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Firm size distribution and employment protection legislation in Italy

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FIRM SIZE DISTRIBUTION AND EMPLOYMENT PROTECTION LEGISLATION IN ITALY

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Abstract

We study the role of employment protection legislation (EPL) in explaining the relative small average size of Italian firms. We construct a simple model that shows that the smooth relation between size and growth probability is disturbed in proximity of the thresholds at which EPL applies differentially. We use a comprehensive dataset of all Italian firms between 1986 and 1998 to estimate the effects of EPL in terms of discouraging small firms from growing. We then construct a stochastic transition matrix for firm size that, together with the estimates, allows for a quantitative evaluation of the effects of EPL in the long run. Our results show that EPL does influence firm size distribution, but that its effects are quantitatively modest: average firm size would increase by less than 1% when removing the threshold effect. In terms of policy, these findings suggest that changes in EPL are not likely to have a large impact on the propensity of small firms to grow.

JEL classification: J65, D21, L11.

Keywords: Firm size distribution, firing costs, employment protection.

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1. Introduction[1]

One of the most important peculiarities of the Italian economy compared with most other industrialized economies is the role of small firms. For example, according to a database of the European Commission (Eurostat 1998), average firm size in Italy is approximately half the European average; moreover, this is not due to the sectoral specialization of the Italian economy: in fact, average size is consistently smaller even within fairly narrowly defined sectors, an indication that some country specificity induces a bias toward the small size in all sectors.[2]

One view holds that the large presence of small firms, often agglomerated in industrial districts, constitutes a strength of the Italian economy, because of their flexibility, the job creation potential and the capacity to successfully survive competition. A less optimistic view claims that, while the entry of small firms is a positive factor, their tendency to remain small constitutes an important drawback because innovation and the adoption of new technology might benefit from large size. For example, Pagano & Schivardi (2003) find that, in a cross-country study, average firm size positively affects productivity growth, particularly in R&D intensive sectors. Indeed, the peculiar Italian size structure is now often blamed as one of the reasons for the rather disappointing growth performance over the last decade,[3] well below the European Union average.

Despite being empirically uncontroversial, the reasons for the distortion toward small size in Italy are not well understood. Different causes have been proposed in the policy debate, such as the weaker enforcement of regulations and taxation for smaller firms, the lack of a legislative framework that favors the establishment and the conduct of large,

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[2] See Pagano & Schivardi (2003) for size comparisons based on the database. Bartelsman, Scarpetta & Schivardi (2003) compare firm size distribution for 9 OECD countries, finding evidence in support of the Italian anomaly. Torrini (2002), using labor force statistics, provides complementary evidence on self-employment shares, here taken as a rough proxy for the number of firms per worker. He shows that self-employment shares in Italy are among the highest in the OECD countries in almost every sector.

[3] A synthesis of this debate can be found in Traù (1999).

complex organizations, a form of family capitalism that prevents newcomers from displacing incumbents. Among these explanations, particular attention has been given to the regulation of the labor market, particularly in terms of employment protection legislation (EPL). While the theoretical literature does not establish any uncontroversial link between EPL *per se* and average firm size,[4] one particular feature of EPL makes it a natural candidate as an impediment to firm growth: *EPL applies differentially to firms of different size.* In particular, the legislation that regulates dismissals imposes substantially higher costs of firing for firms above the 15 employees threshold. This implies that crossing that threshold might impose a high potential cost on firms, which might be discouraged from doing so, thus reducing average firm growth and therefore average firm size.

Although this effect is often called into question in the policy debate, previous studies have been unable to identify it empirically (Anastasia 1999). A recent exception is Borgarello, Garibaldi & Pacelli (2002), who estimate the effects of the EPL on the growth probability of firms below the 15-employee threshold, finding a significant but quantitatively small effect. In this paper, we extend this research along three main lines. First, we construct a simple model that predicts a smooth relation between a firm's probability of growing 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 very stylized, the model singles out the assumptions required for identification. Second, we use a comprehensive dataset for all Italian firms between 1986 and 1998 to estimate the effects of EPL in terms of discouraging small firms from growing. Third, to obtain a precise measure of the impact of the threshold effect on firm size in the long-run, we construct a stochastic transition matrix for firm size and modify it according to our estimates. In this way, we compute a notional steady state distribution of firm size that would emerge in the absence of EPL. Our results can therefore be interpreted as measuring the impact on the long-run firm distribution of the reduction in small firms' propensity to grow induced by EPL.[5]

Our results show that the threshold effect does influence firm growth: we find that the growth probability in the proximity of the threshold is approximately 2 percentage points lower

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

[5] In this exercise, we take the behavior of firms above the threshold as given. In fact, as stated above the theoretical literature has no clear cut predictions on the effects of EPL *per se* on size, and therefore offers little guidance in identifying its effects empirically.

than with no threshold effect, very close to the result obtained by Borgarello et al. (2002) with a different empirical approach. Once we compute its effect on average firm size in steady state, we find it to be very modest: we estimate that, after removing the effect, it would increase by approximately 0.5 per cent, clearly a small amount; moreover the share of firms above the 15 employees threshold would increase only marginally from 8.66% to 8.82%. Extensions of this exercise to take into account the impact of the threshold on the behavior of all the firm size classes below 15 workers show that the overall impact on average firm size would remain below 2%, even in the less conservative hypothesis.

In terms of policy conclusions, these findings indicate that the small average size of Italian firms does not seem to stem mainly from EPL: in fact, the 50% gap in average size with respect to the European partners would remain almost intact according to our simulation exercise. This implies that the roots of the Italian firm size anomaly should be sought elsewhere.

Given the focus on the impact of EPL on small firms' growth, the results of our research do not imply that changes in the legislation might not have other important effects, possibly on productivity growth, reallocation and accumulation (Schivardi 1999), but their evaluation is beyond the scope of this article.

The rest of the paper is organized as follows. Section 2 contains a brief summary of EPL in Italy; Section 3 constructs a simple model of firm growth that illustrates our identifying assumptions, 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 7 concludes.

2. Institutional setting

In economies where "employment at will" does not apply,[6] 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 uncertainty on the result of a possible trial. The first defines when firing is allowed; the second assesses the

[6] Strictly speaking, even in the US, whose legislation is considered one of the least tight among the industrialized countries, employment at will does not apply, as several exceptions have been introduced by the courts (Autor, Donohue & Schwab 2002).

costs a firm can incur; the third describes the actual enforcement of the law and the probability of winning a case for unfair dismissal.

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 due to the firms' need to downsize or to reorganize their activity (*giustificato motivo oggettivo*). A worker cannot be fired to be replaced with another if this is not justified by his misconduct or by the need to restructure the firm's activity. For instance, it would not be possible to fire an employee with a long tenure and a high salary just to replace him with a young worker paid the minimum contractual wage.

Workers can appeal to the court against dismissal and are entitled to compensation if the judge rules the dismissal was unfair that varies according to firm size.[7] Since 1990, these general rules apply on an almost universal basis, irrespective of the employers' 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 case of unfair dismissals, although firing restrictions do not depend on the firm's characteristics, the workers' compensation varies substantially according to the firm 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

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[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 size.

