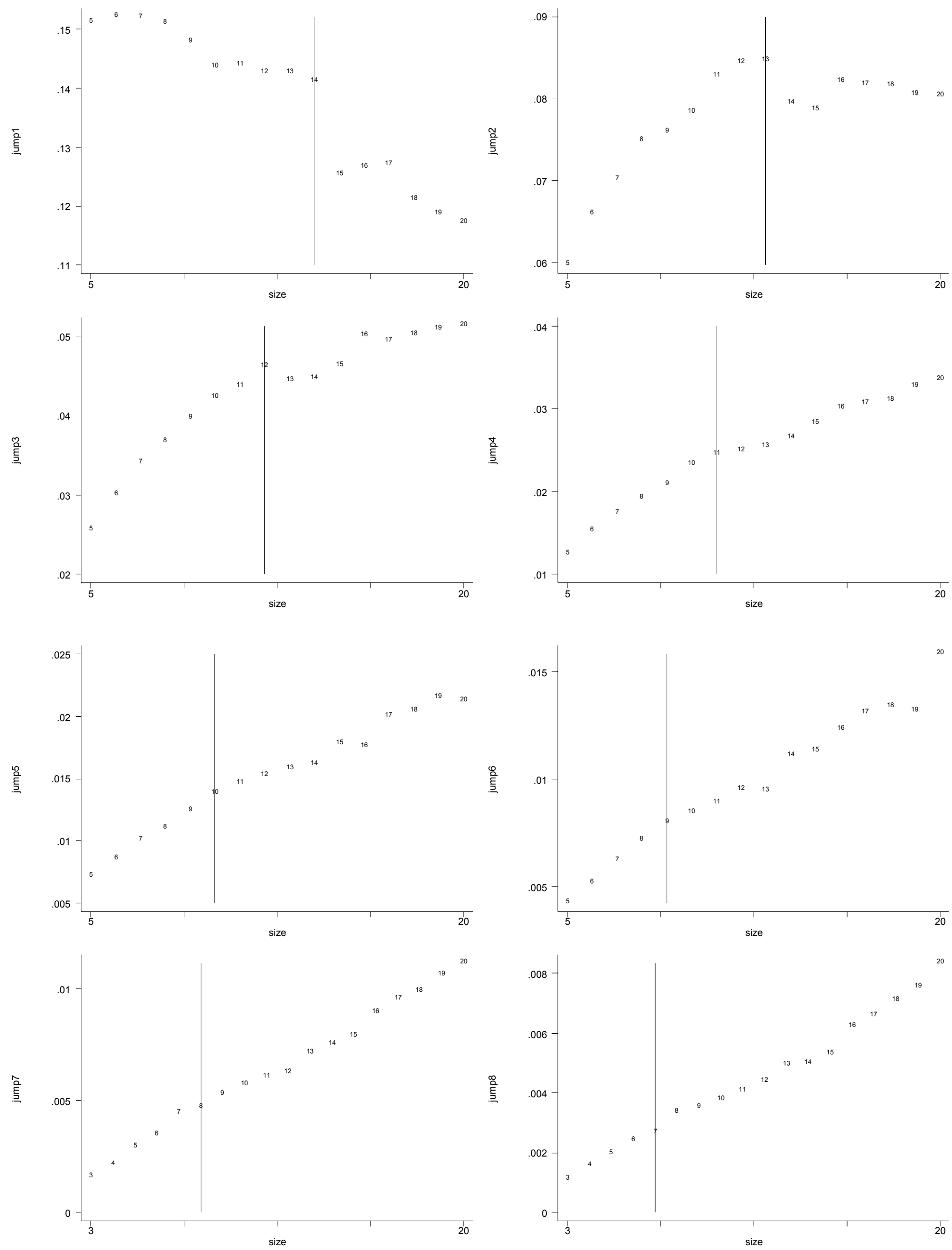
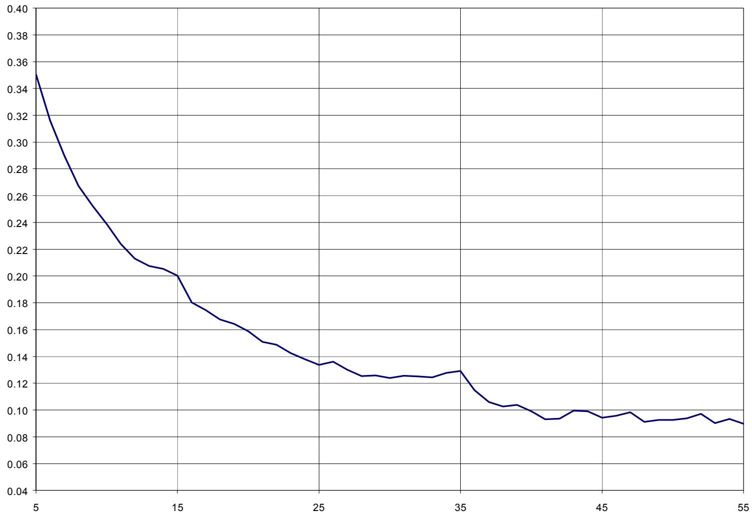


