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# Firms and workers: who fails in times of crisis?

**Priscila Ferreira**
**Mark Taylor**

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# Firms and workers: who fails in times of crisis?

Priscila Ferreira
NIMA and Department of Economics, University of Minho, PT
priscila@eeg.uminho.pt

and

Mark Taylor[1]
Institute for Social and Economic Research (ISER), University of Essex, UK
and NIMA, PT
taylm@essex.ac.uk

**Abstract:**
Using a panel of linked employer-employee data from Portugal, we follow the performance of firms and workers during the first decade of 2000s in terms of the risk of firm shutdown and of chances of workers' entering unemployment. This allows us to identify the characteristics of unsuccessful firms and workers over this period and, of most interest, whether these characteristics changed as a consequence of the global crisis. In addition, and different from previous works, we (i) assess whether there is a differential effect to crisis depending on firm size, and (ii) relate the workers' risk of unemployment to the hazard of firm shutdown. In the analyses of hazard of shutdown and risk of unemployment most of the effects of observed covariates remained unchanged through the business cycle. There is a differential response to crisis depending on firm size. A small firm's risk of shutdown is 9 times the risk of a large firm. However, the chances of becoming unemployed are less than twice larger for a worker in a small firm. This suggests that large firms may be less likely to shutdown, but they are not a shield from unemployment.

**Keywords:** firm survival, employment, crisis, LEED

**JEL classification:** C33; J21; L25

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[1]**Corresponding author:** ISER, University of Essex. Colchester CO4 3SQ, UK. Email: taylm@essex.ac.uk, Phone: +441206 873553, Fax: +441206 873151
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## 1. Introduction

The Portuguese labour market conditions in the first decade of the 2000s can be summarised by splitting the decade into two sub periods. In the first half of the decade, Portugal is reported by the OECD as a country with high rates of labour force participation and low unemployment rates. This strong labour market performance was typically explained by some flexibility in real wage adjustment and the expansion of atypical contracts, such as temporary and/or fixed term employment contracts. The policy challenge was to raise income levels of the population and increase competitiveness through improving the productivity of the labour force via policies aimed at enhancing human capital and labour mobility. Low-skilled sectors were facing higher levels of competition from new EU members, suggesting that the Portuguese economy needed to shift its production towards more high-skilled/higher-value-added sectors. Investments in education and in the acquisition of skills, according to the OECD, would make the labour force more adaptable, foster the use of new technologies and develop the high-skill sectors of the economy.

In the second half of the decade the OECD reported concerns about rising unemployment and the need to prevent cyclical unemployment from becoming structural (OECD, 2010). More attention was drawn to restrictive employment legislation which acted as a barrier to labour mobility. Low levels of job mobility gave incentives to firms to use fixed-term contracts which reduced incentives to provide training (OECD, 2006). The strategy to improve labour market conditions was to impose less restrictive employment legislation in order to facilitate labour mobility, the creation of jobs, and the integration of job seekers back to work. The expectations were for this to shorten unemployment spells and encourage firms to offer permanent contracts and provide training opportunities for their employees.

The changes in the labour market conditions and adjustments in the focus of policy challenges suggested by the OECD are likely to be related to the changes in the international economic conditions. Labour markets become more volatile during periods of unanticipated exogenous shocks such as the world-wide financial crisis of 2008-2010. In a period of global economic crisis, disturbances in aggregate demand drive firms to adjust their production structure and/or their investment decisions, and cause some to shutdown; while some workers are made redundant and lose their jobs.

Furthermore, the recent financial crisis made access to credit from banks more difficult and imposed financial constraints on firms and individuals. It is documented that credit restraints lowers particularly the growth and investment of small businesses (Gertler and Gilchrist, 1994; Bernanke et al., 1996), the predominant firm size in Portugal. It is also argued that there is a differential response of firms, in terms of firm growth and survival, depending on their access to capital and that smaller firms are more sensitive to monetary shocks than larger firms (Berger and Udell, 2002; Gertler and Gilchrist, 1994).

The rather unique labour market circumstances, the impact of the financial crisis and its potential differential effect on the growth and survival of firms depending on their size, prompt our interest in the Portuguese case and motivate us to split our analyses in two periods: before and during the economic crisis. Our aim is to identify not only the determinants of some labour market phenomena, but also whether the effects vary with the business cycle. In particular, in this paper we identify changes to the Portuguese labour market over the period 2002–2009, in terms of both the survival of firms and of workers' probabilities of becoming unemployed. We describe the characteristics of the Portuguese labour market between 2002 and 2009 and address a number of research questions. What determines the risk of firm shutdown? Were there differences in the dynamics of firm destruction before and during the global economic crisis? Which workers were more likely to become unemployed? Furthermore, since 84% of Portuguese firms employ less than 10 workers (micro firms) and given the potential for a differential effect of financial constraints on firm performance, we disaggregate some of our results by firm size.

Our results confirm that firm- and industry-specific variables as well as macroeconomic conditions are significant determinants of the risk of firm shutdown. The average risk of a firm shutting down is larger in the period of crisis, and the effect of some covariates changes with the business cycle. There is also a differentiated risk of firm's closing depending on firm size. Micro and small firms not only have a larger risk of failure when compared to other firm sizes, but also the chances of failure of smaller firms rises more during economic downturns. This supports the hypothesis that large firms face economic downturns by adjusting their structure of production and employment levels, while small firms are more prone to leave the market.

A comparison of the impacts of worker characteristics on the probability of entering unemployment pre-crisis and during the crisis suggests that generally there is little change, and that the crisis did not affect which workers became more or less likely to become unemployed or the relative sizes of these effects. The stability of the effects of observed covariates, associated to the smaller effect of the unobserved match-quality and of the intrinsic risk of firm shutdown suggest that sectoral shocks are relatively more important a determinant of unemployment during economic downturns. The analyses of the probability of unemployment by firm size also support this hypothesis, as it more than doubled between 2002 and 2009 for all firm sizes. This suggests that despite being less likely to shutdown, larger firms do not shield the worker from unemployment.

In the following Section we describe the data used, the *Quadros de Pessoal* from Portugal. In Section 3 we present our empirical strategy, which focus on the determinants of the hazard of firm shutdown and on the determinants of worker's probability of unemployment. Estimation results are presented in Section 4. Section 5 concludes.

## 2. Data

The data used in this analysis are the *Quadros de Pessoal* (QP) from Portugal, a longitudinal data set with matched information on workers and firms. These data have been collected annually since 1985 by the Portuguese Ministry of Employment and the participation of firms with registered employees is compulsory. The data include all firms (over 250 thousand per year) and employees (more than two million per year) within the Portuguese private sector. Our focus is on patterns of firm closure and worker mobility before and during the recession, and so we use data collected from 2002 to 2009.[2] Each firm and each worker has a unique registration number which allows them to be traced over time. All information – on both firms and workers – is reported by the firm. We restrict our analysis to manufacturing and services, and the resulting sample is composed of 537,896 unique firms (who

[2]QP data were not collected in 2001, hence our analysis starts in 2002 rather than 2000. 2009 is the most recent year for which the data set has been built.

contribute 2,400,388 firm-year observations) and 4,526,413 workers (mounting to 20,603,105 worker-year observations) over the period. [3]