[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 5 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 dismiss the workers anyway. When choosing the 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.

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 could be charged a fairly large amount of money. Moreover, firms are obliged to reinstate the unfairly dismissed worker unless he or she opts for a further compensation 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 and on the judges' interpretation of the law. Some Italian jurists deem the discretionary power of judges to be very large (Ichino 1996), so that firms undergoing a trial for unfair dismissal would not be sure of the result of the case even when the dismissal is justified by the firm's need or when it is justified by the worker's behavior. In fact, the firm bears the burden of proof. In principle, however, the judges' discretionary power should be less when the dismissal is due to the need to reduce the workforce or reorganize the production process. In this case judges should refrain from evaluating the firm's strategy and should only make sure that the reasons a firm gives for firing a worker are genuine. Moreover, in the case of collective dismissals, the uncertainty should not be very great as firms and unions bargain on dismissals and the public administration is directly involved. 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. This kind of uncertainty, however, does not seem to be a peculiar characteristic of Italian regulations. Whenever the decision to fire a worker is subject to the judgment of a court, there is some scope for different interpretations of the same facts over time or across different courts. For large Italian firms, however, this uncertainty can be very important in making their decisions, as the compensation in case of unfair dismissal has no upper limit and depends 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

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[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.

[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 Parliament and the government to pass pro-labor reforms.

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.[11] Thus, the expected firing cost would be substantially higher for firms with more than 15 workers, to which Article 18 of the *Statuto dei lavoratori* applies.[12]

As to the relevance of the firing legislation, the scanty international evidence shows that the number of cases relating to the termination of an employment contract brought before the tribunals is lower in Italy than in most European countries (Bertola, Boeri & Cases 2000), but in Italy more than half of these cases are won by the workers. This piece of evidence is difficult to interpret, as expectations about the result of a trial can affect the decision to go to court for both workers and firms, causing a severe selection bias. Thus, one can argue neither that firing legislation is irrelevant due to the limited number of cases decided by the tribunals, nor that judges are more favorable to workers due to the higher frequency of cases won by workers. The first could be due to the fact that firms refrain from firing owing to their fear of adverse decisions, the second could depend on the fact that workers take a case to court only when they have a high probability of winning it.

3. A simple model of threshold effects and size structure

The study of the determinants of the size distribution of firms has a long tradition in economics. Classical theories of size structure concentrated on technical factors, stressing returns to scale and efficient scale of operation as the fundamental determinants of size (Viner 1932). These theories had no role for either heterogeneity or dynamics because the optimal size is unique. Overwhelming empirical evidence both of a persistent dispersion in the cross-sectional distribution of firm size in an industry and of a certain stability in the stochastic pattern of evolution of firm size (Gibrat’s law of independent increments) has challenged this view and prompted the formulation of theories to account for such regularities. Modern

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[11] During the early 1990s’ severe recession, however, big firms were able to shed a large number of workers, while the share of cases for unfair dismissals won by workers recorded a substantial drop. This seems to show that, at least at that time, the judges’ interpretation of the Italian employment protection legislation did not prevent firms restructuring.

[12] 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 activity and call referendums. This, however, should not be of major relevance, as trade union membership and activity within the firm do not depend on the presence of a "Rappresentanza Sindacale Aziendale". Moreover, collective agreements apply also to workers and firms that do not belong to unions and employers’ organizations.

theories of size distribution assume that firms are heterogeneous along some dimension — typically, efficiency — that has a direct impact on their equilibrium size.[13] In this view, the equilibrium size structure will depend not only on technological factors but also on institutional characteristics such as regulation in product and labor markets, taxation, development of the financial sector, size of the market. In particular, labor market institutions such as EPL could influence both the growth pattern at the firm level and the equilibrium size distribution.

The previous consideration suggests a possible empirical strategy to test the effects of EPL on firm size: one could simply correlate country-level indicators of firm size on indicators of stringency of the legislation. This is a rather problematic avenue to follow. First, theory offers very little guidance in determining the effects of EPL itself (i.e. independently of threshold effects) on firm size, making identification difficult. Second, countries differ along different dimensions, many of which are likely to influence firm size[14] and are usually very correlated: in fact, multivariate regressions of this sort tend to be rather unstable. Third, the determination of the stringency of EPL legislation across countries is a difficult and questionable exercise. The most influential comparative study is that conducted by the OECD, which collects detailed information on individual and collective dismissals for most member countries (OECD 1999). The OECD study evaluates (i) how restrictive is the definition of fair dismissal; (ii) how cumbersome are the procedures for firing workers and (iii) the cost of firing a worker, both in the case of a no-fault dismissal and of an unfair one. It explicitly skips the difficulty of assessing the actual application of the rules by courts, arguably a very important component of the total cost of EPL, limiting the analysis to the comparison of

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[13] In Lucas (1978), the size of a firm is determined by the ability of the entrepreneur, with more able entrepreneurs optimally choosing a larger scale of operation and with entrepreneurial ability distributed randomly in the population. He shows that if the elasticity of substitution between capital and labor is less than one, average size is positively correlated with the level of development (i.e. per-capita capital) of the economy. Jovanovic (1982) builds a model in which the optimal size of the firm is determined by a productivity parameter drawn upon entering and unknown to the firm, which learns about it during its life cycle. The model delivers a series of predictions in line with empirical evidence both on the evolution of firm size at the individual level and on the size distribution. Hopenhayn (1992) considers a similar model in which the productivity parameter is known, but evolves as a random process over time. He relates the exogenous characteristics of the industry, such as the entry cost, total demand and the stochastic process for the productivity parameter to the steady-state distribution of firms and to the process of entry and exit. Ericson & Pakes (1995), Pakes & McGuire (1994) endogenize the productivity parameter, assuming that its evolution is (stochastically) determined by the investment choices of the firms, and study the interaction of firms in determining the stochastic distribution of firm size, the evolution of the industry and of the firm at the individual level.

[14] Kumar, Rajan & Zingales (2001) carry out a cross-country analysis of the determinants of firm size, considering factors such as the size of the market, per capita income and judicial efficiency. They do not consider EPL among their country characteristics.

legislations. Even so, it is very hard to come up with reliable statistics. In particular, for the Italian case, the TFR (*trattamento di fine rapporto*, a deferred compensation paid to the worker upon separation, irrespective of the reason) is wrongly classified as a firing cost. This results in an overestimation of the index of rigidity for Italy: in fact, excluding the TFR, the position of Italy in the ranking of the index of stringency of individual dismissal legislation goes from the 5th to the 18th(see Appendix A for more details).

In this paper we follow a different route from the cross-country comparisons. We use the fact that EPL in Italy applies differentially to firms of different sizes, which delivers clear-cut implications for both firm size distribution and the pattern of firm growth. We make this point using an extremely stylized, partial equilibrium model of firm size distribution based on an exogenous determinant of individual size.