Figure 12: Inertia probability by firm size class



A Appendix: The difficulty of assessing employment protection tightness through international comparisons: the OECD index

International comparisons can help us understand how restrictive EPL is in any single country. Unfortunately, international comparisons of institutional arrangements are not easy and the existing attempts do not seem to be fully satisfactory.

The most influential comparative study is that conducted by the OECD, which collected detailed information on individual and collective dismissals for most member countries (OECD 1999). The OECD study tried to evaluate how restrictive is the definition of fair dismissal and how cumbersome are the procedures to fire workers. Moreover, the OECD assessed the cost of firing a worker, both in the case of a no-fault dismissal and in the case of an unfair one. This body of information was then summarized in a numerical index, ranking the OECD countries according to the tightness of their legislation. The OECD study explicitly skipped the difficulty of assessing the actual application of the rules by courts, limiting the analysis to the comparison of legislations. Moreover, to make comparisons feasible, some base-line assumptions, for instance on the duration of trials, were made.

The OECD index has been criticized on the grounds that apparently similar rules can have very different interpretations across countries and that the same rules can have different effects according to the efficiency of the judiciary system, so that this indicator is of little use for the policy-maker (Bertola, Boeri & Cases 2000). Moreover, even disregarding these criticisms the OECD index computed for Italy appears to be affected by some misunderstandings of Italian legislation.

The OECD index is a weighted average of scores assigned to different aspects of national employment regulation. As to the indicator of the strictness of employment protection for regular employment, the OECD analysts took into account the following issues: the procedures; the delay to start of notice; the notice period for workers with 9 months, 4 years and 20 years of tenure; and the severance payment for no-fault individual dismissal for the same tenures; the definition of unfair dismissal; the trial period before eligibility for full protection; unfair dismissal compensation at 20 years of tenure; the extent of reinstatement. The index computed for Italy erroneously considered as a firing cost a special kind of severance payment, the TFR (*Trattamento di fine rapporto*), which can be regarded as a sort of deferred salary: this is a one-time payment of the sum put aside during the worker's tenure in the firm (0.07 of his yearly income for each year of work), which is at the firm's disposal while the worker maintains her job. Italian workers are entitled to this payment irrespective of the reasons for separation, even in the case of retirement or resignation. In companies with a private pension fund, the TFR contributes to its funding. Thus, it is a part of workers' compensation and is not related to firing. Removing the TFR from firing costs changes Italy's ranking dramatically, from fifth to eighteenth position, close to that of Anglo-Saxon countries.