In Table 1 we provide a brief description of the data by year, and report the number of employed workers, the number of firms, the number of new firms, the number of firms that shut down, firm death rates and the unemployment rate. It is possible from the raw data to see the effects of the 2008 global crisis. With respect to employment levels (column i), after consecutive years of systematic net job creation, over 100 thousand jobs were lost between 2008 and 2009 (from nearly 2.8 million to 2.7 million employed workers in 2009). The yearly stock of firms (column ii) follows a similar pattern: the number of private sector firms grew from 2002 (269,943 firms) to 2008 (323,524 firms), while in 2009 there was a net destruction of firms (to 317,155) – about six thousand firms fewer than in 2008. The number of firms created per year (column iii) grew continuously over the period from 2002 until 2008 and nearly 25,000 firms were created in 2008. However, in 2009 only 20,976 new firms were created, similar to the number in 2005 (when 20,819 firms were created). Firm destruction (column iv) is identified as the year in which firms were last observed in the data, and we assume that firms die within the 12 subsequent months (that is, between $t$ and $t+1$). Until 2006 less than 31,000 firms died yearly. The number of firm closures rose to 37,000 in the period 2007-2008 and to 45,000 between 2008 and 2009. The rates of firm shutdown (computed as the number of deaths between $t$ and $t+1$ over the number of firms in year $t$) ranged from 9% in the first half of the decade to 14% by the end of it (column v). These patterns of creation and destruction of jobs and firms are reflected in the official unemployment rate (column vi) which rose 2 percentage points between 2008 and 2009, when it exceeded 9%.

[Table 1 about here]

In Table 2 we summarise the distributions of firms and employment by firm size. The Portuguese economy is dominated by small and medium sized firms (column i), 84% of firms have less than 10 employees (micro firms) and almost 14% are small firms (with 10 to 49 employees). That is, 98% of Portuguese firms employ less 50 workers

[3] We do not consider the primary sector (agriculture, fishing, extraction) owing to most firms being family businesses and coverage of this sector in the QP data set thus being low.

overall. Medium (50 to 249 employees) and large (250+ employees) firms correspond to 2% of the total number of firms in the country, but they account for nearly 45% of total employment.[4] The 98% of micro and small firms account for the remaining 55% of total employment (column ii). Most of the dynamics of firm creation and destruction (columns iii and iv) happens amongst small and micro firms: 99% of firms created and destroyed are either small or micro firms. Larger firms are less likely to be destroyed than smaller firms.

[Table 2 about here]

In Table 3 we present the rates of firm destruction by year and firm size. For all firm size categories, death rates of firms are relatively stable up until 2006, and then increase sharply in the years of the global crisis. For example, death rates of micro firms increased by 4 percentage points between 2006 (11%) and 2009 (15%), while those of small and medium sized firms increased by 3 percentage points in the same period (from 4% to 7% and from 3% to 6%, respectively). Death rates of large firms remained fairly stable over the period. These stylized facts are consistent with the argument that large firms may be more likely to reflect the shocks of the economy on sales performance, while for smaller firms shocks and policy changes are more likely to be reflected in rates of survival, destruction or creation (Berger and Udell, 2002; Gertler and Gilchrist, 1994).

[Table 3 about here]

Our strategy is to identify the sample of firms in 2002 (and those who have entered the panel since) and follow their performance over subsequent years in terms of survival and the probability of shutting down. This allows us to identify the characteristics of unsuccessful firms in this period and, of most interest, whether these characteristics changed with the global financial crisis. That is, we investigate whether firms that died during the recession are different from those dying previously. For that purpose we start by estimating the models with the full sample period (2002-2009), and then allow the estimated coefficients to vary before and during the crisis.

[4]This classification of categories of firm size (micro, small, medium, large) follows the European Commission Recommendation 2003/361/EC.

We also select the sample of workers who worked in firms over this period and follow them over time, so we are able relate the success of the worker with the success of the firm. In particular, we examine the impact of the risk of firm shutdown on the probability that the worker separates becomes unemployed for a year or more.

## 3. Estimation

We conduct two sets of analysis. First, we analyse the determinants of the risk of firm shutdown by estimating duration models of the probability of firm shutdown in *t+1* conditional on survival up to time *t*. In doing so, we control for the characteristics of the firms, of the economic environment, and of the firm's workforce. Secondly, we identify the characteristics of workers who were more likely to be exposed to the crisis in terms of the risk of leaving the current firm (between *t* and *t+1*).

### 3.1 Hazard of firm shutdown

We estimate the hazard of firm shutdown between two consecutive years (*t* and *t*+1) using a discrete time multivariate proportional hazards approach. In particular we apply a complementary log-log model with firm-specific random effects (Jenkins, 2004).[5] The nature of our data implies that we have an inflow sample with left truncation and right censoring (that is, we include in our sample all firms existing in 2002 plus firms that were created between 2002 and 2009, and we observe only a proportion of them shutting down over the period). Because information on the year the firm was created is available in our data, we are able to model the time dependence of the risk of shut down. In other words we can model the correlation between the probability of firm shutdown and the age of the firm. We do this using a non-parametric baseline hazard rate identified by duration-interval-specific dummy variables. We allow the baseline hazard rate to vary yearly up to the $10^{th}$ year of survival of the firm. We then assume the baseline hazard to be constant during the second and third decades of firm survival (one baseline hazard for each decade), and then assume the hazard to be the same for all ages after the third decade of firm survival. We therefore have thirteen interval-specific baseline hazard rates.

[5] We use this discrete time representation of a continuous time proportional hazards model because our data are interval censored. That is, we know the firm leaves the panel between t and t+1 but we do not know the exact date when this event occurs.

The hazard rate (h(t)) is conditional on a range of firm-level covariates (x) as well as firm survival (t), such that

$$h(t) = \Pr(T = t_j \mid T \geq t_j; x). \quad \text{Eq. 1}$$

Assume that firm *j* shuts down between *t* and *t*+1 with probability $\Pr(y_{jt}=1)= \lambda_j$ and that it survives with probability $\Pr(y_{jt}=0)=1- \lambda_j$. Assume further that this probability is a function of covariates (x) and of an unobserved firm-specific effect ($\psi_j$), such that the hazard rate can be expressed by the following

$$\lambda_{jt} = \beta_0 + \beta_1 x_{1jt} + \beta_2 x_{2jt} + ... + \beta_k x_{kjt} + \psi_j. \quad \text{Eq. 2}$$

Although our underlying continuous time model is summarized by the hazard rate (h(t)), our data is interval-censored. Therefore, we estimate the parameters describing the hazard rate taking into account the discrete nature of the duration data using a complementary log-log specification

$$\log[-\log(1-\lambda_{jt})] = \beta_0 + \beta_1 x_{1jt} + \beta_2 x_{2jt} + ... + \beta_k x_{kjt} + \psi_j. \quad \text{Eq. 3}$$

This implies

$$\hat{\lambda}_{jt} = 1 - e^{-e^{x_{jt}\beta}}. \quad \text{Eq. 4}$$

Where $\lambda_{jt}$ is the estimated hazard rate of firm shutdown conditional on the characteristics of the firm, and of the economic environment (**x**); on survival up to time *t;* and on the firm-specific random effect $\psi_j$. We assume the latter follows a normal distribution and is independent from both time and the other explanatory variables.

