Excess worker turnover in two-tier systems: Firm and match heterogeneity*

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Abstract

Portuguese firms engage in intense reallocation, most employers simultaneously hire and separate from workers, resulting in high excess worker turnover flows. These flows are constrained by employment regulation, which is characterized by a two-tier system in which rigid permanent contracts and flexible fixed-term contracts coexist. Our results at the firm level show that the level of excess worker turnover is positively associated with fixed-term contracts. This evidence lends support to matching models in two-tier systems, namely to the prediction that the larger burden of the employment adjustment costs fall upon flexible contracts.

Keywords: Worker flows; Excess worker turnover; Fixed-term contracts; Two-tier systems
JEL Codes: J21; J23; J63.

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1 Introduction

Nine percent of Portuguese workers separate from their firms each quarter and a similar percentage is newly hired. The simultaneity of separations and hires at the firm level generates considerably smaller job flows (half the worker flows). The resulting excess worker turnover is at the core of search and matching theories and is analyzed empirically in this paper. The work of Davis, Haltiwanger and Schuh (1996) highlighted the importance of computing firm level flows to understand fluctuations in employment and unemployment. The theoretical basis for the existence of a continuous flow of hires and separations in the same firm can be found in Jovanovic (1979), Davis and Haltiwanger (1990) or Gibbons and Katz (1991). The existence of shocks (uncertainty) to the allocation of labor is the main explanation for the simultaneous occurrence of hires and separations.

This paper contributes to the characterization of excess worker turnover at the firm level within an institutional framework that imposes constraints on labor adjustments. In Portugal, as in most European countries, labor market institutions developed into a two-tier system, in which protected permanent contracts coexist with more flexible temporary arrangements. Rather than flexing the rules governing permanent contracts, policy makers increased labor market flexibility by introducing fixed-term contracts, creating a wedge between incumbents (on permanent contracts) and newly hired workers (mostly on fixed-term contracts).

The short duration nature of fixed-term matches can be associated with worker turnover at the firm level. In Abowd, Corbel and Kramarz (1999) and Boeri (2010) matching models, permanent and fixed-term contracts co-exist and the latter play a specific role in the matching process. The fixed-term contract is interpreted as an initial investment that, if successful, may be converted into a permanent contract. The flexibility of fixed-term contracts reduces the conversion rate to permanent contract, increasing the number of workers hired until a vacancy is permanently filled. Thus, it generates a high degree of excess worker turnover.

We use two administrative matched employee-employer datasets covering all private sector jobs: the monthly records of the Portuguese Social Security (2000-2009) and the annual data from *Quadros de Pessoal* (2002-2008). The two datasets complement each

other in our analysis. The Social Security data has intra-annual information, and *Quadros de Pessoal* is richer in terms of firm and worker information.

Worker rotation rates in the Portuguese labor market largely exceed the rates of job creation and destruction. The ratio of the worker hiring and job creation rates equals 2 – for every job created in the economy there are two hirings (a similar figure is obtained for the ratio between worker separation and job destruction rates). Davis, Faberman and Haltiwanger (2006) report similar ratios for the U.S. as do Bassanini and Marianna (2009) for a large number of OECD countries.

The data reveal a strong heterogeneity in the pattern of workers rotation. In small firms hires and separations move symmetrically during periods of expansion and contraction of employment – expanding firms rely on hires, whereas shrinking firms rely on separations to adjust their employment level. On the contrary, when shrinking, large firms adjust by reducing entry and not so much by increasing separations. For larger firms the separation rates of growing and shrinking units are roughly equal, but the hiring rate is significantly larger for firms with net job creation. These large degrees of excess worker turnover do not mean that most workers rotate. Instead, the hiring and separation variability is obtained by quite heterogeneous hiring and separation rates across workers. Workers rotation is much higher among workers with fixed-term contracts, who are also the ones with the largest gains in employment. Our results are in line with those observed for other developed economies (Abowd et al. 1999, Burgess, Lane and Stevens 2001, Haltiwanger and Vodopivec 2002, Abowd and Kramarz 2003, Gómez-Salvador, Messina and Vallanti 2004).

We test the link between excess worker turnover and fixed-term contracts within a regression setup. The broad picture revealed by simple bivariate relationships still holds true. In the long-run, there is a positive association between the portion of fixed-term contracts in firms and the rate of excess worker rotation. An increase of 25 percentage points (one standard deviation) in the share of fixed-term contracts leads firms, on average, to churn 10 more workers for each 100 employees than otherwise similar firms would do. The short-run dynamics are weaker, a result in line with theoretical reasoning regarding the discrete nature of employment adjustment costs. Additionally, the idiosyncratic and stochastic nature of the matching process may be masked in the estimation of

long-run associations, resulting in a weaker association when properly accounted for in an econometric model.

2 Two-tier systems and the Portuguese labor market institutions

The design of labor market institutions in most developed countries was subject to a large number of reforms in the last decades. These policy changes aimed at introducing flexibility in labor markets characterized by a strong protection of permanent employment. As surveyed in Boeri (2010), the most common reform was the introduction of fixed-term contracts, with lower dismissal costs (procedural and financial). These reforms left unchanged the regulation of permanent contracts, which generated two-tier systems, and affected the level and composition of job and worker flows.

There are few theoretical descriptions of the role of fixed-term contracts to promote labor mobility in the matching process. The model of Davis and Haltiwanger (1990) describes the matching process based on the forces that create and destroy jobs, namely the aggregate and allocative shocks (the latter generating simultaneous creation and destruction). Abowd et al. (1999) extends the Davis and Haltiwanger (1990) model to include the forces that may affect the mobility of workers between jobs, featuring a specific role for fixed-term contracts. In their model, the worker is hired initially under a fixed-term contract, which is interpreted as a period of investment required to generate a high-productivity job. The worker mobility induced by fixed-term contracts reflects the uncertainty in the success of the initial match-specific investment. In the model, workers are hired for a fixed-term period during which the firm and the worker invest to create a high-productivity job. However, the number of periods required to produce a productive job is uncertain, and may involve the hiring and separation from several workers. In order to permanently fill a vacancy the firm may engage in a succession of fixed-term appointments, each eventually with a different probability of being successful. This chain of matches describes the mobility process of workers and generates excess worker turnover at the firm level, i.e., a firm may hire more than one worker in order to fill a high-productivity job.

Boeri (2010) also models the impact of fixed-term contracts in job and worker flows. He finds that increasing the degree of flexibility of fixed-term contracts decreases the conversion of fixed-term into permanent jobs, implying that firms will churn a higher fraction of their workers in the same job.

The issue of employment mobility has also been addressed in the literature on adjustment costs of labor demand (Hamermesh 1995). The differences in firing costs among different contracts generate asymmetries in the adjustment costs and interfere with the type of employment mobility observed. Taking into account their adjustment costs when analyzing the optimal turnover policies of firms has been the subject of a large literature that dates to back the seminal paper of Oi (1962). The process of mobility is the result of an investment decision, in the sense of Jovanovic (1979), in which the firm and the worker compare the costs of changing labor market partner with the benefits of future earnings. As a result, most firms would engage in simultaneous hiring and separation of workers, choosing from a continuum of excess worker turnover outcomes. However, the timing of the decision and the degree of heterogeneity of firms' personnel policies may lead several of them to opt for a zero excess worker turnover, at least in some periods.