Firms produce output with a decreasing return to scale Cobb-Douglas technology with labor as the only input, and with a productivity or demand shock 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, following the literature on Gibrat's law, that ε evolves according to a random walk:[15]

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

where u is and iid random variable drawn from a density function f with $E(u) = 0,$ $V(u) = \sigma^2$; we assume that the likelihood of a shock is inversely related to its absolute values (f reaches a maximum at zero and declines as we move away from it). This formulation can accommodate two features that have appealing implications for firm size dynamics:

[15] Our results generalize to the case that ε is an AR(1) process, as long as the autoregressive coefficient is sufficiently close to 1.

A. Firm productivity is highly persistent;

B. Shocks are proportional to the level of productivity:

$$\Delta \log A = u_t. \tag{4}$$

The first feature reproduces the empirical regularity that firm size growth is a regular process rather than an erratic one; the second reflects the fact that absolute changes in employment depend on initial size.

Assume now that, due to indivisibility of labor or to any form of adjustment costs, a firm changes employment only when the shock is above or below a certain threshold x, and remains inactive otherwise:[16]

$$\text{adjust} \iff |A_{t+1} - A_t| > x$$

Using the definition of A and the autoregressive structure of ε, we can reformulate the probability of inaction as:

$$\begin{aligned} \Pr\{l_{t+1} &= l_t\} = \Pr\{|A_{t+1} - A_t| < x\} = \\ &= \Pr\{|e^{u_{t+1}} - 1| < \frac{x}{e^{\varepsilon_t}}\} \end{aligned} \tag{5}$$

Using a first order approximation, (5) simplifies to:

$$\Pr\{l_{t+1} = l_t\} = \Pr\{-\frac{x}{e^{\varepsilon_t}} < u_{t+1} < \frac{x}{e^{\varepsilon_t}}\} = F(\frac{x}{e^{\varepsilon_t}}) - F(-\frac{x}{e^{\varepsilon_t}}) \tag{6}$$

Using the fact that, by inverting (2), $e^{\varepsilon} = l^{1-\alpha}\frac{w}{\alpha}$, we obtain

$$\Pr\{l_{t+1} = l_t\} = \Pr\{-\frac{x}{l_t^{1-\alpha}\frac{w}{\alpha}} < u_{t+1} < \frac{x}{l_t^{1-\alpha}\frac{w}{\alpha}}\} \tag{7}$$

Equation (7) states that the probability of inaction declines smoothly with firm size: in fact, the larger l_t, the smaller the interval in which inaction is the preferred choice. This result is

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[16] We are assuming that the cost x is independent of size, an assumption that is reasonable because we are considering an absolute level of employment changes. In practice, this requires that the cost of hiring one additional worker to be similar across firms of different size. The results below can be reached even with less restrictive assumptions, as long as the cost does not increase proportionally with size, a clearly unrealistic hypothesis.

due to the fact that the adjustment cost is assumed to be independent of firm size, while the size of the shocks is proportional to it.

To model the effects of EPL, the fundamental observation is that the legislation applies differentially to firms of different sizes. Although the rules defining a fair dismissal do not differ according to the employer's characteristics, the consequences of an unfair dismissal critically depend on firm size. The *"Articolo 18"* of EPL imposes a higher expected cost of firing for firms above the 15-employee threshold, as the compensation depends on the length of the trial and workers can ask for reinstatement. A full modelization of the firing cost is well beyond the scope of this paper; however, as shown by Bentolilla & 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. We therefore assume that firms above the relevant employment threshold $\tilde{l}$ pay a wage $w_H = \lambda w$, with $\lambda > 1$.[17]

Define $\Pi(A)$ as the maximized value of profits for a firm with productivity level A. It is immediately evident that

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

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

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

where $I_{\{l\leq\tilde{l}\}}$ is the indicator function taking the value of 1 if $l \leq \tilde{l}$ and zero otherwise. The problem is non differentiable at $\tilde{l}$. Define $\tilde{A} = \frac{w\tilde{l}^{1-\alpha}}{\alpha}$ as the productivity level at which optimal employment is right at the threshold. Clearly, optimal employment will be equal to $(\frac{\alpha A}{w})^{\frac{1}{1-\alpha}}$ for $A \leq \tilde{A}$. When the productivity shock passes this threshold, we need to compare the profits at the threshold employment level, which on condition the threshold is not passed, maximizes profits, and those at the optimized value of employment given w_H :

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

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17 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.

By construction, evaluated at $\tilde{A}$, the left-hand side of (10) is larger than the right-hand side; moreover, the former increases linearly with A, while the latter does so exponentially. This implies that there exist one and only one $\bar{A}$ at which (10) is satisfied as an equality, and above which it is optimal to pass the employment threshold. It is immediately evident that the size of the region in which $\tilde{l}$ is the preferred employment level increases the λ, i.e. the higher the differential cost implied by the EPL. We can therefore characterize optimal employment as follows:

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

As long as the costs of EPL are sufficiently high, i.e. $\bar{A}$ sufficiently higher than $\tilde{A}$, the optimal employment policy in the presence of EPL has important consequences for the probability of growth:

$$\text{(11)} \qquad \Pr\{l_{t+1} > \tilde{l}|\tilde{A}\} = \Pr\{A_{t+1} \geq \bar{A}|\tilde{A}\} < \Pr\{A_{t+1} \geq \tilde{A} + x|\tilde{A}\}$$

if and only if $\bar{A} > \tilde{A} + x$, where we use the notation $\Pr\{A_{t+1}|z\} \equiv \Pr\{A_{t+1}|A_t = z\}$ The inequality in (11) formalizes the identifying assumption that we will use in the empirical work: EPL makes employment growth less attractive for firms in the proximity of the threshold. This implies that, with respect to a situation without the differential effect of the EPL, we should observe:

A. An increase in the share of firms in the proximity of the threshold;

B. A drop in growth probability for firms at the threshold.

These predictions, coupled with the smoothness of the employment level-probability of inaction relation implied by (7), 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 growing follows a smooth pattern, broken in the proximity of the threshold, than we can speculate that the deviation from this smooth relation is attributable to the effects of EPL.

4. Estimating the threshold effect

We use data on firms collected in the period 1986-1998 by the Social Security Administration (Inps),[18] 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.[19] Figure 1 reports the share of firms and of employment by size class for the whole economy in the entire sample period 1986-1998. The main features of the pictures are by now well known:[20]

– 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, while those with at least 250 employees for 35%.

The density function of Italian firms declines smoothly with the firm 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. Similarly to Istat (2002), which uses data on 1999 from the Statistical Archive on Active Firms,[21] 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

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

[19] 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 the law refers to.

[20] 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 due to technological factors.

[21] This archive, organized by the Italian Statistical Institute is the most reliable source on the universe of Italian firms.