Specific characteristics of the firm and of its product market are likely to affect the risk of a firm exiting the market (Audretsch and Mahmood, 1995; Mata et al, 1995; Holmes et al, 2010). To account for these effects we include in our vector of covariates (**x**) a number of variables. These include firm size (micro, small, medium, large), as previous evidence suggests that the risk of failure is expected to be larger for smaller firms (Berger and Udell, 2002; Gertler and Gilchrist, 1994). We also include a measure of firm growth, defined as the percentage change in employment from period *t* to *t+1,* to control for adjustment processes in firm size. The ownership structure of the firm should also have an effect on the hazard rate of shutdown. We control for ownership status – that is, whether the firm is private-, public- or foreign-

owned. These ownership categories are distinguished by whether the financial capital necessary to constitute the firm is at least 50% owned by private-nationals, public entities, or private-foreign entities, respectively. We expect foreign-owned firms to be geographically more mobile and have higher rates of exit from the Portuguese market than national firms. We also control for whether a firm is multi-establishment. Multi-plant firms are expected to have lower rates of shutdown than single establishment firms. The rationale behind this is that multi-plant firms are more likely to have accumulated more knowledge about the economic environment and may also have a more experienced management structure, thus reducing their chances of failure. Controls for the industry of the firm (17 sectors) and industry growth (measured as the percentage change in employment from *t* to *t+1*) are also included. The growth rate of the industry may be a signal of market growth; we expected it to be negatively related to the risk of shutdown. We also control for whether, within an industry, the firm is high wage or low wage. A firm is defined as high wage if the average wage within the firm is in the top quartile of the distribution of average wages of all firms within the industry. It is defined as low wage if the average wage is in the bottom quartile of the average wage distribution of all firms in the industry. Our expectation is that firms with higher wages are more likely to invest in training and in the provision of firm-specific human capital, therefore are less likely to exit the market. A set of covariates constructed by aggregating the characteristics of workers employed at the firm is also included. Our hypothesis is that a more stable and skilled workforce reduces the risk of firm closure since such a workforce is possibly more productive and more likely to have accumulated firm/industry specific human capital. The covariates included are the proportion of workers in the firm that have an upper secondary or university education, the proportions of workers that are high- and medium-skilled[6], and the proportion of workers with open-ended contracts of employment in the firm (as opposed to temporary employment contracts). Macroeconomic conditions also affect the survival rates of firms. To control for aggregate shocks we include both year and region indicators (there are six standard regions in Portugal). As discussed previously, time dependence is captured by variables indicating the firm's age.[7]

[6] Firms are requested to classify workers into nine skill levels according to the complexity and responsibility of the tasks performed; we group these into three categories: high, medium and low skilled workers.

[7] Summary statistics of variables over the samples analysed (the three sub-periods) are presented in Table A.1 in the Appendix.

### 3.2 Workers' probability of unemployment

In the job separation models the dependent variable $s_{it}$ equals one if the worker will become unemployed between t and t+1, and zero otherwise. Here we define entering unemployment as the worker separating from the current firm and not being observed in the data for more than one year (or exits the data permanently).[8] The model is specified as:

$$s_{it}^{*} = x_{it}\beta + \gamma_{ij} + \varepsilon_{it} \qquad \text{Eq. 5}$$

where $s_{it}^{*}$ denotes the unobservable propensity for the worker to separate between *t* and *t*+1; $x_{it}$ is a vector of observed individual, firm and job-related characteristics; $\gamma_{ij}$ captures the unobserved time-invariant quality of the match between the worker and the firm; and $\varepsilon_{it}$ is random error.[9] We treat $\gamma_{ij}$ as random and estimate this using a random effects probit model under the common assumption that $\varepsilon_{it} \sim IN\left(0, \sigma_{\varepsilon}^{2}\right)$ and are orthogonal to the covariates.

Two explanations are commonly used for the mobility of workers between firms and sectors: sectoral demand shifts, and worker-firm mismatch. The demand shifts approach argues that intersectoral job mobility arises as a response to shifts in demand for labour caused by shocks in product preferences and technology in different industries of the economy (Lucas and Prescott, 1974; Lillien 1982; Abraham and Katz, 1986). These shifts lead to changes in the relative marginal products of labour in different activities which, in turn, call for a reallocation of labour. The process of reallocating workers across industries involves unemployment, which should be frictional. In matching models, separations are a consequence of optimal reassignment caused by the accumulation of better information about the quality of the worker-firm match as time elapses. If the worker-firm pairing is a mismatch, a separation is likely

[8] The data is a panel of private sector firms and the workers employed in such firms. Workers who disappear from the sample may be either in unemployment, in economic inactivity, or working in the public sector. As transitions from private to public sector employment are infrequent in Portugal (DGAEP, 2005), and economic inactivity rates (for reasons other than being in education or retirement) are low and declining over the 2000s (INE/Pordata, 2011), we interpret exits from the data as unemployment.

[9] Since we use linked employer-employee data we could choose the unobserved effects to be worker-, firm- or match-specific. Our choice leans towards match-specific random effects to account for the possibility of match quality influencing job mobility. In doing so, we are implicitly also controlling for unobserved time invariant worker and firm-specific effects.

to happen. But, in good matches, investment in firm-specific human capital will be greater and the match will be less likely to end (Jovanovic, 1979a, 1979b, 1984). As firms pay (at least) part of the training costs, they are particularly concerned about the turnover of employees with firm-specific human capital and, recognizing that quits depend on wages, they may offer these workers a higher wage that could not be easily matched by competing firms (Bernhardt and Scoones, 1993).

Stylized findings suggest that most mobility happens within sectors and that flows of workers between sectors tend to cancel out (Jovanovic and Moffitt, 1990). These findings suggest that the dynamics behind separations from firms depend on sectoral shocks, worker and firm's decisions, and the quality of the worker-firm match. To account for the various sources of labour mobility, in our models we include a range of worker characteristics such as the log monthly real earnings, gender, education (ISCED – 4 levels) and skill levels (high, medium-, low-skilled), seniority at the firm and potential labour market experience, and type of employment contract (permanent vs. temporary).[10] Employer characteristics include firm size (micro, small, medium, large) and growth (change in employment between t and t+1), firm ownership (private, public, foreign), whether the firm is multi-establishment, and whether the firm's average wage is high/low compared to the average of wages paid within an industry. Controls for location (6 regions) industry of the firm (17 sectors), and industry growth (measured as the percentage change in employment from *t* to *t+1*) are also included. Year dummies capture any aggregate macroeconomic effects, such as fluctuations in product demand induced by the global economic crisis. The quality of the match is controlled for by the inclusion of the match-specific random effect. We also include in the worker-separation model the estimated hazard of firm shutdown. A positive relationship indicates that workers in firms that have higher hazards of shut down have a higher probability of becoming unemployed for a year or more. Our hypothesis is that if this effect is constant (or declines) across the business, then we may have a signal that the risk of unemployment in times of global macroeconomic

[10] ISCED stands for International Standard Classification of Education (as defined by UNESCO). In Portugal we can identify 4 levels: 1 – up to primary education; 2 – lower secondary education; 3 – upper secondary education; and 4/6 – post secondary and tertiary education.

disturbances is more related to sectoral shocks affecting the economy as a whole, than it is to the idiosyncratic risk of firm shutdown.[11]

## 4. Results

### 4.1 Estimates of hazards of firm-shutdown

Estimates from the discrete-time representation of the continuous time proportional hazards model of firm shutdown are presented in Table 4. The reported coefficients are hazard ratios. They summarise the proportional effect on the hazard rate of a one unit change in the covariates (a coefficient above/below one implies a proportionally larger/smaller hazard). For the sake of clarity and brevity we omit some coefficients (industry, region, and aggregate characteristics of the firm's workforce) and report only those of most interest.

In column (i) we present estimates from the model where the whole period under analysis is considered. We then estimate models with the same specification but referring to the two sub-periods relating to 2002-2005 (column ii) and 2006-2009 (column iii). We do this to identify any changes in the impacts of the covariates on the hazard rate of firm shutdown before and during the global crisis.