Moving to the regulation of collective dismissals, we find the interpretation that OECD analysts gave to Italian rules questionable. Given that collective dismissals impose more burdensome procedures, they valued the employment regulation of a country to be more restrictive, the lower the number of dismissals above which a firm is required to apply this procedure. In the Italian case, as we stated above, this is set at 5 workers, which is quite low compared to most OECD countries. Therefore, taking the OECD score at face value, Italian regulation would become less restrictive by raising this threshold to a higher level. This conclusion, however, is probably incorrect considering together the rules and their enforcement. On the basis of our earlier remarks, it is plausible that collective dismissal procedures reduce the uncertainty about the result of a dismissal, so that it could be advantageous for Italian firms to make use of collective dismissals despite additional burdens. In that case, all things being equal, it would be better to maintain a low threshold. These considerations are just an example of the kind of difficulty we face when we do not take account of both the rules and their actual application; moreover, they shed further doubt on the possibility of using the OECD index to orient policy making (Bertola et al. 2000).

References

Acemoglu, D. and Angrist, J. (2001), 'Consequences of Employment Protection? The Case of the American with Disabilities Act', Journal of Political Economy, 109, pp. 915-957.

Anastasia, B. (1999), 'I vantaggi competitivi della piccola impresa nell'utilizzo del fattore lavoro: formazione, costi, obblighi e norme, in F. Traù, (ed.), *La questione dimensionale nell'industria italiana*, il Mulino: Bologna.

Autor, D. (2003), 'Outsourcing at Will: The Contribution of Un just Dismissal Doctrine to the Growth of Employment Outsourcing', Journal of Labor Economics, 21, pp. 1-41.

Autor, D., Donohue, J. and Schwab, S. (2004a), 'The Costs of Wrongful-Discharge Laws', unpublished, Mit.

Autor, D., Donohue, J. and Schwab, S. (2004a), 'The Employment Consequences of Wrongful-Discharge Laws: Large, Small or None at All?', Forthcoming in American Economic Review.

Baffi, G. and Baffi, E. (1999), 'Il diritto del lavoro e le soglie dimensionali: presentazione di un quadro sinottico', in F. Traù, (ed.), *La questione dimensionale nell'industria italiana*, il Mulino: Bologna.

Bartelsman, E., Scarpetta, S. and Schivardi, F. (2003), 'Comparative Analysis of Firm Demographics and Survival: Micro-Macro Evidence for the OECD Countries', OECD Economic Department Working Paper, no. 348.

Bentolilla, S. and Bertola, G. (1990), 'Firing Costs and Labor Demand: How Bad is Eurosclerosis?', Review of Economic Studies, 57, pp. 381-401.

Bertola, G., Boeri T., and Cases, S. (2000), 'Employment Protection in Industrialised Countries: The Case for New Indicators', International Labour Review, 139, pp. 57-72.

Boeri, T. and Jimeno, J. F. (2003), 'The Effects of Employment Protection: Learning from Variable Enforcement', FEDEA Discussion Paper 2003-12.

Borgarello, A., Garibaldi, P. and Pacelli, L. (2002), 'Employment Protection Legislation and the Size of Firms', LABORatorio Revelli Working Paper no. 24.

Caplin, A. and Spulber, D. (1987), 'Menu Costs and the Neutrality of Money', Quarterly Journal of Economics, 46, pp. 703-725.

Contini, B., ed. (2002), *Labour Mobility and Wage Dynamics in Italy*, Rosenberg & Sellier: Torino.

Davis, S. and Henrekson, M. (1999), 'Explaining National Differences in the Size and Industry Distribution of Employment', Small Business Economics, 12, pp. 59-83.

Hopenayn, H. (1992), 'Entry, Exit, and Firm Dynamics in Long Run Equilibrium', Econometrica, 60, pp. 1127-1150.

Ichino, A., Polo, M. and Rettore, E. (2003), 'Are Judges Biased by Labour Market Conditions?' European Economic Review, 47, pp. 913-944.

Ichino, P. (1996), *Il lavoro e il mercato*, Mondatori: Milano.

Istat (2002), *Rapporto annuale*, Istat.

Jovanovic, B. (1982), 'Selection and the Evolution of Industry', Econometria, 50, pp. 649-670.

Karlin, S. and Taylor, H.M. (1975), *A First Course in Stochastic Processes. Second Edition*, Academic Press.