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 range from 5 to 25 employees; the relation between the probability of growth and size is a reasonably regularly increasing one, as predicted by the model. Moreover, a clear downward spike emerges at 14-15 employees, just at the threshold we suspect influences firm size dynamics. Similar patterns are observed separately analyzing services and manufacturing, the main difference being that smaller firms in the service sector have a smaller probability of growing (Figure 4).[22]

To quantify this effect, we estimate a probit model where the probability of growing is assumed to be a function of the size of the firm and of a set of control variables (age, sector, region and time effects). We include in the regression three dummies for firms with 13, 14 and 15 employees respectively, which should capture the threshold effect due to employment protection legislation. Given the apparent non-linearity between growth probability and firm size, we have taken a four-degree polynomial in size, while age was introduced in the standard quadratic form. Our results are robust to alternative specification. [23]

Table 1 reports the results of the estimates and Figure 5 plots the average probability of growth and the average of the predicted values of our model by size. As the figure shows, the model fits the actual probabilities quite well, and the dummy at size 15 is approximately -1.5% and significant, while at 14 it already drops to -.35%, and it is not statistically different from zero at 13. These values are similar to those obtained by Borgarello et al. (2002) using yearly averages instead of micro data, and therefore not controlling for age, sector and location.

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[22] 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.

[23] 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 above 25 employees, or restrict ourselves to firms belonging to specific age groups.

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 in the estimate of the threshold effect. Table 1, column 2, reports the estimates and Figure 6 plots actual and predicted probabilities for manufacturing, while column 3 and Figure 7 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).[24]

Given that we consider the probability of growth, irrespective of its magnitude, the dummy at 14, which turns out to be significant, is harder to interpret, as a firm at 14 could still grow by 1 employee without passing the threshold. The fact that we observe a significant effect at 14 could thus depend on our measure of firm size, which does not necessarily coincide with that relevant for the application of the employment protection legislation, producing some noise in the identification of the firms potentially affected by the threshold. Instead we should expect the reduction in the probability of growing that we find at 15 also to be present for lower employment levels for size increases that imply crossing the threshold. In fact, equation (11) can be generalized to any employment level below the threshold:

$$\Pr\{l_{t+1} > \tilde{l} | A_t \leq \tilde{A}\} = \Pr\{A_{t+1} \geq \bar{A} | A_t\} < \Pr\{A_{t+1} \geq \tilde{A} + x | A_t\}$$

if and only if $\bar{A} > \tilde{A} + x$. To visualize this effect, Figure 8 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 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 decreases 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., reported in Figure 9.

Table 2 reports the estimates of the dummy 15 for the probability to grow 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 probability. We used a fourth-degree polynomial in size for rows 1 and

[24] Note this two sectors are not exhaustive, as constructions and mining are not therein.

2, a third-degree polynomial for row 3 and a second-degree polynomial in size in the other probits to accommodate the different relations between these probabilities and size, which is apparent from Figure 8. 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 of 10 a reduction of the probability of growing by 6 or more equal to 0.1 percentage points and for a size increase of 8 workers or more a reduction of only 0.06 percentage points for firms with 8 workers. The effects are negligible afterward.

4.1 *Extensions*

It has been argued (Ichino, Polo & Rettore 2001) 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. (2001) seem to find some supporting evidence for their argument by analyzing the personnel data of a large bank with branches spread all over the country.[25] According to this hypothesis, the actual application of EPL and the cost of trespassing 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, first year of the new labor force survey, it 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 can test this hypothesis by repeating our exercise and computing the threshold effect by area. In columns 4 to 7 of Table 1 we report the estimates by area. Our evidence does not support the hypothesis. Contrary to what one would expect, the effect seem 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)[26].

Saint-Paul (2002) claims that EPL should be more relevant for firms in innovative sectors, as they face a more uncertain environment and therefore require a higher worker

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[25] This evidence, even if based on a single case study and only relying on dismissals due to workers' behavior, has by now become a sort of stylized fact relating to the Italian labor market, and it is often quoted in international reports.

[26] The hypothesis that a high unemployment rate is associated with less strict application of EPL is not supported by time series analysis either. In fact, considering litigations 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 1990s, recession and the unemployment rate was very high as well.

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 (textiles, leather goods 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-à-vis 1.2), but the difference between the two sectors is not statistically significant.

Labor laws introduce multiple thresholds relevant for different aspects of the employment relation (Baffi & Baffi 1999). To check for the presence of other significant thresholds, Figure 10 reports the inaction probability 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, above 35 employees firms were requested, until the reform of 1999,[27] to hire 15 per cent of 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 assess its impact quantitatively 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 growing and size is not as smooth as in the range from 5 to 25, the relation is stable enough to single out a drop in the probability just around the threshold 3: the probability of growing is reduced between 1 and 2%, again in this case a significant but rather limited amount.

5. EPL and firm size in steady-state

We have seen that the threshold effects of EPL are quite evident, even if their magnitude seems rather small. However, we lack a precise measure of their real impact: 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

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

any size class subdivision. Given that we have the firm 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 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.[28] Then, the evolution of X is governed by the system of difference equations

$$X^{t+1} = PX^t \tag{12}$$

We show in Appendix B that, using the theory of Markov chains (see, for example, Karlin & Taylor 1975), under regularity conditions 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 prevail in the absence of the threshold effect, thus obtaining a well-defined measure of the long-run impact of EPL on firm size.

Table 4 reports the STM, constructed as an average of the yearly matrices for the period 1986-1998 to minimize the possibility that business cycle factors influence the long-run behavior. 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 individual level clearly emerges from the diagonal, whose entries are always the largest in the column. 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.

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[28] 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.

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.[29] Table 5 reports the actual distribution (calculated as the average over the period 1986-1998) 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 average size within class μ_j;[30] we can compute the implied average steady state size as $\mu^{ss} = \sum_j x_j^{ss} \mu_j$. In 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, however indicating that for the period 1986-1998 there seems to be no important 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. Our probit estimates show that the threshold effect reduces the probability of growing 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

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[29] Indeed, we find that changes in average size over the period 1986-1998 are very small, ranging from 9.1 in 1986 to 8.8 in 1998, a reduction of approximately 3%. Comparing the employment and firm shares for the first and the last year of our sample, i.e. 1986 and 1998, there is no clear shift in the distribution. However, an interesting pattern emerges: there is evidence that the tails are becoming thinner and the center of the distribution fatter. This is more apparent from the employment share picture, which shows clearly that employment from 1986 to 1998 decreased by approximately 4% in the class 250+ and increased by approximately the same amount in the size class 16-249.

[30] 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.

of moving to each class (excluding the exit class).[31] Formally, if the reduction in the persistence probability is δ, then we modify the entries in the matrix as follows:

$$\tilde{p}_{9,9} = p_{9,9} - \delta \tag{13}$$

$$\tilde{p}_{10,9} = p_{10,9} + \delta \tag{14}$$

$$\tilde{p}_{i,9} = p_{i,9} + \delta \frac{p_{i,9}}{\sum_{l=10}^{n} p_{l,9}},\ i = 10, .., n \tag{15}$$

where a tilde indicates values that would prevail in the absence of EPL and (14) and (15) 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 6 reports the results of these experiments. The first column reports the size classes modified in the experiment; the second, the size of the probability moved from cell $(9, i)$ (the probability of moving the ninth size class, just below the threshold) to those above; the last 4 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 2 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 14) and of 0.7% using the second (equation 15). 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 European Union.