Our estimates confirm the hypothesis that firm size matters – all coefficients on the firm size indicators are positive relative to micro-firms and highly statistically significant. This indicates that the hazard rate of shutdown is inversely related to size with micro and small firms being more likely to close down than larger firms. Column (i) shows that over the period as a whole small firms are 68% (1-0.32) less likely to shutdown than micro-firms while large firms are 82% (1-0.18) less likely. The effects of firm size became less pronounced in 2006-09 (shown in Column ii) relative to 2002-05 (column iii), that is all coefficients became closer to one – the baseline. Hence firm size was less important in explaining firm shutdowns during the financial crisis than in the preceding period, although it remained an important factor.

We include the growth of the firm (percentage change in employment) between t and t+1 to control for some adjustment process in firm size. The coefficient on this

[11] Summary statistics of variables over the samples analysed (the three sub-periods) are presented in Table A.2 in the Appendix.

variable is statistically significant. Reducing employment by 10 percentage points increases the hazard of firm shutdown by 0.5%.

Our estimates indicate that foreign and public owned firms have shutdown rates different from those of privately owned firms. On average public firms have a lower hazard rate of shutdown (0.62) while foreign owned firms have a 13% higher hazard of shutdown than privately owned firms (column i). However this effect only emerges in the pre-recession period and the effect of ownership is statistically insignificant during the crisis years (column iii). Hence during the financial crisis public and foreign owned firms were as likely to shutdown as private firms. Being a multi-establishment firm, however, reduces the hazard of shutdown by 40% relative to single-establishment firms and this effect persisted through the crisis. Such multi-establishment firms may use their experience and accumulated knowledge about the economic environment to appropriately respond to the recession.

The growth rate of the industry, used as a proxy for market growth, is important in determining shutdowns, but only during the recession. The effect is not statistically significant in the period preceding the crisis (column ii), but becomes statistically significant during the global crisis: increasing employment in the industry by one percentage point reduces the hazard of shutdown by 1.2%.

The relative wage of the firm is an important determinant of the hazard rate of shutdown. High wage firms are less likely to shutdown than average wage firms, while low wage firms are more likely to shutdown. Furthermore these effects are more pronounced in times of economic crisis. For example, before the crisis (column ii) being a high wage firm within an industry was associated with a hazard rate of shutdown that was 19% below that of an average wage firm, while during the crisis it was associated with a 26% lower hazard rate of shutdown. In contrast, low wage firms were 23% more likely to shutdown than average wage firms pre-crisis, and 29% more likely during the crisis. Firms paying higher wages may be more likely to invest in training and in developing firm-specific human capital, which reduces their chances of exiting the market. Not rejecting this hypothesis, may imply that investing in workforce skills and firm-specific human capital is a potential means of surviving negative economic shocks.

The year dummies reflect aggregate macroeconomic effects, and the estimated impacts of the global financial crisis on the hazard of shutdown are quite strong. The 2007 indicator relates to the period 2007-2008 when the financial crisis first hit the USA, and the 2008 indicator relates to 2008-2009. Controlling for other covariates, for duration dependence and for time-invariant unobserved firm-specific effects, the hazard of firm shutdown in 2007-08 was almost three times larger than in 2002 (a hazard ratio of 2.8), while that in 2008-09 was almost four times larger (hazard ratio of 3.8). Therefore even when holding other factors constant, our estimates confirm the sharp rise in the year-on-year rates of firm shutdowns obtained from the raw data presented in our descriptive statistics. [12]

[Table 4 about here]

The pattern of duration dependence estimated for each sample is presented in Figure 1. On average, the estimated the hazard of firm shutdown rises up to the fourth year of age of the firm (positive duration dependence) and declines as the firm ages (negative duration dependence), as expected. Since the estimated hazards are computed from three different samples and refer to the relative risk with respect to the baseline (constant of the model), the lines in the figure are not directly comparable. The average risk of a firm shutting down for the period 2002-2009 is 0.03; and for period 2006-2009 is 0.05 (see Table 4). During recession, the hazard of shut down in the second year of age is 23% larger than the baseline; while the hazard of shutting down in the second year of age during the period 2002-2009 is 21% larger than that of the first year. Therefore, in times of crisis both the baseline risk of shutdown and the risk of dying in the first couple of years of firm survival are larger.

[Figure 1 about here]

As an exercise to further highlight the relative impact of the crisis on firm survival, we have computed predicted probabilities of firm shutdowns based on the estimates

[12] We have controlled for firm unobserved effects in our models. For all three periods, the firm random effects are important, and account for more than 60% of the variance (rho). The formal tests, for each model, comparing the pooled estimator with this panel estimator (not shown here) reject the hypothesis that the panel-level variance (rho) is zero.

for the period as a whole (column i). These predicted hazards are displayed in Table 5. Our estimates reinforce the observations from the raw data (Table 3) and support the argument on the differential effect of credit constraints by firm size. Micro firms have the highest hazard of closing down, and this risk increases sharply in the years of crisis (from 0.05 in 2002-03 to 0.17 in 2008-09). The rates of firm shutdown are negatively related to firm size. The rates of shutdown of larger firms are not only smaller, but they also rise less sharply over the period of analysis. This is particularly so for large firms, which have a predicted hazard of shutdown of 0.005 in 2002-03 and of 0.02 in 2008-09.

[Table 5 about here]

Therefore, we conclude that firm- and industry-specific variables are significant determinants of the risk of firm shutdown, and that macroeconomic conditions are important too. The effect of some covariates depends on the business cycle, though most of them are statistically significant determinants pre- and during-crisis. There is a differentiated risk of firm's closing depending on firm size, micro and small firms not only have a larger risk of failure, but also this risk is more sensitive to the business cycle as it rises more in times of crisis.

### 4.2 Probability of workers separating from firms

We next discuss the estimates of the probability of the worker separating from a firm and becoming unemployed – that is, the probability of a worker leaving a firm and taking more than one year to reappear in the dataset or not reappearing in the data at all. The analysis is again divided into three periods: 2002-2009, 2002-2005 and 2006-2009, and the estimates are presented on Table 6. The reported coefficients are average marginal effects obtained from the random effects probit model as specified in Equation 5.[13]

[Table 6 about here]

Our estimates indicate that the probability of becoming unemployed falls with the wage received. A one log-point increase in the wages of workers reduces their probability of unemployment by about five percentage points over the period as a

[13] The average marginal effects are interpreted as proportionate effects on the probability of becoming unemployed of a marginal increase (or a unit increase) in the explanatory variable.

whole. If wages reflect the accumulation of firm-specific human capital and the value of the marginal product of workers, then high wage workers are more valuable to the firm in terms of skill, and hence are less likely to be dismissed. This hypothesis is supported by the estimated effects of skill level on the probability of becoming unemployed; less skilled workers have a higher probability of becoming unemployed. In the period 2002-2009 the probability of a low-skilled worker becoming unemployed was 2.2 percentage points higher than that of a high skilled worker. Women are less likely than men to become unemployed, and this emerges for both the overall period (2002-2009) and the early 2000s.[14] Differences between men and women in the probability of entering unemployment became smaller in the period of the global crisis (women were only 0.8 percentage points less likely to enter unemployment than men).

More educated workers are more likely to become unemployed (ISCED5/6 are 3.6p.p. more likely to experience unemployment than ISCED1 workers). This result may appear surprising, but is possibly explained by results obtained in Ferreira (2009). The author concludes that more educated workers have a higher risk of making transitions out of a firm, but they are also more likely to find a new job within a shorter period of time than less educated workers.[15] As expected, workers on temporary employment contracts are, on average, seven percentage points more likely to experience unemployment than workers with more permanent employment relationships.
A comparison of the impacts of worker characteristics on the probability of entering unemployment pre-crisis and during the crisis suggests that generally there is little change. This suggests that the crisis did not affect which workers became more or less likely to become unemployed or the relative sizes of these effects.