In two-tier systems, fixed-term contracts are the institution that facilitates the process of employment adjustment. In Portugal, fixed-term contracts were first introduced in 1976, revised several times since and offered concurrently with permanent contracts. A fixed-term contract can be signed for a specific duration and renewed for up to 6 years. It is a legal instrument for all levels of qualifications and most tasks. At the expiration of a fixed-term contract and in the absence of a conversion into a permanent position, the worker receives a severance payment equal to 3 days for each month of employment (2 days if the employment relationship lasted less than 1 year). For permanent contracts the severance payment is set in court, between 15 and 45 days for each year of seniority (usually it is set at 30 days), with a minimum of 90 days. But the largest difference between the two contracts resides in the procedural costs. These are absent at the expiration of fixed-term contracts, but are rather significant to terminate a permanent position. According to the OECD employment protection legislation indicator, Portugal has one of the largest protection gaps between these two type of contracts. In 2002, fixed-term contracts represented almost 20 percent of total salaried employment, increasing to more

than 27 percent in 2008. Dolado, Garcia-Serrano and Jimeno (2002) and Kahn (2007) survey the European experience with temporary workers.

3 Data and Concepts of Job and Worker Flows

3.1 Data

The analysis of the process of job and workers flows in the Portuguese economy is based on two administrative statistical sources. This is particularly useful, not only because it allows for a cross-validation of the results, but mainly because the two datasets complement each other in important aspects.

Social Security Records (SSR) database

The SSR database is a matched employer-employee census of private and public sector employment (excluding only firms with individual pension funds and civil servants). Social security data have been increasingly used in labor market studies. These studies include issues related with mobility and the wage determination process (e.g. Lalive 2008, Dustmann, Ludsteck and Schönberg 2009). The nature of the information, self-declared wages subject to mandatory contributions to the Portuguese Social Security system, makes the SSR a unique source of information on labor market developments. The data set registers, not only wages, but all social and unemployment related financial transfers paid to workers by the Social Security system.

The SSR data cover the period from January 2000 to December 2009. The dataset includes all employer-employee pairs for which there is at least one month of wages declared to the Social Security. For each of these pairs, the dataset has the information on the first and last month in which there are wage payments.

Quadros de Pessoal (QP) database

The QP is an administrative dataset collected on an annual basis (reported to the month of October of each year). Its coverage is similar to the SSR (we are able to cross-validate around 98 percent of all the employer-employee matches in the two datasets). The QP is a source of information of great importance in the microeconomic analysis of employment

in Portugal and has been extensively used (for a detailed description of the dataset, see Cabral and Mata (2003)).

The data are available since 1982 (with the exception of 1990 and 2001), but we restrict the analysis to the 2002 – 2008 period for two reasons. Data for the type of contract is available only since 2002 and this is the period for which we have Social Security data. We restrict our sample to firms that employed 5 or more workers for at least one year, an average of 71,355 firms, employing 2,273,994 workers per year.

3.2 Job and Worker Flows Concepts

The concepts of job and worker flows used in the paper follow Davis et al. (1996). For a given firm the year-to-year job creation and destruction rates are, respectively,

$$C_t = max\left(0, \frac{(X_t - X_{t-1})}{(X_t + X_{t-1})/2}\right) \qquad \text{and} \qquad D_t = max\left(0, \frac{(X_{t-1} - X_t)}{(X_t + X_{t-1})/2}\right), \tag{1}$$

where X_t is the number of employees in (October of) year t.

The hirings in year t, H_t, are defined as the number of workers in a firm at time t that were not employed in that firm at $t-1$. The year-to-year hiring rate is

$$HR_t = \frac{H_t}{(X_t + X_{t-1})/2}. \tag{2}$$

The separations in year t, S_t, are equal to the number of workers in a firm at time $t-1$ that are not employed in that firm at t. The year-to-year separation rate is

$$SR_t = \frac{S_t}{(X_t + X_{t-1})/2}. \tag{3}$$

The year-to-year rates do not take into account within-year hiring and separation activities by firms, i.e. they exclude all hirings made after the reference month (October in our case) that do not last until the same month in the following year. To address this, we follow Abowd et al. (1999) and define the total hirings and total separations rates as:

$$THR_t = \frac{\sum_{q=1}^{4} H_{t,q}}{(X_t + X_{t-1})/2} \qquad \text{and} \qquad TSR_t = \frac{\sum_{q=1}^{4} S_{t,q}}{(X_t + X_{t-1})/2}, \tag{4}$$

where $H_{t,q}$ is the number of entries during quarter q of year t and $S_{t,q}$ is the number of separations that occurred in quarter q of year t.

The worker flow rate (WFR) is defined as the sum of hires and separations, $WFR_t = HR_t + SR_t$. The rate of net employment change (NEC) is equal to the difference between the hiring and separation rates, $NEC_t = HR_t - SR_t$.

Finally, we are interested in the concept of excess worker turnover. This is equal to the difference between worker flows and the absolute value of net employment change:

$$EWT_t = WFR_t - |NEC_t|. \tag{5}$$

This is the key concept in this study. Intuitively, excess worker turnover corresponds to worker flows in excess of those strictly necessary to expand or shrink a certain amount of employment. Notice that the excess worker turnover equals twice the separations for expanding firms; twice the hirings for contracting firms; and equals hirings plus separations for firms with stable employment.

4 Aggregate job, worker, and excess worker turnover flows

Table 1 shows the rates of job creation and destruction, as well as the rates of hires and separations of workers for all firms in the economy. We compute both annual and quarterly rates, using Social Security data, between 2000 and 2009, and compare them with the U.S. flows reported in Davis, Faberman, Haltiwanger and Rucker (2010). In Portugal, during this period, the average rate of annual job creation is 12.7 percent and the destruction rate is 11.9 percent. These figures are very close to the ones obtained from Quadros de Pessoal in Blanchard and Portugal (2001) and more recently in Centeno, Machado and Novo (2008). The process of creation and destruction of jobs is characterized by much larger flows of entry and exit of workers. In aggregate terms, annual worker flows are around twice the number of job flows (25 percent, on average).

[TABLE 1 (see page 29)]

The level of job and worker flows differs substantially according to the frequency with which these flows are observed; higher-frequency quarterly data capture flows that are left

unidentified in annual observations. On average in each quarter, expanding Portuguese firms create 5 new jobs for every 100 existing jobs (and a similar number is destroyed). This process of expansion and contraction of employment in firms is achieved through the hire and separation from 9 employees. The ratio between worker and job flows can be used as a measure of excess worker turnover. In columns 5 and 6 of Table 1, these ratios are close to 2; firms expanding one employment position hire two workers and firms contracting one employment position separate from two workers.

The comparison of job and worker flows across countries is hindered, among other things, by the protocol used to collect the data (administrative data vs specific business surveys), the level of coverage (census vs. sample of specific parts of the population, for example large firms), and the sectoral composition of each country employment. We compare the flow rates of Portugal with those for the U.S., trying to minimize the impact of these caveats. The U.S. data sources are the Job Openings and Labor Turnover Survey (JOLTS) for worker flows, and the Business Employment Dynamics (BED) for job flows. The BED data are based on a census of private sector establishments, and the adjusted JOLTS data from Davis et al. (2010) approximates the firm demography in BED (note that the original JOLTS data do not cover new firms, and the sample design does not allow for a treatment of exiting firms). These adjustments make the U.S. flows more comparable with the ones obtained for Portugal using Social Security data.[1]

Labor market flows in Portugal are smaller than in the U.S. both on annual and quarterly terms. On average, for the period considered, the annual flows in Portugal are 90 percent of those for the U.S. and the quarterly flows are about two-thirds. More important, the hiring-to-job creation and separation-to-job destruction ratios are equal in both countries. This means that the cross-country differences in job flows are similar to the cross-country differences in worker flows. Albæk and Sorensen (1998) reports similar ratios for Denmark using annual data from 1980 to 1990 for the manufacturing sector and also Bassanini and Marianna (2009) for a large number of OECD countries, using comparable datasets.