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 too there is a clear decline in the probability of growing above the threshold. We

[31] 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 a robustness check.

therefore also modify the probability for the previous size classes according to the estimate reported in Table 2. The next two lines report the results when we modify, in addition to the 9^{th}, the entries in columns 8 and 7 (corresponding to the 10-12 and 8-9 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 the increase in the probability of moving to the size class just below the threshold, $p_{9,j}$ for $j = 1, 2, ..., 8$ is proportional to that estimated for the size class 9: formally,

$$\delta_j = \delta \frac{p_{9,j}}{p_{9,9}},\ j = 1, 2, ...8 \tag{16}$$

so that

$$\tilde{p}_{9,j} = p_{9,j} - \delta_j \tag{17}$$

$$\tilde{p}_{10,j} = p_{10,j} + \delta_j \tag{18}$$

$$\tilde{p}_{i,j} = p_{i,j} + \delta_j \frac{p_{i,j}}{\sum_{l=10}^{n} p_{l,j}},\ i = 10, .., n \tag{19}$$

Results are reported in lines 4-9 of Table 6. The second column reports the size of the probability reallocation calculated according to equation (16). 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 over. 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 coming 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 $\delta = 4\%$ 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% 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 anomaly.

6. Conclusions

This paper has analyzed one of the possible causes of the small average size of Italian firms, i.e. EPL. We have exploited the fact that EPL applies differentially to firms of different size, which has some clear-cut implications for firm dynamics. Our results show that EPL does influence firm dynamics, but that its effects are quantitatively rather modest: in most of our experiments, average firm size increases by less than 1% when removing the effect of EPL.

Two important qualifications should be kept in mind. First, we only identify the effects due to the fact that EPL threshold discourages small firms from growing, ignoring the potential effects of EPL on firms already above the threshold. Second, our analysis is partial equilibrium and refers to firm size distribution, and has nothing to say about employment: the increase in average firm size should not automatically be taken to imply a similar increase in employment. In fact, the response of employment will depend on many factors not included in this analysis, such as the impact on wages, the effects of larger average size on entry at the lower end of the size distribution and so on.

In terms of policy, our results imply that, while EPL does play a role, it is probably not the most important factor in explaining the Italian anomaly. Moreover, the small effects we find imply that we should not expect legislation changes to have a large impact on firm size, either if they extend the more stringent EPL to firms below the 15-employee threshold or if they relax that of firms above it. This does not mean that changes in the legislation might not have other important effects, possibly on productivity growth, reallocation and accumulation; but if the aim is to increase firm size, then our results suggest that the effort might be more fruitful elsewhere. The question of where remains unanswered.

Appendix I

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 et al. 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; 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-off payment of the sum put aside during the worker's permanence 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 his 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 require more burdensome procedures, they valued the employment regulation of a country to be more restrictive, the lower the threshold for applying the collective dismissal procedure. In the Italian case, as we said above, this threshold 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 procedure reduces the uncertainty about the result of a dismissal, so that it could be advantageous for Italian firms to make use of collective dismissals even with the 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, and they shed further doubts on the possibility of using the OECD index to orient policy making (Bertola et al. 2000).

Appendix II

The transition matrix

This simple model is based on the Markovian structure of the productivity shocks and therefore of size: size today is a sufficient statistics to determine the size distribution tomorrow. This, of course, is a strong assumption, and in reality other elements affect the evolution of size at the firm level. In the aggregate, however, the individual factors will tend to cancel out and this structure is likely to be a good approximation of the evolution of firm size distribution. Equally importantly, the Markovian structure allows for a very general representation of the size distribution in terms of Markov transition matrices, which do not require any parametric assumption about the distribution of firm size. To determine the Markov transition matrix we need to split the size distribution into some classes and then to calculate the probability of going from any class to any other. From our data, we calculate the stochastic transition matrix $\mathbf{P}$, i.e. a $(n+1, n+1)$ matrix where p_{ij} is the probability of going from class j to class i. The entries of $\mathbf{P}$ sum to one by column: $\sum_i p_{ij} = 1$.

The only problematic aspect is how we treat entry and exit. For year t, define X^t as the $n+1$ column vector representing the share of firms in each class. The element x_{n+1} is the share of entrants between t and $t+1$. Then, the last column of $\mathbf{P}$ is the share of entrants that end up in each class. The last row of $\mathbf{P}$ represents exit, and $p_{n+1n+1} = 0$, which excludes the case of entrants that immediately exit. The dynamic system has the form

$$X^{t+1} = \mathbf{P}X^t \tag{20}$$

where, at each step, one needs to enter the share of entrants between t and $t+1$ to track down the actual evolution of X. In steady state, however, the share of entrants must be equal to that of exiters.

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) which can be computed as follow. In steady state, $X^{t+1} = X^t$ so that from (20) we get a system of $n+1$ equations in $n+1$ unknowns

$$(\mathbf{I} - \mathbf{P})X = 0 \tag{21}$$

Given that $\sum_i p_{ij} = 1$, one equation is linearly dependent on the others. We use the additional equation $\sum_i x_i = 1$, with which we can solve for the $n + 1$ unknowns. The resulting vector is the steady-state distribution of firms in the classes, which can be compared with the actual one.

Tables

Probit model. Probability of growth, by sector and area

	Total	Man.	Serv.	N-W	N-E	C	S
Size	4.89^{***} (0.34)	4.12^{***} (0.54)	6.20^{***} (0.53)	4.93^{***} (0.90)	1.58 (1.03)	4.70^{***} (1.21)	6.28^{***} (1.33)
Size^2	-0.37^{***} (0.04)	-0.26^{***} (0.07)	-0.52^{***} (0.06)	-0.36^{***} (0.11)	0.09 (0.12)	-0.35^{***} (0.15)	-0.58^{***} (0.17)
Size^3	0.01^{***} (0.02)	0.01^{*} (0.00)	0.02^{***} (0.00)	0.01^{**} (0.01)	-0.013^{**} (0.01)	0.01 (0.1)	0.02^{***} (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^{***} (0.01)	$-.97^{***}$ (0.01)	-0.74^{***} (0.01)	-0.92^{***} (0.03)	-1.05^{***} (0.03)	-0.86^{***} (0.03)	-0.96^{***} (0.03)
Age^2	0.01^{***} (0.00)	0.01^{***} (0.00)	0.01^{***} (0.00)	0.01^{***} (0.00)	0.01^{***} (0.00)	0.01^{***} (0.00)	0.01^{***} (0.00)
Du13	0.07 (0.14)	.06 (0.22)	0.11 (0.24)	0.14 (0.38)	−0.44 (0.41)	0.57 (0.49)	−0.07 (0.56)
Du14	-0.35^{**} (0.15)	.22 (.23)	-0.96^{***} (0.25)	−0.45 (0.38)	0.35 (0.43)	−0.04 (0.53)	0.39 (0.60)
Du15	-1.51^{***} (0.16)	-1.78^{***} (−1.78)	-1.76^{***} (0.27)	-1.98^{***} (0.39)	-1.51^{***} (0.44)	-2.42^{***} (0.53)	−0.91 (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 were included in the model. Firms in the range 5 - 25 workers. *** indicate significance at 1%, ** at 5% and * at 10%.