The characteristics of firms are also important in explaining the probability of a worker becoming unemployed. The smaller the firm, the more likely a worker is to enter unemployment. On average over the period, working in a large firm reduces the chance of becoming unemployed by 3.4 percentage points relative to working in a micro-firm. Firm ownership also affects the probability of unemployment. Over the

[14] A similar result was obtained with Portuguese data by Ferreira (2009).
[15] Could be voluntary unemployment while looking for better job, but larger effect during crisis suggests not.
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period 2002-2009, workers employed by either public or foreign-owned firms are one percentage point more likely to become unemployed than workers employed by private home-owned firms. The effect of ownership status, though, changes during the business cycle. During the financial crisis of 2006-2009, workers employed by public firms were one percentage point less likely to become unemployed than those in private firms, while workers in foreign-owned firms were still one percentage point more likely.

We can associate product market growth (industry change in employment from t to t+1) to unemployment, and it is inversely related to the chances of unemployment. Comparing the two time periods, between 2002-05 industry growth increased the chance of entering unemployment by 0.1 percentage points, while between 2006-09 industry growth reduced the chances of entering unemployment by 0.2 percentage points. This may reflect patterns of voluntary unemployment. During periods of economic growth and industry growth, workers are more willing to quit and look for better job, while during recession, workers in industries that are growing stay in their jobs rather than quit.

The relative average wages paid by the firm in which a worker is employed are also statistically significant determinants of entering unemployment, and the effect is stronger in the lower tail than in the upper tail of the industry's average wages distribution. Working in firms that pay wages in the bottom quartile of the industry-specific wage distribution is associated with a two percentage point higher probability of becoming unemployed, while working in a firm that pays wages in the top quartile of the industry's wage distribution is associated with a 0.5 percentage point lower probability of becoming unemployed. Furthermore the effects of firms' relative wages are stronger in times of crisis. Workers in high wage firms became relatively less likely to enter unemployment in 2006-09 relative to 2002-05 (0.4 percentage points compared with 0.2 percentage points), while those in low wage firms became relatively more likely to enter unemployment (2.1 percentage points compared with 1.6 percentage points).

The estimated coefficients on the year indicators show that aggregate macroeconomic conditions strongly affect the chances of unemployment even when controlling for

individual and firm level characteristics, and they became more important in the period of the global economic crisis. The chances of becoming unemployed in 2008-2009 were eight percentage points higher than those of becoming unemployed in 2002-2003. The increased risk of unemployment caused by aggregate shocks also emerges during the crisis. The risk of becoming unemployed in 2008-2009 is seven percentage points higher than that of becoming unemployed in 2006-2007.

Overall, during 2002-2009, a one percent increase in the hazard rate of firm shutdown increases the chances of unemployment by 14 percentage points. This suggests that, in the case of a firm closing down, workers are likely to take more than a year to find a new job. The effect of the risk of firm shutdown on the probability of entering unemployment is higher in the pre-crisis period than during the crisis itself. It increases the risk of entering unemployment by 29 percentage points between 2002 and 2005, and by 9 percentage points between 2006 and 2009. We therefore conclude that, in times of crisis, the chances of unemployment become less related to the dynamics of the firm itself, and more associated to the general downturn in the economic environment that affects all firms across the economy overall. [16]

[Table 7 about here]

We illustrate the relative sizes of the estimated effects by computing predicted probabilities of a worker entering unemployment by firm size and year. These are displayed in Table 7. The smaller the firm the higher the predicted probability of a worker becoming unemployed. However, the evolution of the predicted probabilities of entering unemployment differs less by firm's size than the probability of firm shutdown (shown in Table 5). The probability of becoming unemployed is negatively related to firm size, but the probability of becoming unemployed more than doubled between 2002 and 2009 for all firm sizes. This suggests that although larger firms are less likely to shutdown, they do not shield the worker from unemployment.

[16] We included worker-firm random effects to control for unobserved heterogeneity in match quality. The estimate of rho gives the proportion of the total variance contributed by the unobserved match quality. Our estimate of rho is statistically different from zero and indicates that unobserved match effects are responsible for over 54% of variance in the error term, and so we conclude that worker-firm match quality is an important component affecting workers' mobility.

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## 5. Conclusions

The global economy was hit by a financial crisis and a subsequent recession from 2007 onwards. This crisis severely limited the access to credit for both firms and workers. The financial crisis constrained the ability of firms to invest and expand, and the ability of workers to borrow and consume goods and services both directly through lower income growth and indirectly through, for example, job loss prompted by firm failure.

In this paper we use micro data to identify resulting changes in the Portuguese labour market, both in terms of the survival of firms and in terms of job mobility. In terms of the likelihood of firm shutdown, in particular, our results suggest that firm-specific, industry-specific and macroeconomic variables are all important determinants of the hazard of a firm closing down. We estimated models separately for the pre-crisis and crisis periods and we conclude that the effects of the covariates were, in general, intensified by the downturn in the business cycle rather than being changed by it. Therefore, we conclude that it is likely that aggregate demand shocks were more important than market-specific shocks in determining the risk of firm shutdown during the global crisis. We have also attempted to verify the hypothesis that smaller firms are more sensitive to monetary shocks than larger firms, hence having a different response of firms, in terms of firm survival. And conclude that, conditional on the effects of the covariates, the estimated risk of shutdown is inversely related to firm size and is larger for smaller firms than for large firms. Although both rates of death rise during the global crisis, the risk of a large firm shutting down remains fairly low (2%) while that of a small firm reaches 17%.

The failure of firms is expected to have an impact on the mobility of workers, and may become a potential source of problem in terms of unemployment. The financial crisis may have increased the risk of cyclical unemployment becoming structural unemployment (such a risk had already started to be pointed out by the OECD on the second half of the decade). We conclude for the importance of worker- and firm-specific covariates in determining the risk of unemployment, and the effects of these covariates are in line with those obtained in previous research: women, low skilled and temporary workers have higher chances of becoming unemployed. The risk of unemployment is also larger for workers in small, private sector, and low-wage firms. We attempted to identify changes between the risk of a worker becoming unemployed

for a year or more with the inherent risk of a firm shutting down. Our results suggest that during time of crisis the effect of the hazard of firm shutdown is less pronounced than it is in the pre-crisis period, thus suggesting that sectoral shocks are relatively more important a determinant during economic downturns. The analyses of the probability of unemployment by firm size also support this hypothesis. Although the probability of becoming unemployed is negatively related to firm size, it more than doubled between 2002 and 2009 for all firm sizes. This suggests that despite being less likely to shutdown, larger firms do not shield the worker from unemployment. And is a further signal that large firms react to economic downturns by adjusting their structure of production and employment levels, while small firms are more prone to leave the market.

The years that will follow are of most importance in shaping the future of the Portuguese economy. Analyses of the structure of firms created after this crisis and the assessment of whether these firms are being created in higher value-added sectors will shed light on whether the economy is making the transition claimed by OECD. If so, then the Portuguese economy is likely to be within a process of creative destruction with the global crisis resulting in the death of more fragile and less competitive firms and in the survival and birth of more productive “good” ones.