[1]We thank Jason Faberman for making available the comparable JOLTS data.

Excess worker turnover and employment growth

The phenomenon of excess worker turnover is easier to analyze if the information is presented in a less aggregated way. Table 2 separates firms according to their type of employment growth in two successive periods. We have a group of firms with net job creation, another with net job destruction, and finally a group of firms with stable employment. For each group, we study job creation and destruction, worker hires, separations, and excess turnover. On average, for the overall economy, the employment level (line 8) in expanding firms is similar to the one in contracting firms, each representing about 41.5 percent of total employment. The remaining 17 percent of salaried workers are in firms that did not change their employment level in a given year.

[TABLE 2 (see page 29)]

Firms with increasing employment during year t created on average 20.6 jobs per 100 workers. We can compare this year-to-year job creation rate with the worker flow measures using the hiring and separation rates (lines 2 and 5). This expansion of employment is supported on the hiring of 36.4 and the separation from 15.8 workers; as a result, the excess worker turnover in expanding firms is 31.5 percent (line 7). The behavior of contracting firms is symmetric. To reduce their employment level by 18.8 workers, they separate from 30.7 and hire 11.8 workers; the excess worker turnover rate is close to 24 percent.

One interesting result is obtained for firms that have stable employment. These firms have hiring and separation rates lower than the other two groups, yet they still engage in substantial turnover; on average, they separate from 10 percent of their workforce each year. Firms with stable employment level are not lethargic.

We also compute the total hiring and separation rates, which include the within year quarterly accessions and separations (lines 3 and 4). These are better measures of the intensity of the entry and exit of workers in firms during the year. In expanding firms, the total flow rates exceed the year-to-year flows by 12.5 percentage points, whereas for firms with net job destruction total flows exceed the year-to-year measure by almost 10 percentage points.

The symmetric behavior of expanding and contracting firms is revealed in their quite different intensity of hires and separations. Firms in expansion separate from a much

smaller fraction of their workforce than firms in contraction. Similarly, contracting firms hire a percentage of new workers much smaller than expanding ones. Burgess et al. (2001) use a census of Maryland firms and find that expansion relies on hirings, while when contracting firms increase separations; a result similar to the one we obtain for the census of Portuguese firms (Table 2).[2]

Hires and separations, and employment growth at the firm level

The pattern of excess worker turnover can be further detailed if we relate the individual firm behavior of workers flows and its net employment growth. Figure 1, which follows Davis et al. (2006), shows the sectional relationship between the hiring and separation rates and the net employment growth. The hiring and separation rates are measured in the vertical axis as a percentage of total employment. The rate of employment growth is measured in the horizontal axis (also as a percentage of total employment). The solid lines starting from the origin (zero net creation of employment) show the minimum level of recruitment (for firms in expansion) and separations (for firms in contraction) needed to change the level of employment in a particular percentage. This means that the vertical distance between the two lines is a measure of excess worker turnover.

[FIGURE 1 (see page 27)]

Figure 1 uses all annual observations for continuing firms, between 2001 and 2009, and estimates, for small intervals of the distribution of the rate of employment growth, the average hiring and separation rates. These rates are weighted by firm size, using total employment. The main results drawn from the figure can be summarized as follows: the hiring and separation rates are non linear functions of the employment growth rate, having an inflection point around the null employment growth; the hiring rate grows at about the same pace (and in a linear fashion) as the employment growth rate in firms in expansion; the same behavior is displayed by the separation rate in firms in contraction; expanding firms have higher rates of worker separation than the observed hiring rate in firms reducing employment; finally, firms with lower net job creation rates have higher

[2] A more thorough analysis of this symmetric behavior would benefit from distinguishing quits and dismissals, which may differ by firm growth type. However, this is not feasible because in our data the two types of separations are not identified.

excess worker turnover. Interestingly, this result is in line with the one reported for U.S. firms in Burgess, Lane and Stevens (2000).

Worker flows and the firm size

The magnitude and composition of job and worker flows is highly correlated with the firm size (Davis et al. 1996). We analyze the relationship between job and worker flows and the size of firms, as measured by the (average) number of workers.

The results by average firm size over the period under review (2001 to 2009) reported in Table 3 highlight three key facts. First, for expanding firms separation rates increase monotonically with firm size, decreasing monotonically for contracting firms. Secondly, hiring rates have a less monotonic behavior. They are U-shaped for expanding firms; decreasing with size for firms up to 250 workers and slightly increasing for larger firms. Second, the pattern of the hiring rate for contracting firms is more irregular, although with a tendency to increase with the firm size. Finally, regardless of the firm size, the hiring rates of firms in expansion are always clearly above the hiring rates of firms in contraction. But separation rates in the two types of firms converge quite significantly with firm size (they are virtually the same for those with more than 500 workers). This means that, contrary to the symmetry reported for the overall sample, large firms shrinking their employment level rely on a reduction in entry, and not on an increase in separations. This result is fully consistent with the behavior of French firms reported in Abowd et al. (1999), who also find that employment adjustments in firms with more than 50 workers are primarily made through adjustments in hirings, rather than in separation rates. This behavior may be associated with the more stringent dismissals costs imposed on larger firms in Portugal, but also common to other European countries (Kugler and Pica 2008, Martins 2009).

[TABLE 3 (see page 30)]

5 Employment duration, labor market flows and fixed-term contracts

We have seen that hiring and separation decisions account, in similar ways, for the variability of employment in Portuguese firms. We now ask how do firms achieve this variability within the Portuguese two-tier system. The high numbers of flows and excessive worker turnover do not mean that most workers rotate between jobs, as they are compatible with the prevalence of long-term employment (Hall 1982, Ureta 1992). However, this requires enough heterogeneity in hiring and separation rates across workers, which can be accomplished by placing the burden of the high turnover on fixed-term contracts.

Table 4 presents the share of workers in a given firm in 2002 that preserve their match in the following years (from 2003 up to 2008, regardless of the number of years of tenure they had in 2002).[3] The results confirm that there is a stable core of employment in Portuguese firms – around 40 percent of the workers are still employed by the same firm after six years (column 1). This figure is slightly smaller than the ones reported by Burgess et al. (2000) for the U.S. (42.5 percent for manufacturing and 47.3 for non-manufacturing). As expected, workers with a fixed-term contract in 2002 have a much smaller probability of remaining in the firm. In 2003, 40 percent were still in a fixed-term contract (column 2) and 14 percent had been converted to a permanent contract (column 3). In 2006, only one quarter were still in the same firm, the majority with a permanent contract, 19 percent, but 6 percent were under a fixed-term contract.