Kumar, K. Rajan, R. and Zingales, L. (2001), 'What Determines Firm Size?', unpublished, University of Chicago.

Lucas, Jr. R.E. (1978), 'On Size Distribution and Growth', Bell Journal of Economics, 2, pp. 508-523.

OECD (1999), *Employment Outlook 1999*, OECD.

Pagano, P. and Schivardi F. (2003), 'Firm Size Distribution and Growth', The Scandinavian Journal of Economics, 105, pp. 255-274.

Saint-Paul, G. (2002), 'Employment Protection, International Specialization, and Innovation', European Economic Review, 46, pp. 375-395.

Schivardi, F. (2000), 'Labor Market Rigidities, Unemployment and Growth', Giornale degli Economisti e Annali di Economia', 59, pp.115-141. In Italian, English version available at http://digilander.iol.it/schivardi.

Schumpeter, J. (1911), *The Theory of Economic Development*, Harvard University Press: Cambridge, Mass.

Verick, S. (2004), 'Threshold Effects of Dismissal Protection Legislation in Germany', IZA Discussion Paper, no. 991.

CENTRE FOR ECONOMIC PERFORMANCE
Recent Discussion Papers

632	Paul Gregg Jonathan Wadsworth	Two Sides to Every Story: Measuring the Polarisation of Work
631	Jeremy Grant Thomas Kirchmaier	Corporate Ownership Structure and Performance in Europe
630	Neal Knight-Turvey Andrew Neal Michael A. West Jeremy Dawson	The Impact of an Innovative Human Resource Function on Firm Performance: the Moderating Role of Financing Strategy
629	Nicholas Oulton	A Statistical Framework for the Analysis of Productivity and Sustainable Development
628	Vasileios Gkionakis	Short Job Tenures and Firing Taxes in the Search Theory of Unemployment
627	L. Rachel Ngai Christopher A. Pissarides	Balanced Growth With Structural Change
626	Malcolm Patterson Peter Warr Michael West	Organizational Climate and Company Productivity: the Role of Employee Affect and Employee Level
625	John Schmitt Jonathan Wadsworth	Is There An Impact of Household Computer Ownership on Children's Educational Attainment in Britain?
624	Andrew Neal Michael A. West Malcolm G. Patterson	Do Organisational Climate and Strategic Orientation Moderate the Relationship Between Human Resource Management Practices and Productivity?
623	Michele Pellizzari	Do Friends and Relatives Really Help in Getting a Good Job?
622	Steven McIntosh	The Returns to Apprenticeship Training
621	Steven McIntosh	The Impact of Vocational Qualifications on the Labour Market Outcomes of Low-Achieving School-Leavers

620	David Marsden	The 'Network Economy' and Models of the Employment Contract: Psychological, Economic and Legal
619	Alan Manning	Instrumental Variables for Binary Treatments with Heterogeneous Treatment Effects: A Simple Exposition
618	Mari Kangasniemi L. Alan Winters Simon Commander	Is the Medical Brain Drain Beneficial? Evidence from Overseas Doctors in the UK
617	Vicente Cuñat Maria Guadalupe	Executive Compensation and Product Market Competition
616	James Harrigan Anthony J. Venables	Timelines, Trade and Agglomeration
615	Howard Gospel Paul Willman	Comparatively Open: Statutory Information Disclosure for Consultation and Bargaining in Germany, France and the UK
614	Andrew B. Bernard Stephen Redding Peter K. Schott Helen Simpson	Relative Wage Variation and Industry Location
613	David Marsden	Unions and Procedural Justice: An Alternative to the Common Rule
612	David G. Blanchflower Alex Bryson	The Union Wage Premium in the US and the UK
611	Stephen Gibbons Stephen Machin	Valuing Rail Access Using Transport Innovation
610	Johannes Hörner L.Rachel Ngai Claudia Olivetti	Public Enterprises and Labor Market Performance

The Centre for Economic Performance Publications Unit
Tel 020 7955 7673 Fax 020 7955 7595 Email info@cep.lse.ac.uk
Web site http://cep.lse.ac.uk