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## Tables and Figures

**Table 1** Distribution of firms and workers by year, 2002-2009

| Year | Employment (i) | No. of Firms (ii) | Firm Creation (iii) | Firm Destruction (iv) | % of deaths (v) | Unemp. Rate (vi) |
|---|---|---|---|---|---|---|
| 2002 | 2,319,279 | 269,943 | 17,292 | 25,986 | 9.63 | 4.5 |
| 2003 | 2,366,768 | 277,190 | 29,747 | 25,668 | 9.26 | 6.1 |
| 2004 | 2,422,340 | 282,847 | 18,489 | 26,389 | 9.33 | 6.3 |
| 2005 | 2,620,413 | 303,791 | 20,819 | 30,420 | 10.01 | 7.2 |
| 2006 | 2,652,511 | 307,793 | 21,941 | 31,092 | 10.10 | 7.3 |
| 2007 | 2,737,951 | 318,145 | 24,351 | 36,546 | 11.49 | 7.9 |
| 2008 | 2,793,915 | 323,524 | 24,844 | 44,640 | 13.80 | 7.3 |
| 2009 | 2,689,928 | 317,155 | 20,976 | -- | -- | 9.1 |

Notes: Unemployment rates as of the 2nd quarters of each year, source: INE. All other statistics are the authors' own calculations based on Quadros de Pessoal 2002-2009.

**Table 2** Distribution of firms and employment by firm size, average 2002-2009

| | % Distribution of | | | |
|---|---|---|---|---|
| Firm Size | Firms (i) | Employment (ii) | Firm Creation (iii) | Firm Destruction (iv) |
| Micro | 83.66 | 27.21 | 94.31 | 93.23 |
| Small | 13.91 | 27.35 | 5.24 | 6.03 |
| Medium | 2.13 | 21.28 | 0.41 | 0.67 |
| Large | 0.30 | 24.20 | 0.05 | 0.07 |
| Total | 2,400,388 | 20,603,105 | 168,459 | 220,741 |

**Table 3** Death rates by year and firm size (%)

| Year | Micro | Small | Medium | Large | Total |
|---|---|---|---|---|---|
| 2002-2003 | 10.85 | 4.16 | 2.46 | 2.22 | 9.63 |
| 2003-2004 | 10.43 | 3.68 | 2.93 | 1.92 | 9.26 |
| 2004-2005 | 10.50 | 3.65 | 2.61 | 1.84 | 9.33 |
| 2005-2006 | 11.21 | 4.03 | 2.78 | 2.40 | 10.01 |
| 2006-2007 | 11.28 | 4.10 | 2.74 | 3.37 | 10.10 |
| 2007-2008 | 12.76 | 5.11 | 3.59 | 2.77 | 11.49 |
| 2008-2009 | 15.15 | 6.93 | 5.56 | 2.23 | 13.80 |
| Total | 11.83 | 4.55 | 3.33 | 2.41 | 10.60 |

Note: death rates are computed as the number of firms in year *t* that will die in year *t+1* (rates computed using number of firms in year *t* as baseline)

**Table 4** Hazard estimates of firm shutdown for the periods 2002-09, 2002-05 and 2006-09

| | 2002-2009 (i) | 2002-2005 (ii) | 2006-2009 (iii) |
|---|---|---|---|
| Firm size (baseline: micro) | | | |
| Small | 0.316*** | 0.288*** | 0.341*** |
| | (0.004) | (0.006) | (0.007) |
| Medium | 0.224*** | 0.209*** | 0.272*** |
| | (0.008) | (0.011) | (0.013) |
| Large | 0.184*** | 0.180*** | 0.218*** |
| | (0.019) | (0.026) | (0.031) |
| Firm growth (t, t+1) | 0.994*** | 0.992** | 0.995* |
| | | (0.001) | (0.003) |
| Ownership status (baseline: private) | | | |
| Public | 0.622*** | 0.507*** | 0.802 |
| | (0.72) | (0.086) | (0.013) |
| Foreign | 1.126** | 1.233*** | 1.051 |
| | (0.041) | (0.063) | (0.053) |
| Multi-establishment | 0.600*** | 0.586*** | 0.607*** |
| | (0.010) | (0.015) | (0.015) |
| Industry growth (t, t+1) | 0.997** | 1.003 | 0.988*** |
| | (0.001) | (0.002) | (0.003) |
| Wages (baseline: average wage, industry Q2-Q3) | | | |
| High wage firm | 0.777*** | 0.809*** | 0.736*** |
| | (0.006) | (0.010) | (0.009) |
| Low wage firm | 1.225*** | 1.233*** | 1.290*** |
| | (0.009) | (0.013) | (0.013) |
| Year (baseline: (i) 2002; (ii) 2002; (iii) 2006) | | | |
| 2003 | 1.242*** | 1.318*** | |
| | (0.013) | (0.018) | |
| 2004 | 1.565*** | 1.716*** | |
| | (0.021) | (0.037) | |
| 2005 | 1.818*** | 2.100*** | |
| | (0.024) | (0.047) | |
| 2006 | 2.164*** | | |
| | (0.032) | | |
| 2007 | 2.769*** | | 1.658*** |
| | (0.044) | | (0.032) |
| 2008 | 3.759*** | | 2.515*** |
| | (0.070) | | (0.081) |
| constant | 0.033*** | 0.031*** | 0.045*** |
| | (0.038) | (0.059) | (0.065) |
| Industry effects | Yes | Yes | Yes |
| Region effects | Yes | Yes | Yes |
| rho | 0.609 | 0.653 | 0.656 |
| | (0.004) | (0.007) | (0.010) |
| Log Likelihood | -672,528 | -343,896 | -330,302 |
| No. of observations | 2,083,182 | 1,133,771 | 949,411 |

Notes: Discrete hazard model of firm shutdown with firm random effects. Hazard ratios reported, std errors in parenthesis (* p<0.05, ** p<0.01, *** p<0.001). Coefficients on aggregate characteristics of the firm's workforce, mentioned in Section 3, were included in the specifications but are omitted from the Table.