[TABLE 4 (see page 30)]

These numbers hint at a great deal of turnover for fixed-term contracts. The heterogeneity in hiring and separation rates by type of contract is confirmed in Table 5. The share of fixed-term contracts is larger in firms increasing employment (28.9 percent of employment) than in firms decreasing employment (20.5 percent of employment). However, fixed-term contracts are the most important port of entry into these two types of firms; 54 percent of all accessions in expanding firms and 53 percent for firms contracting their employment level. Around 40 percent of all exits come from separation of workers under

[3] These results are based on the QP, the only data source with information on the type of contract.

fixed-term contracts; this share is larger for expanding firms, around 47 percent, than for shrinking firms, where only 37 percent of all exits are from workers under fixed-term contracts. Table 5 also shows that expanding firms rely more on hires under fixed-term contract to expand their operation (60 percent of net employment gains) whereas contracting firms separate from a much larger share of permanent workers (almost three quarters of the net employment losses result from a reduction in the level of permanent positions).

[TABLE 5 (see page 30)]

6 Regression analysis

We have already presented the main characteristics of the Portuguese labor market flows. Now, we perform a more systematic analysis of the relationship between the rate of excess worker turnover and a set of covariates capturing firm, match, and worker characteristics. We are going to make the case that fixed-term contracts play a preeminent role in determining the shape of the distribution of excess worker turnover. We will start by considering a cross-section of Portuguese firms and then extend the analysis to an (unbalanced) panel of firms covering 7 years.

The use of both cross-section and panel data is justified by the economic nature of excess worker turnover and the distinct interpretations that both estimates have. The cross-section estimates are interpretable as representative of long-term relationships, while the panel random effects estimates account also for short-term dynamics (time series estimate short-run effects; see Kennedy (2007, p. 307), for a full discussion). For instance, a firm expanding its workforce with fixed-term hires may have low levels of excess worker turnover in the short-term, but over time it is most plausible that a large portion of its turnover will occur among workers on fixed-term contracts. This suggests that these short- and long-term dynamics are different; strong and positive correlations in the long run and weaker in the short run. Additionally, the panel data estimates should account for unobserved idiosyncratic behavior. Therefore, the two sets of estimates should complement each other.

6.1 Data

Due to the interest in the relationship of worker turnover and the type of labor contracts, the analysis carried out in this section is based exclusively on *Quadros de Pessoal*, which is the only database with information on the type of contract.

Although our data constitute an annual unbalanced panel covering 2002-2008, we start by taking averages of the variables by firm. We will refer to these collapsed data as a cross-section sample. Table 6 reports the summary statistics of the cross-section data both unweighted and weighted by the firm average employment, which we identify as firm size. After excluding one-year-old firms, agriculture and mining firms, and those that never had more than 4 employees, we are left with a sample with 71,355 firms, employing an average of 2.3 millions salaried workers.

[TABLE 6 (see page 31)]

On average, workers under a fixed-term contract represent 29% of each firm's workforce, although larger firms tend to use more fixed-term contracts (the weighted average increases to 32%). Blue-collar workers represent slightly more than a third of a typical workforce. Conforming with the stylized fact of low levels of education in the Portuguese economy (Centeno and Novo 2009), more than two-thirds of a firm's workers have less than a high-school degree. The average workforce is aged 37.5 years and has a tenure of 74 months (88 months in the case of the weighted average, as larger firms last longer and have more stable relationships).

6.2 Cross-section: Long-term evidence

We start our regression analysis of the rates of excess worker turnover by considering firm averages.[4] We want to establish what's the long-term relationship between the average turnover policy followed by the 71,355 firms and the average value of a set of firm, match, and worker characteristics, for instance, the proportion of fixed-term contracts, the average (log) base wage, the educational level and average age of the firm's workforce, and the firm

[4] An alternative to using sample averages is to estimate the model separately for each of the annual cross-sections. The year-based results are in line with the average-based, and are available upon request from the authors.

size. A comprehensive list of the variables used in the different regression specifications is presented in Table A1 in the Appendix.

[TABLE A1 (see page 35)]

On average, 43 percent of the worker turnover is in excess of the amount required to achieve a particular change in employment; raising to 47 percent if weighted by the firm size (Table 6). In the 2002-2008 period, the median rate of excess worker turnover is only 0.27, with 95 percent of the firms with a rate below 1.375. The 99th percentile increases substantially to 2.4. In this period, only 3.95 percent of the firms did not churn workers in any year and of these only 11 percent did not change its workforce composition. Given the small percentage of zero excess worker turnover, we establish the relationships of interest by estimating least square and quantile regression models.

Quantile regression, first introduced by Koenker and Bassett (1978), specifies and estimates a family of conditional quantile functions, $Q_{y|x}(\tau|x) = x\beta(\tau)$, where Q is the conditional quantile function of Y given X, a vector of conditioning variables, and τ is a quantile in the interval $[0, 1]$. Quantile regression has a descriptive advantage over least squares by providing several point estimates, $\beta(\tau)$'s, which characterize and distinguish the effects of covariates over the quantiles of the distribution. For instance, if after controlling for other characteristics, fixed-term contracts indeed generate higher degrees of excess worker turnover, than both estimation methods yield a positive marginal effect. But in the quantile regression setting, we can test whether the marginal effect increases with the quantile (the degree) of excess worker turnover. Furthermore, quantile regression is robust to the presence of extreme observations in the dependent variable. As reported above, this may be important because while most firms exhibit excess worker turnover rates in a "central" range, there are a few firms that engage in high levels of turnover.

In Table 7, we use the same specification in least squares and in quantile regression (25th, 50th, and 75th quantiles).[5] These estimates are complemented with additional quantiles in Figure 2 for some of the key covariates. Also, for convenience, the horizontal red-dashed lines replicate the least squares estimates of column (1).

[5]The results presented throughout the paper are non-weighted. We also run firm-size weighted regressions and the point estimates are in general larger.

[TABLE 7 (see page 32)]

[FIGURE 2 (see page 28)]

The first noteworthy fact is that qualitatively the results are the same across the two estimation methods. However, for the range of quantiles plotted, there are a few variables for which the point estimates of the two methods do not coincide. For instance, the least squares coefficient on the (log) base wage is always smaller than the quantile coefficient (top-right plot). This fact may be explained by the sensitivity of the least squares estimates to outliers in the dependent variable.

The second plot in the first row shows that fixed-term contracts have a positive impact on the rate of excess worker turnover. The mean effect is 0.354, but the quantile coefficients are clearly increasing and precisely estimated, with point estimates ranging from 0.1 at the 10th quantile, to slightly more than 0.5 at the 90th quantile. Were this an experimental setting and we could say that, with everything else the same, higher degrees of excess turnover are increasingly caused (up to 5 times more) by fixed-term contracts. In our setting, we have only an association, but that reduces only the assertiveness of our statement.

The increasing profile of the quantile fixed-term coefficient suggests not only that the distribution of excess worker turnover is changing location – shifting to the right – due to fixed-term contracts, but also that the degree of dispersion is increasing – a scale shift that is causing more heterogeneity (variance) in the distribution of turnover. This result is compatible with the outcomes of two-tier labor markets (Boeri 2010), which are characterized by an unequal sharing of employment adjustments among different types of contracts. We can test formally for these shifts with the methodology developed in Koenker and Xiao (2002).

Table 8 reports test statistics for the null hypotheses of a simple location (mean) shift and also a location and scale (mean and variance) shift, both for each coefficient included in the specification and jointly. From the point of view of our exercise, it is more interesting to see how each covariate contributes to the joint behavior. A caveat is due, however. As Koenker and Xiao (2002) point out, but not exclusive to their statistic, testing individual hypotheses is subject to the criticism that the covariates are not independent.