Table 2

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. Sector, year and regional dummies were included in the models. *** indicate significance at 1%, ** at 5% and * 10%. 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 relations between these probabilities and size which is apparent from Figure 8 .

Table 3

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. Sector, year and regional dummies were included in the model. *** indicate significance at 1%, ** at 5% and * 10%. 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 consists of firms in the size interval 16-20. Boldface entries represent the persistance probability. Average values for the 1986-98 period.

Table 5

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.

Percentage increase in average firm size and in the share of firms above the 15-emp. 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 over the 1986-1998 period)

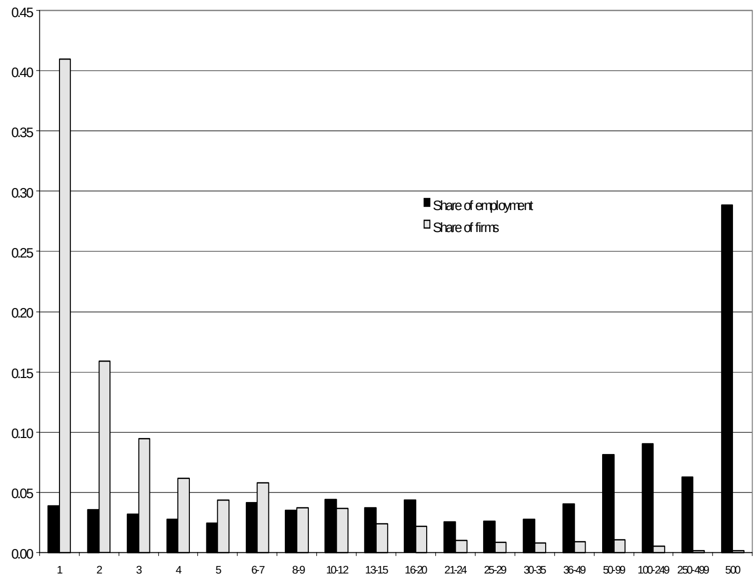


Figure 2

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

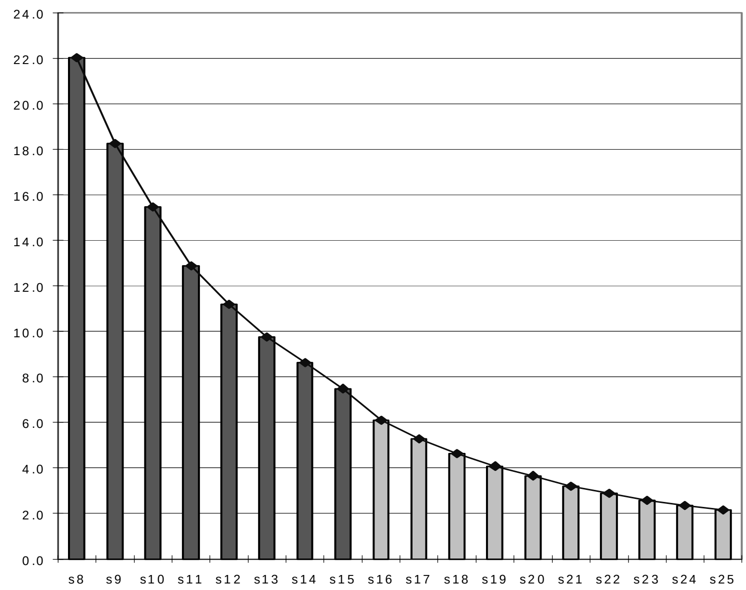


Figure 3

Probability of growth by size class
(average 1986-1997)

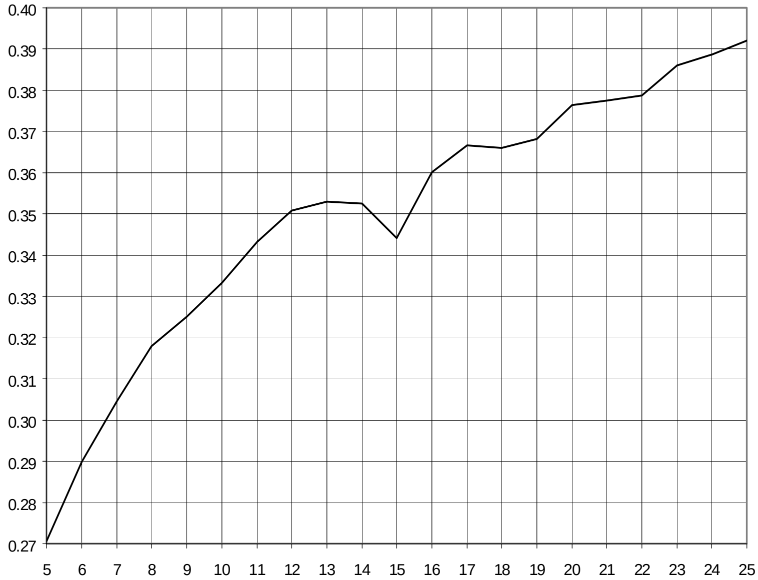


Figure 4

Probability of growth by size class in the service and manufacturing sectors
(average 1986-1997)