**Figure 1** Patterns of duration dependence over the 3 periods of analysis

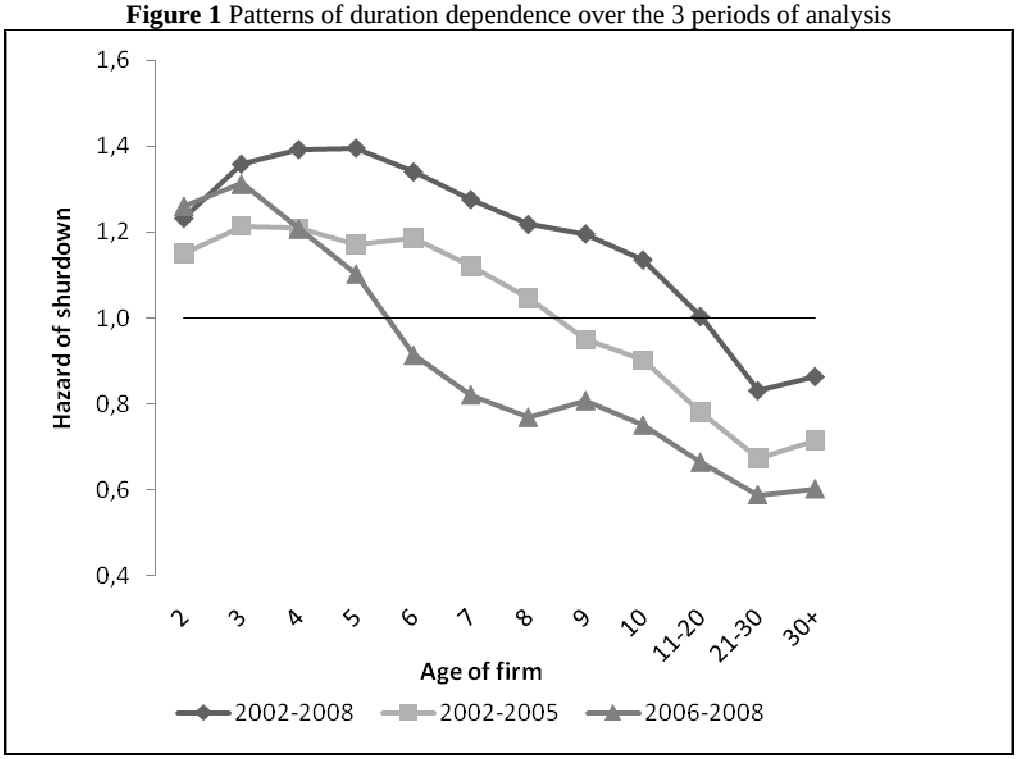


**Table 5** Predicted hazards of firm shutdown between t and t+1, 2002-2009

| Year | Micro | Small | Medium | Large | Overall |
|---|---|---|---|---|---|
| 2002-2003 | 0.047 | 0.013 | 0.008 | 0.005 | 0.041 |
| 2003-2004 | 0.058 | 0.017 | 0.010 | 0.006 | 0.051 |
| 2004-2005 | 0.069 | 0.020 | 0.011 | 0.008 | 0.061 |
| 2005-2006 | 0.084 | 0.024 | 0.014 | 0.009 | 0.074 |
| 2006-2007 | 0.096 | 0.027 | 0.016 | 0.011 | 0.084 |
| 2007-2008 | 0.122 | 0.036 | 0.021 | 0.014 | 0.108 |
| 2008-2009 | 0.167 | 0.050 | 0.029 | 0.019 | 0.148 |

Note: mean of predicted hazards by year and firm size obtained from estimates of the hazard model as of Table 6, column (i)

**Table 6** Estimates of probabilities of workers becoming unemployed for the period 2002-2009, and sub-periods 2002-2005 and 2006-2009

| | 2002-2009 (i) | 2002-2005 (ii) | 2006-2009 (iii) |
|---|---|---|---|
| Log(monthly real wage) | -0.060 *** | -0.052 *** | -0.045 *** |
| | (0.000) | (0.000) | (0.000) |
| Women | -0.013 *** | -0.013 *** | -0.008 *** |
| | (0.000) | (0.000) | (0.000) |
| Education (baseline: ISCED 1) | | | |
| ISCED 2 | 0.012 *** | 0.011 *** | 0.011 *** |
| | (0.000) | (0.000) | (0.000) |
| ISCED 3 | 0.011 *** | 0.007 *** | 0.013 *** |
| | (0.000) | (0.000) | (0.000) |
| ISCED 5/6 | 0.036 *** | 0.036 *** | 0.031 *** |
| | (0.001) | (0.001) | (0.001) |
| Skill level (baseline: high-skilled) | | | |
| Medium-skilled | 0.006 *** | 0.002 *** | 0.004 *** |
| | (0.000) | (0.000) | (0.000) |
| Low-skilled | 0.022 *** | 0.016 *** | 0.017 *** |
| | (0.000) | (0.000) | (0.000) |
| Temporary contract | 0.071 *** | 0.068 *** | 0.064 *** |
| | (0.000) | (0.000) | (0.000) |
| Firm size (baseline: micro firms) | | | |
| Small firm | -0.012 *** | -0.007 *** | -0.007 *** |
| | (0.000) | (0.001) | (0.001) |
| Medium firm | -0.027 *** | -0.020 *** | -0.016 *** |
| | (0.001) | (0.001) | (0.001) |
| Large firm | -0.034 *** | -0.020 *** | -0.025 *** |
| | (0.001) | (0.001) | (0.001) |
| Ownership status (baseline: private) | | | |
| Public | 0.009 *** | 0.022 *** | -0.010 *** |
| | (0.001) | (0.001) | (0.001) |
| Foreign | 0.011 *** | 0.005 *** | 0.011 *** |
| | (0.000) | (0.001) | (0.000) |
| Industry growth (t, t+1) | -0.000 *** | 0.001 *** | -0.002 *** |
| | (0.000) | (0.000) | (0.000) |
| Average wage of firm vs. Average industry wages | | | |
| High wage firm | -0.005 *** | -0.002 *** | -0.004 *** |
| | (0.000) | (0.000) | (0.000) |
| Low wage firm | 0.023 *** | 0.016 *** | 0.021 *** |
| | (0.000) | (0.000) | (0.000) |
| Year (baseline 2002 in (i) and (ii); 2006 in (iii)) | | | |
| 2003 | 0.034 *** | 0.039 *** | |
| | (0.000) | (0.000) | |
| 2004 | 0.047 *** | 0.055 *** | |
| | (0.000) | (0.000) | |
| 2005 | 0.035 *** | 0.052 *** | |

| | | | |
|---|---|---|---|
| | (0.000) | (0.000) | |
| 2006 | 0.031 *** | | |
| | (0.000) | | |
| 2007 | 0.045 *** | | 0.032 *** |
| | (0.000) | | (0.000) |
| 2008 | 0.081 *** | | 0.065 *** |
| | (0.001) | | (0.001) |
| Hazard 2002-2009 | 0.142 *** | 0.293 *** | 0.094 *** |
| | (0.005) | (0.011) | (0.005) |
| rho | 0.543 | 0.672 | 0.629 |
| | (0.001) | (0.001) | (0.002) |
| No. of observations | 16,006,410 | 8,643,791 | 7,362,619 |
| mean pun(pu0) | 0.114 | 0.081 | 0.074 |
| | [0.086] | [0.076] | [0.091] |

Note: Random effects probit models of probability of becoming unemployed controlling for match (worker-firm) unobserved effects. Standard errors in parenthesis: *** p<0.001; ** p<0.01; *p<0.05. Standard deviations in squared brackets. Further controls include: age, tenure, firm growth (t, t+1), multi-plant firm, industry, and region.

**Table 7** Predicted probabilities of unemployment between t and t+1, 2002-2009

| Year | Micro | Small | Medium | Large | Overall |
|---|---|---|---|---|---|
| 2002-2003 | 0.099 | 0.074 | 0.059 | 0.051 | 0.070 |
| 2003-2004 | 0.139 | 0.104 | 0.083 | 0.078 | 0.100 |
| 2004-2005 | 0.152 | 0.115 | 0.092 | 0.087 | 0.111 |
| 2005-2006 | 0.146 | 0.109 | 0.086 | 0.085 | 0.106 |
| 2006-2007 | 0.143 | 0.106 | 0.083 | 0.082 | 0.103 |
| 2007-2008 | 0.169 | 0.126 | 0.099 | 0.099 | 0.122 |
| 2008-2009 | 0.238 | 0.176 | 0.141 | 0.139 | 0.172 |

Note: mean of predicted probabilities of becoming unemployed, by year and firm size, obtained from estimates of the random effects probit model model as of Table 6, column(i)