In accordance with the hypothesis that fixed-term contracts play a preeminent role in the determination of turnover, the location hypothesis is more convincingly rejected for the proportion of fixed-term contracts in the firm than for any other covariate. Together with the fact that the location and scale hypothesis is not rejected, it is further evidence that such type of contracts are not only increasing the level of turnover, but also increasing the degree of dispersion of turnover among firms and workers in the economy.

[TABLE 8 (see page 33)]

The other covariates present also interesting results to the characterization of worker turnover in the Portuguese labor market. Higher average wages, as far as they reflect higher productivity and better matches between workers and firms, should be associated with lower turnover (Jovanovic 1979). The estimates (Figure 2, top-right) show that firms with higher average wages have lower turnover. However, the impact of wages is stronger among firms with higher turnover; the marginal impact goes from around -0.05 at the bottom to -0.15 at the 90th quantile. The larger impact for higher quantiles may suggest that the mean regression estimate is strongly influenced by the behavior of firms with high degrees of worker turnover. Following a similar rational, if tasks associated with blue-collar matches require less-specific human capital or are more substitutable, one could expect higher churning among such type of matches. This hypothesis is confirmed in the data (Figure 2, bottom-left). An increase in the proportion of blue-collar matches results in slightly higher turnover; a one-standard-deviation variation increase excess turnover, but only by 0.01 points.

The level of education does not have a monotonous impact on the excess turnover practiced by firms (Figure 2, bottom left and middle). An increase in the share of workers with 9 or less years of education or of college graduates reduces excess worker turnover. This result may seem at odds with the arguments put forward for both wages and blue-collar workers, which associates lower turnover with higher skills. However, the higher turnover among high-schoolers may be the other side of the coin in the well-documented process of wage polarization, which depressed the demand for middle qualifications in favor of the more- and less-qualified workers; see Centeno and Novo (2009) for Portugal and Goos, Manning and Salomons (2009) for other European countries.

In order to keep the focus of the paper, we do not discuss the remaining estimates presented in Table 7. We note, however, that they are in line with results in the empirical job search literature (Topel and Ward 1992, Burgess et al. 2001, Haltiwanger, Jarmin and Miranda 2010).

6.3 Panel data: Dynamics and unobserved heterogeneity

In the previous section, we established long-run associations with the rate of excess worker turnover, but also hinted at the existence of a substantial firm heterogeneity, potentially unobserved, which may be masked in the point estimates of observed covariates. By making use of panel data estimation methods, we hope to address two issues: unveil some of the dynamic behavior of worker turnover and account for potential unobserved heterogeneity.

There are good economic reasons to believe that firms' adjustment process is of a more discrete nature; for instance, convex adjustment costs lead to bands of inaction followed by more active periods. This is confirmed by the data. Even though, during our time window almost all firms incur in excess worker turnover in at least one period, with panel data it becomes evident that a considerable proportion of the observations – 27.5 percent – corresponds to zero excess worker turnover, i.e., firms that do not hire or separate from workers in a period. Thus, with panel data, tobit models are an inescapable statistical tool to address this mass point of "zeros." In the most common tobit setting, the zeros are due to some form of censoring; the econometrician has data on y, an incomplete observation of the latent variable, y^*, for instance, due to top coding in survey data. Our empirical setting is conceptually different and the accumulation of zero turnover is not an issue of data observability – a "censored" outcome – but rather a "corner solution."

Panel data allows to tackle unobserved heterogeneity, a recurrent concern in labor economics. One approach is to use the random effects Tobit model, which specifies that $y_{it} = \max\{0, x_{it}\beta + c_i + u_{it}\}$, $i = 1, 2, \ldots, N$ and $t = 1, 2, \ldots, T$, where $u|x_i, c_i \sim N(0, \sigma^2)$. This model is appropriate if the firm-specific effects, c_i, are orthogonal to all right-hand side variables, admittedly a strong hypothesis. However, a more general model, designated Chamberlain-like model, can be specified. It allows for correlation between the unobserved effect, c_i, and the firm-specific means of time-varying covariates, $\bar{x}_i$, of the form

$c_i = \psi + \bar{x}_i\xi + a_i$. With the additional assumption that the $u_{i1}, \ldots, u_{iT}$ are independent given x_i and a_i, it can be estimated with the standard random effects estimator.

As stated, zero excess worker turnover is interpreted as a corner solution. In this case, the relevant estimates are not the model coefficients directly, which correspond to the impacts on the latent variable. Rather, one is interested in the impact on the observed variable. These marginal effects can be computed for the full support of the distribution of excess worker turnover or only for the support that excludes the corner solution (zero excess turnover). Formally, the first marginal effect corresponds to $\partial E[y|x]/\partial x_j$ and the second to $\partial E[y|x, y > 0]/\partial x_j$. These are computable given the parametric nature of the tobit models; see Wooldridge (2002) for the full computational details.

In Table 9, we present the marginal effects estimated with tobit models. We adopt the same specification as in the previous estimations. However, since the mean and quantile estimates are not directly comparable with tobit estimates, we report first tobit result with the cross-section sample (columns (1)-(2)). This will give us a more accurate sense in which the long-run (cross-section) estimates differ from the panel estimates that incorporate also short-term dynamics. Qualitatively the panel data marginal effects are the same as in the cross-section analysis; but, quantitatively, the marginal contributions are typically smaller. There are two complementary interpretations for this fact. First, panel estimates also reflect the short-term dynamics, which due to adjustment costs lead to weaker relations with the firms, match, and workers' characteristics. This is evident when comparing pooled estimates (columns (3) and (4)) with the cross-section estimates (columns (1) and (2)). For instance, for the share of fixed-term contracts, the marginal effects for firms that engaged in excess turnover decreases from 0.39 to 0.15 and for all firms from 0.49 to 0.21. Second, it also suggests that idiosyncratic factors play an important role in determining the personnel policy of firms; the marginal effects of the random effects model in columns (5) and (6) are weaker than the pooled estimates in columns (3) and (4). Again, focusing on the share of fixed-term contracts, the marginal effects are only one-third of the pooled estimates, but still statistically significant. The significant role of idiosyncratic factors is confirmed by the proportion of the total variance attributable to the unobserved heterogeneity, which in the case of the pure random effects model stands above one-third, 0.38.

[TABLE 9 (see page 34)]

Personnel policies of previous years may condition the policy of the following years (Burgess et al. 2000). To capture this (auto-)dependence, it is necessary to estimate dynamic models. Using the Chamberlain-like tobit model, it is straight forward to incorporate lagged values of the dependent variable. Let the dynamic unobserved effects model be $y_{it} = \max\{0, z_{it}\delta + \rho y_{i,t-1} + c_i + u_{it}\}$, where $u_{it}|(z_i, y_{i,t-1}, \ldots, y_{i0}, ci) \sim N(0, \sigma_u^2)$. In this model, an additional problem arises, namely the dependence of the system on the initial value of the dependent variable. To overcome it, a general approach is to specify that the distribution for the unobserved individual effect, c_i, given the initial value y_{i0} and the average values of time-varying strictly exogenous variables z_i, is $N(\psi + \xi_0 y_0 + z\xi, \sigma_a^2)$. Under these assumptions, the likelihood takes the form of a standard random effects Tobit model, where the explanatory variables at time t are $z_{it}, y_{i,t-1}, y_{i0}, z_i$. The inclusion of the initial condition and of z_i each period allows for the c_i to be correlated with the initial condition and the z_{it} (Wooldridge 2002).