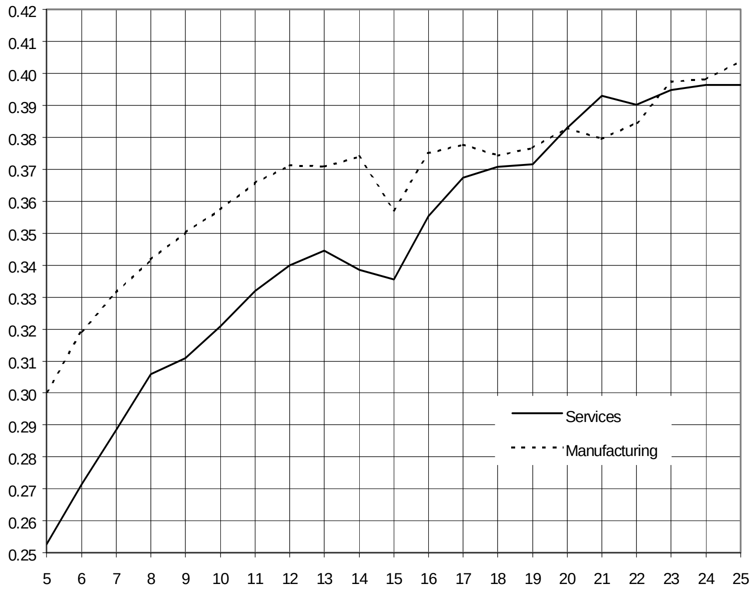


Figure 5

Probability of growth and predicted probabilities, all sectors

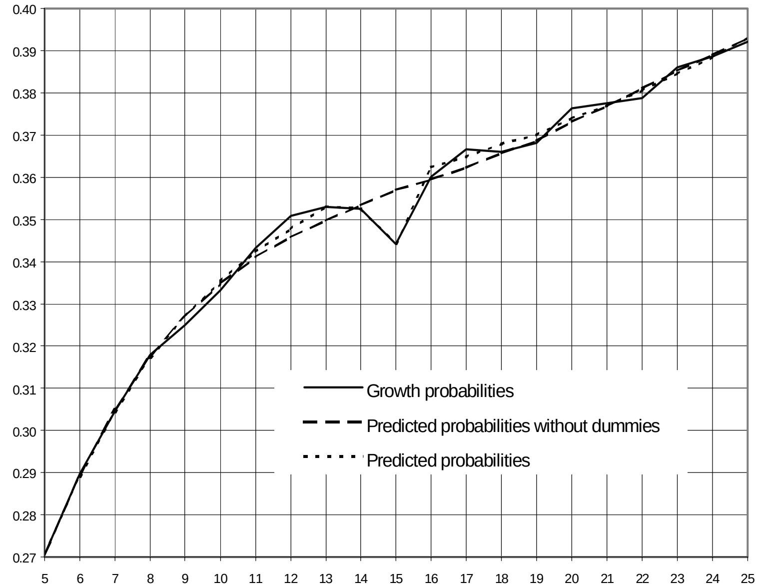


Figure 6

Probability of growth and predicted probabilities, manufacturing

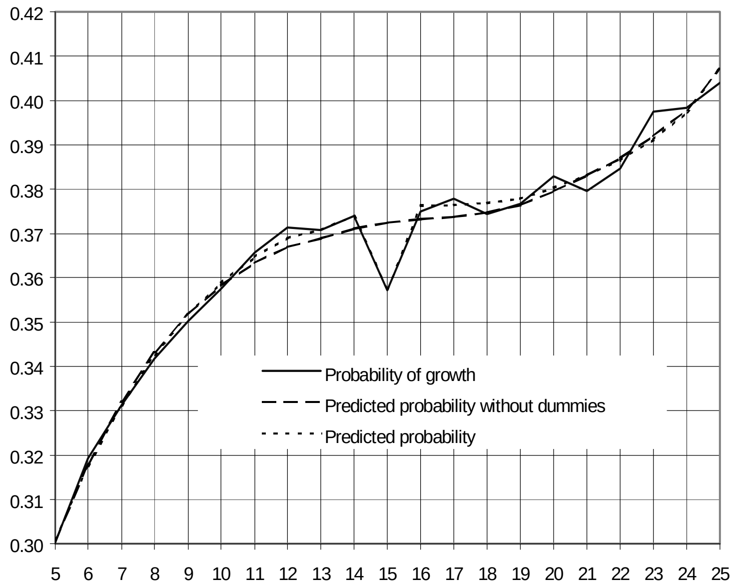


Figure 7

Probability of growth and predicted probabilities, services

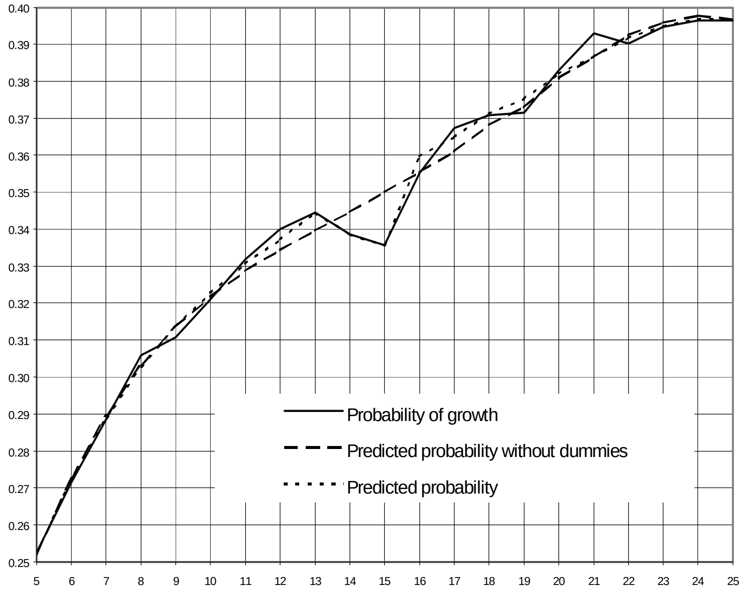


Figure 8

Probability of growth by size of the increase (1 or more, 2 or more, etc.) and firm size