## Appendix

**Table A.1** Summary statistics of firm-level data: sample means of variables for the 3 periods analysed

| Variable | 2002-2009 | 2002-2005 | 2006-2009 |
|---|---|---|---|
| Rate of death of firms | 0.106 | 0.096 | 0.118 |
| Industry growth (t, t+1) (%) | 1.911 | 2.695 | 0.974 |
| Firm growth (t, t+1) (%) | 2.266 | 3.338 | 0.986 |
| Prop. High educ (%) | 28.454 | 25.001 | 32.578 |
| Prop. High skilled (%) | 33.369 | 32.541 | 34.358 |
| Prop. Medium skilled (%) | 37.602 | 39.350 | 35.514 |
| Prop. Stable contracts (%) | 58.123 | 58.587 | 57.570 |
| High wage firm | 0.221 | 0.221 | 0.220 |
| Low wage firm | 0.202 | 0.202 | 0.202 |
| Firm size (baseline: micro firms, <10 workers) | | | |
| Small firm (10 – 49 workers) | 0.140 | 0.144 | 0.136 |
| Medium firm (50- 249 workers) | 0.021 | 0.021 | 0.021 |
| Large firm (250+ workers) | 0.003 | 0.003 | 0.003 |
| Ownership status (baseline: private) | | | |
| Public | 0.001 | 0.001 | 0.002 |
| Foreign | 0.011 | 0.010 | 0.011 |
| Multi-establishment | 0.059 | 0.058 | 0.061 |
| Industry (baseline: food, beverages & tobacco) | | | |
| Textiles, clothing, leather | 0.035 | 0.038 | 0.031 |
| Wood, cork, paper | 0.024 | 0.026 | 0.022 |
| Non-metallic products | 0.016 | 0.017 | 0.015 |
| Metal products | 0.037 | 0.040 | 0.034 |
| Furniture & other manufacture | 0.016 | 0.017 | 0.016 |
| Electricity, gas, water | 0.001 | 0.000 | 0.001 |
| Construction | 0.152 | 0.156 | 0.148 |
| Wholesale & retail trade | 0.309 | 0.313 | 0.305 |
| Hotels & restaurants | 0.116 | 0.116 | 0.117 |
| Transport, storage, communications | 0.044 | 0.044 | 0.045 |
| Post & telecommunications | 0.001 | 0.001 | 0.001 |
| Financial intermediation | 0.008 | 0.007 | 0.009 |
| Real estate | 0.113 | 0.105 | 0.122 |
| Education | 0.013 | 0.012 | 0.014 |
| Health & social work | 0.042 | 0.040 | 0.045 |
| Other services | 0.053 | 0.049 | 0.058 |
| Region (baseline: North coast) | | | |
| Center Coast | 0.164 | 0.165 | 0.162 |
| Lisbon and Tagus Valley | 0.332 | 0.333 | 0.330 |
| Inland | 0.125 | 0.126 | 0.124 |
| Algarve | 0.056 | 0.055 | 0.058 |
| Islands | 0.037 | 0.037 | 0.037 |
| Age of firm (years, baseline 1 year old firms) | | | |
| 2 | 0.069 | 0.074 | 0.062 |
| 3 | 0.065 | 0.073 | 0.056 |
| 4 | 0.062 | 0.071 | 0.051 |
| 5 | 0.059 | 0.063 | 0.053 |
| 6 | 0.056 | 0.051 | 0.061 |
| 7 | 0.053 | 0.046 | 0.060 |
| 8 | 0.047 | 0.042 | 0.053 |
| 9 | 0.040 | 0.039 | 0.042 |
| 10 | 0.037 | 0.036 | 0.038 |

| | | | |
|---|---|---|---|
| 11-20 | 0.177 | 0.140 | 0.221 |
| 21-30 | 0.176 | 0.192 | 0.157 |
| 30+ | 0.110 | 0.122 | 0.095 |
| Year | | | |
| 2003 | 0.133 | 0.244 | |
| 2004 | 0.136 | 0.249 | |
| 2005 | 0.146 | 0.268 | |
| 2006 | 0.148 | | |
| 2007 | 0.153 | | 0.335 |
| 2008 | 0.155 | | 0.341 |
| No. of observations | 2,083,182 | 1,133,771 | 949,411 |

**Table A.2** Summary statistics of worker-level data: sample means of variables for the 3 periods analysed

| Variable | 2002-2009 | 2002-2005 | 2006-2009 |
|---|---|---|---|
| Unemployment | 0.139 | 0.143 | 0.134 |
| Log(monthly) wages | 6.552 | 6.550 | 6.555 |
| Tenure | 7.522 | 7.550 | 7.488 |
| Experience | 20.797 | 20.655 | 20.963 |
| Hazard of firm shutdown | 0.035 | 0.024 | 0.047 |
| Women | 0.442 | 0.435 | 0.450 |
| Education (baseline: ISCED1) | | | |
| ISCED2 | 0.211 | 0.197 | 0.227 |
| ISCED3 | 0.204 | 0.188 | 0.222 |
| ISCED56 | 0.112 | 0.097 | 0.129 |
| Skill (baseline:high-skill) | | | |
| Medium Skill | 0.413 | 0.427 | 0.396 |
| Low-skill | 0.371 | 0.365 | 0.377 |
| Type of contract (baseline: open-end) | | | |
| Closed-end | 0.225 | 0.206 | 0.247 |
| Other | 0.046 | 0.052 | 0.039 |
| Firm wages | | | |
| High wage firm | 0.488 | 0.497 | 0.477 |
| Low wage firm | 0.114 | 0.108 | 0.121 |
| Firm size (baseline: micro firms, <10 workers) | | | |
| Small firm (10 – 49 workers) | 0.282 | 0.284 | 0.279 |
| Medium firm (50 – 249 workers) | 0.228 | 0.228 | 0.228 |
| Large firm (250+ workers) | 0.260 | 0.258 | 0.263 |
| Multiestablishment | 0.357 | 0.351 | 0.364 |
| Ownership status (baseline: private) | | | |
| Public | 0.035 | 0.036 | 0.034 |
| Foreign | 0.101 | 0.097 | 0.105 |
| Industry (baseline: food, beverages & tobacco) | | | |
| Textiles, clothing, leather | 0.083 | 0.092 | 0.073 |
| Wood, cork, paper | 0.030 | 0.032 | 0.027 |
| Non-metallic products | 0.039 | 0.041 | 0.035 |
| Metal products | 0.072 | 0.078 | 0.066 |
| Furniture & other manufacture | 0.017 | 0.018 | 0.017 |
| Electricity, gas, water | 0.006 | 0.006 | 0.005 |
| Construction | 0.125 | 0.126 | 0.124 |
| Wholesale & retail trade | 0.204 | 0.203 | 0.205 |
| Hotels & restaurants | 0.067 | 0.065 | 0.069 |

| | | | |
|---|---|---|---|
| Transport, storage, communications | 0.046 | 0.046 | 0.046 |
| Post & telecommunications | 0.014 | 0.015 | 0.012 |
| Financial intermediation | 0.033 | 0.033 | 0.033 |
| Real estate | 0.112 | 0.103 | 0.123 |
| Education | 0.021 | 0.019 | 0.024 |
| Health & social work | 0.058 | 0.051 | 0.065 |
| Other services | 0.036 | 0.034 | 0.039 |
| Region (baseline: North coast) | | | |
| Center Coast | 0.143 | 0.146 | 0.139 |
| Lisbon and Tagus Valley | 0.414 | 0.412 | 0.415 |
| Inland | 0.082 | 0.082 | 0.083 |
| Algarve | 0.035 | 0.033 | 0.036 |
| Islands | 0.039 | 0.039 | 0.039 |
| Year (baseline: 2002) | | | |
| 2003 | 0.131 | 0.243 | |
| 2004 | 0.135 | 0.251 | |
| 2005 | 0.147 | 0.272 | |
| 2006 | 0.149 | | |
| 2007 | 0.154 | | 0.334 |
| 2008 | 0.157 | | 0.342 |
| No. of observations | 16,006,410 | 8,643,791 | 7,362,619 |