The marginal effects of the lagged dependent variable are small, 0.09 and 0.13. In a standard autoregressive model, this would constitute a low degree of autocorrelation. Burgess et al. (2001) find also a small degree of autocorrelation for a sample of Maryland firms. Thus, high levels of excess turnover in a particular year are not necessarily good predictors of high levels of turnover in the following year.

The positive marginal effect of the share of fixed-term contracts on the expected values of excess worker turnover is still significant (columns (7) and (8)). In firms with positive turnover ($y > 0$), the marginal effect of the share of fixed-term contracts is around 0.05. Similarly to the previous econometric models, when including the zero excess turnover firms in the support of outcomes, the marginal effect increases slightly to 0.07.

Finally, it is interesting to know whether the type of employment growth – expansion, contraction, or stability – influence the rate of excess turnover. Admittedly, firms in contraction may engage in policies based primarily on separations, which could result in low rates of excess turnover; on the other hand, firms increasing their employment level may have to engage in more trial and error, leading to higher turnover; and firms with stable employment may be the ones with the largest degree of churning as, by definition,

all worker separations and accessions count towards excess turnover. The dummy variables introduced in the panel estimation answer this question. Indeed, firms in contraction have the lowest level of excess turnover among the three types of employment growth. Firms expanding their workforce have slightly lower levels of excess turnover than firms with stable levels of employment. Notice, however, that in the pooled estimation (columns (1) and (2)) expanding firms had the highest degree of turnover, followed by contracting firms. The difference between the pooled and the unobserved heterogeneity estimates is rather informative of the key role of idiosyncratic factors. The pooled estimates indicate that there is more turnover in expansion periods, but the remaining estimates indicate that most of that turnover is attributable to firm idiosyncratic characteristics and not necessarily to the economic decision of expanding the firm's workforce.

7 Conclusions

The literature on job and worker flows has established a set of stylized facts common across labor markets. Most notably, filling a vacancy requires the hiring and separation of more than one worker. Labor legislation influences the intensity of such flows, but it is not enough to curtail the rate at which workers rotate in a given job. Our analysis of labor market flows in the Portuguese economy adheres to these stylized facts. The personnel policies of Portuguese firms, however conditioned by the perceived rigid labor code, are conducive to an intense reallocation of workers.

Abowd et al. (1999) and Boeri (2010) highlight the role of fixed-term contracts, in two-tier systems, as an instrument of adjustment in the matching process. Motivated by these theoretical frameworks and the sustained increase in the share of fixed-term contracts registered in the Portuguese economy, we study in greater detail their role in the determination of the observed levels of excess worker turnover.

As predicted by the models, fixed-term contracts and excess worker turnover correlate positively in the Portuguese economy. In the long run, this association is strong and heterogeneous, with a larger influence attributable to fixed-term contracts among firms with higher levels of churning. Quantile regression evidence suggests that fixed-term contracts result not only in higher excess worker turnover, but also in an increase of the degree of

variability of churning observed among firms. The short-term dynamics point towards a weaker, but still significant, association between fixed-term contracts and excess turnover. Note, however, that this reflects the discrete nature of employment adjustment costs.

The political economy debate on the creation of a unique contract should not focus on the reduction of excess worker turnover. After all, as motivated by several search models, the stochastic nature of the matching process leads necessarily to a trial process. Our research shows that the virtue of the unique contract, as discussed in Blanchard and Tirole (2008), would be to spread more uniformly the costs of adjustment across all workers, without hindering the formation of long-term employment relationships.

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Figures and Tables

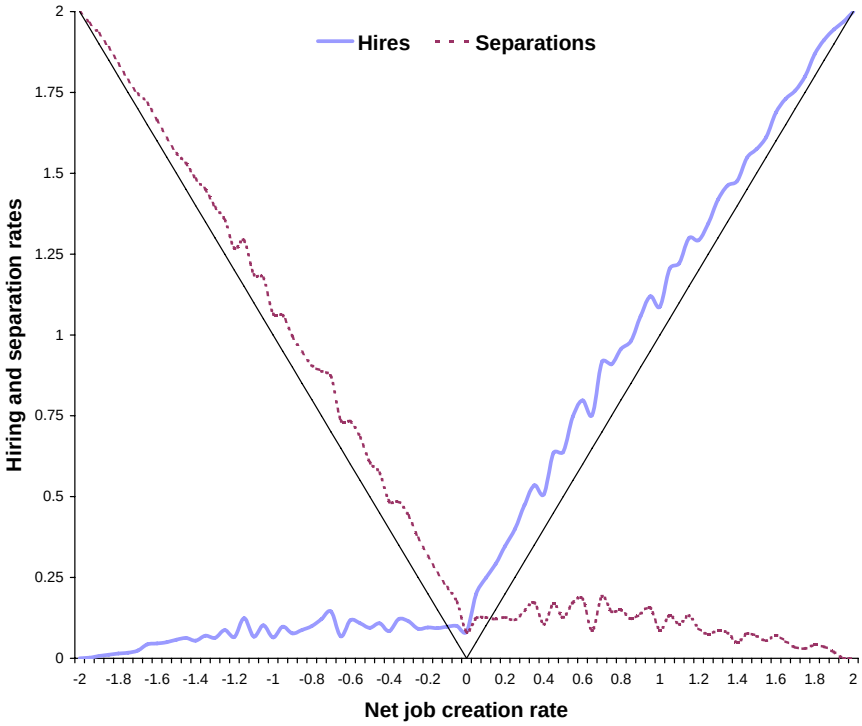

Figure 1: Firm level workers flows and net job creation rate, annual data, 2001-2006