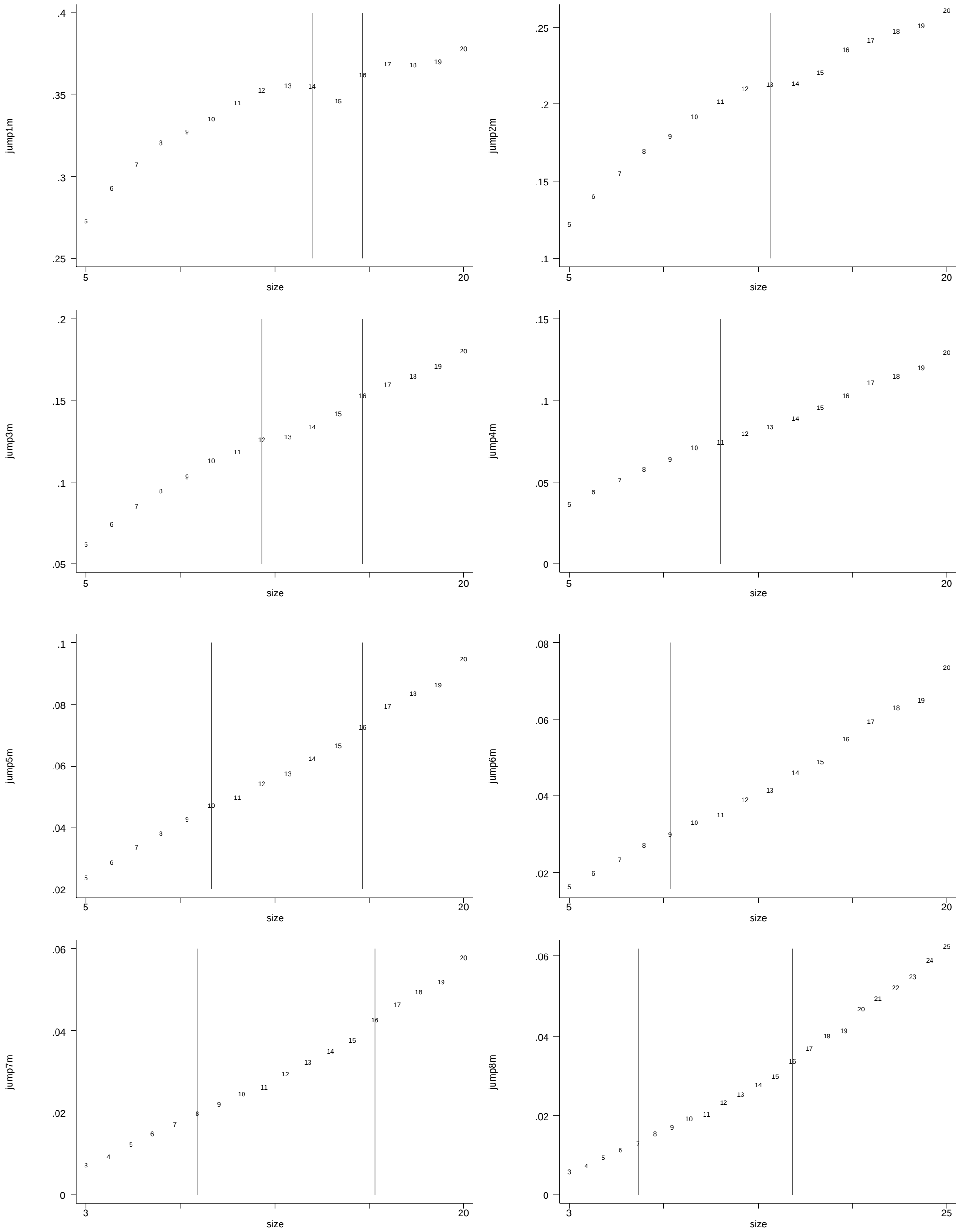


Figure 9

Probability of growth by size of the increase (1 , 2, 3, etc.) and firm size

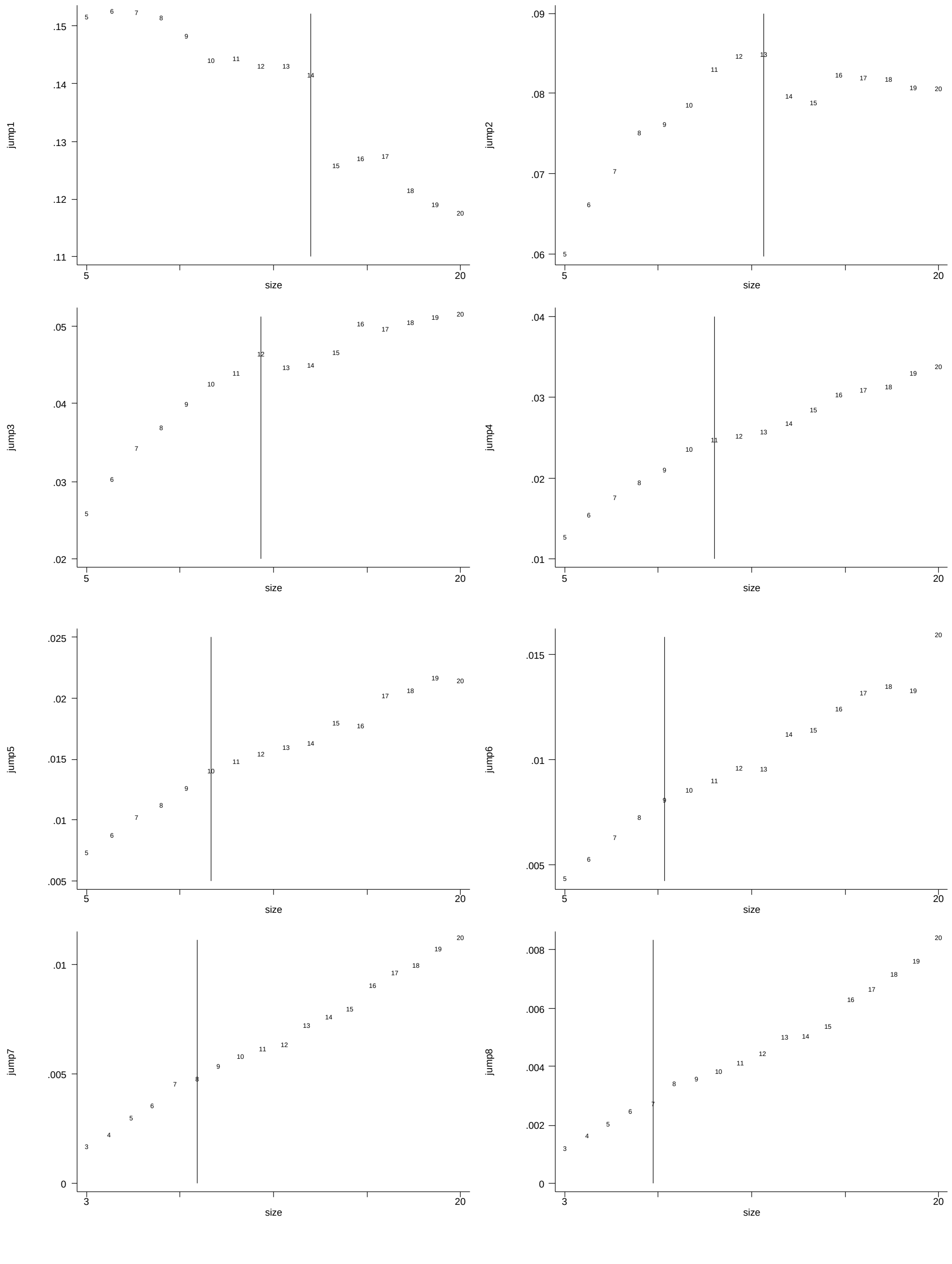
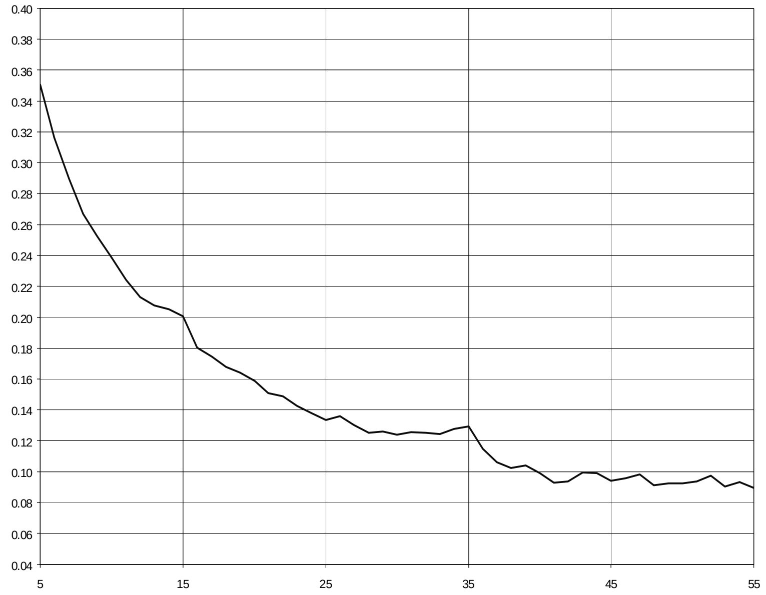


Figure 10

Inertia probability by firm size



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