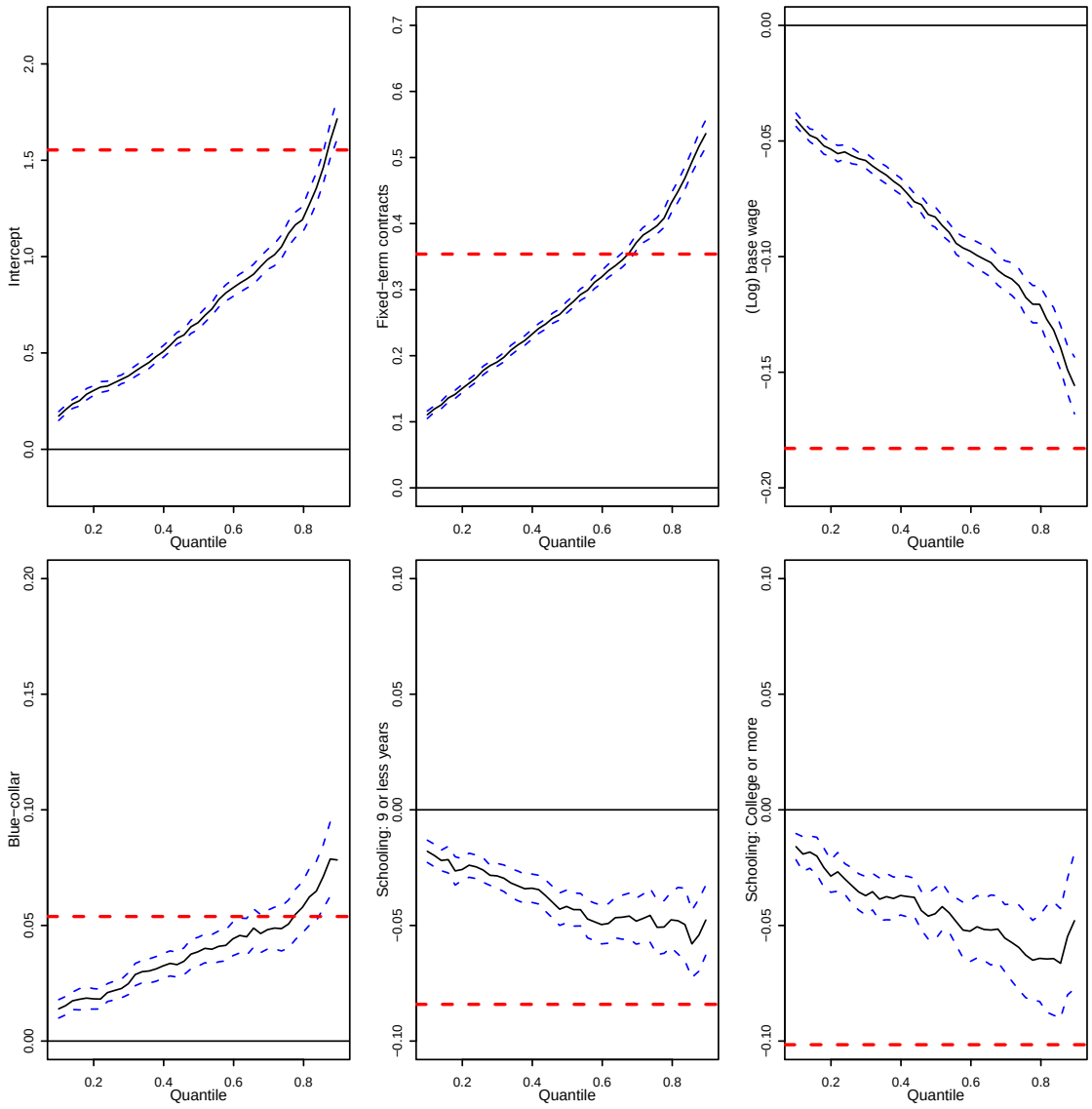

Figure 2: Rate of excess worker turnover: Quantile regression estimates. In each plot, the solid line represents coefficient point estimates of a particular covariate for each of the quantiles estimated (10th to 90th); the dashed lines around it are 90 percent confidence intervals. For convenience, the horizontal red-dashed lines represent the ordinary least squares estimates of column (1). For the full set of covariates included see Table 7 and notes therein.

Table 1: Job and worker flows in Portugal and the United States

	Job Creation	Hiring	Job Destruction	Separation	Hiring/ JC	Separation/ JD
				Annual		
Portugal (2001-2009)	12.7	25.2	11.9	24.5	2.0	2.1
Portugal (2001-2006)	12.8	25.4	12.0	24.7	2.0	2.1
USA (2001-2006)	14.6	28.5	13.7	28.0	2.0	2.0
Ratio PT/USA (2001-2006)	0.88	0.89	0.88	0.88		
				Quarterly		
Portugal (2001:Q1-2009:Q4)	5.0	9.2	4.9	9.0	1.8	1.8
Portugal (2001:Q1-2006:Q4)	5.2	9.4	5.0	9.2	1.8	1.8
USA (2001:Q1-2006:Q4)	7.9	14.9	7.6	14.8	1.9	1.9
Ratio PT/USA (2001:Q1-2006:Q4)	0.66	0.63	0.66	0.62		

Sources: Portugal: *Social Security.* U.S.: The job flows are based on BED, covering all private establishments (Davis et al. 2006). The quarterly data cover the 1990:2-2005:1 period; the annual data cover 1998-2002. The workers flows are based on JOLTS with the adjustments introduced in Davis et al. (2010) to approximate the firm demography based on the BED.

Table 2: Average worker flows rates by type of employment growth, 2001-2009

		Firms with	
	Net job creation	Net job destruction	Stable employment
(1) Job creation year-to-year	20.6	-	-
(2) Hiring rate year-to-year	36.4	11.8	9.8
(3) Total hiring rate (within year)	48.9	21.1	18.8
(4) Total separation rate (within year)	28.3	40.0	18.8
(5) Separation rate year-to-year	15.8	30.7	9.8
(6) Job destruction year-to-year	-	18.8	-
(7) Excess worker turnover	31.5	23.6	19.6
Employment	1,224,738	1,174,261	489,639

Source: *Social Security*, 2001-2009. The values reported are the 2001-2009 averages. The year-to-year rates are computed by comparing the employment in the months of October of two consecutive years. The within-year rates add up the quarterly flows registered in the months of January, April, July and October of each year.

Table 3: Average worker flows rates by firm size, 2001-2009

	Firms with								
	Net job creation			Net job destruction			Stable employment		
Firm size	Hiring	Separation	Turnover	Hiring	Separation	Turnover	Hiring	Separation	Turnover
$[1, 4]$	62.1	10.1	20.1	8.7	60.7	17.4	8.3	8.3	16.6
$[5, 9]$	43.6	12.3	24.7	10.4	40.7	20.7	10.5	10.5	21.0
$[10, 49]$	36.0	14.9	29.9	12.1	31.4	24.2	11.5	11.5	23.0
$[50, 99]$	30.6	14.4	28.8	11.3	25.9	22.5	11.3	11.3	22.6
$[100, 249]$	29.4	14.3	28.6	10.5	24.0	20.9	10.5	10.5	20.9
$[250, 499]$	31.9	16.3	32.6	12.1	24.9	32.6	9.7	9.7	19.4
+500	35.5	21.8	43.5	14.1	24.8	28.3	11.1	11.1	22.2

Source: *Social Security*, 2001-2009. Firm size is proxied by the employment size.

Table 4: Duration of matches by contract type

	Probability holding the same job as in 2002	Fixed-term contract in 2002	
		Still fixed-term	Open-ended contract
	(1)	(2)	(3)
2003	70.3	41.4	14.1
2004	58.3	22.3	19.6
2005	53.2	13.8	22.9
2006	46.7	9.7	22.0
2007	42.1	7.5	20.4
2008	38.1	5.8	19.0

Source: *Quadros de Pessoal*, 2002-2008.

Notes: (1) Probability that an individual has the same employer in 2003, 2004, ..., 2008 that (s)he had in 2002. (2) Probability that an individual who had a fixed-term contract in 2002 still has a fixed-term contract with the same firm in 2003, 2004, ..., 2008. Note that, in 2003, fixed-term contracts could last up to 6 years. (3) Probability that an individual who had a fixed-term contract in 2002 has an open-ended contract with the same firm in 2003, 2004, ..., 2008.

Table 5: Average worker flows by contract type, 2002-2008

	Firms with		
	Net job creation	Net job destruction	Stable employment
Hiring rate	37.2	12.3	13.4
into open-ended	17.1	5.8	8.0
into fixed-term	20.1	6.5	5.4
Separation rate	15.7	30.4	13.4
of open-ended	8.3	18.9	9.1
of fixed-term	7.4	11.5	4.3
Employment			
open-ended	734,506	733,350	327,518
	71.1%	79.5%	83.5%
fixed-term	299,118	189,538	64,580
	28.9%	20.5%	16.5%

Source: *Quadros de Pessoal*, 2002-2008.

Table 6: Firms summary statistics

	Unweighted		Weighted by firm size	
	Mean	Std deviation	Mean	Std deviation
Rate of excess worker turnover	0.43	(0.52)	0.47	(0.55)
Rate of total worker flows	0.67	(0.69)	0.67	(0.68)
Fixed-term contracts (%)	0.26	(0.27)	0.28	(0.26)
Average base (log) wage	6.34	(0.37)	6.45	(0.42)
Blue collar (%)	0.36	(0.25)	0.39	(0.26)
Education:				
9 or less years (%)	0.71	(0.28)	0.67	(0.27)
High school (%)	0.20	(0.20)	0.21	(0.18)
College or more (%)	0.10	(0.16)	0.12	(0.17)
Female (%)	0.42	(0.33)	0.44	(0.31)
Foreigners (%)	0.05	(0.14)	0.05	(0.12)
Firm age	18.52	(24.10)	25.68	(39.26)
Workforce age	37.46	(5.38)	37.46	(5.27)
Workforce tenure	73.79	(57.51)	88.13	(66.12)
Regions:				
Porto	0.20	(0.40)	0.19	(0.39)
Lisbon	0.23	(0.42)	0.35	(0.48)
Azores	0.02	(0.14)	0.02	(0.13)
Madeira	0.02	(0.16)	0.02	(0.15)
Algarve	0.05	(0.21)	0.03	(0.17)
Alentejo	0.03	(0.17)	0.02	(0.14)
Inland regions	0.07	(0.26)	0.05	(0.22)
Coastal regions	0.38	(0.49)	0.32	(0.47)
No of firms		71,355		
Employment		2,273,994		
Firm size		31.87		

Notes: Quadros de Pessoal, firm average values 2002-2008.

Table 7: Rate of excess worker turnover: mean and quantile regression

	OLS		Quantile regression					
	β_{OLS}	Sd. Error	$\beta_{\tau=0.25}$	Sd. Error	$\beta_{\tau=0.50}$	Sd. Error	$\beta_{\tau=0.75}$	Sd. Error
Fixed-term contracts (%)	0.354	(0.006)	0.173	(0.004)	0.274	(0.005)	0.396	(0.007)
Average base wage	-0.183	(0.007)	-0.055	(0.002)	-0.083	(0.003)	-0.114	(0.004)
Blue collar (%)	0.054	(0.007)	0.021	(0.002)	0.039	(0.004)	0.050	(0.006)
Education:								
9 or less years(%)	-0.084	(0.009)	-0.025	(0.003)	-0.042	(0.004)	-0.048	(0.007)
College or more(%)	-0.102	(0.015)	-0.031	(0.004)	-0.045	(0.006)	-0.061	(0.011)
Females (%)	-0.094	(0.006)	-0.038	(0.002)	-0.051	(0.003)	-0.058	(0.005)
Foreigners (%)	0.509	(0.013)	0.333	(0.016)	0.511	(0.015)	0.679	(0.022)
Workers average age:								
$[15, 30]$	0.086	(0.009)	0.058	(0.004)	0.080	(0.005)	0.084	(0.008)
$[31, 40]$	0.032	(0.006)	0.028	(0.001)	0.031	(0.002)	0.025	(0.004)
$[41, 45]$	0.012	(0.006)	0.012	(0.001)	0.015	(0.002)	0.013	(0.004)
Workers average tenure: (in months)								
$[1, 36]$	0.365	(0.007)	0.240	(0.003)	0.329	(0.005)	0.477	(0.007)
$[37, 60]$	0.132	(0.006)	0.107	(0.002)	0.137	(0.003)	0.179	(0.004)
$[61, 120]$	0.038	(0.005)	0.035	(0.001)	0.045	(0.002)	0.064	(0.003)
Firm size:								
$[5, 9]$	-0.195	(0.014)	-0.096	(0.004)	-0.094	(0.005)	-0.091	(0.009)
$[10, 24]$	-0.144	(0.014)	-0.050	(0.004)	-0.055	(0.005)	-0.057	(0.009)
$[25, 49]$	-0.083	(0.014)	-0.024	(0.004)	-0.029	(0.005)	-0.033	(0.009)
$[50, 99]$	-0.084	(0.015)	-0.017	(0.004)	-0.026	(0.005)	-0.039	(0.010)
$[100, 249]$	-0.063	(0.016)	-0.005	(0.004)	-0.018	(0.005)	-0.031	(0.010)
Firm age:								
2	0.806	(0.019)	0.049	(0.040)	0.343	(0.065)	1.083	(0.188)
3	-0.001	(0.012)	-0.008	(0.008)	-0.020	(0.013)	-0.034	(0.023)
4	-0.070	(0.012)	-0.038	(0.007)	-0.044	(0.014)	-0.037	(0.021)
5	-0.084	(0.008)	-0.077	(0.002)	-0.077	(0.005)	-0.085	(0.008)
6	-0.083	(0.010)	-0.046	(0.003)	-0.072	(0.004)	-0.082	(0.010)
7	-0.073	(0.010)	-0.047	(0.003)	-0.052	(0.003)	-0.081	(0.006)
8	-0.050	(0.009)	-0.026	(0.002)	-0.035	(0.005)	-0.050	(0.009)
9	-0.054	(0.010)	-0.020	(0.004)	-0.036	(0.004)	-0.051	(0.007)
10	-0.039	(0.010)	-0.015	(0.004)	-0.022	(0.003)	-0.043	(0.005)
$[11, 15]$	-0.018	(0.005)	-0.007	(0.001)	-0.011	(0.002)	-0.019	(0.003)
$[16, 20]$	-0.017	(0.005)	-0.006	(0.001)	-0.011	(0.002)	-0.018	(0.003)
No of observations	71,355		71,355		71,355		71,355	

Notes: *Quadros de Pessoal*, 2002-2008 average values, excluding the observations of the entry (and exit) year(s). (i) Education level omitted: percentage of high-schoolers; (ii) Workers average age omitted category: 46 or more years. (iii) Workers average tenure omitted category: 121 or more months. (iv) Firm size omitted category: 250 or more workers; (v) Firm age omitted category: 21 or more years. The regression includes also dummy variables for years in which the firm operated, its sector of activity, and its region. See Table A1 for a complete list of variables included in the regressions.

Table 8: Quantile regression: Location and Location-and-scale shift tests

	Null hypotheses	
	Location	Location & Scale
Joint test	179.9114	1.9035
Individual tests		
Fixed-term contracts (%)	9.4373	0.0199
Average base wage	3.2959	0.0210
Blue collar (%)	2.5904	0.0137
Education		
9 or less years (%)	2.1188	0.0115
College or more (%)	0.7490	0.0147
Females (%)	2.2399	0.0071
Foreigners (%)	2.3534	0.0394

Notes: Individiuals hypotheses critical values at the 10, 5 and 1 percent are, respectively, 1.730, 1.986, and 2.483. The joint hypothesis critical values are not available for the number of variables included in the regression. However, for 20 degrees of freedom, the critical values at the same confidence levels are, respectively, 20.81, 18.95, and 17.97. Following Koenker and Xiao (2002), to mollify the behavior of the transformation in the tails, these test statistics were computed for $\tau \in [0.20, 0.80]$.

Table 9: Rates of excess worker turnover: Tobit models

Excess worker turnover	**Cross-section**		**Panel data** (3)-(8)					
			Pooled		Random effects		Dynamic r. effects	
	$E[y\|y>0]$	$E[y]$	$E[y\|y>0]$	$E[y]$	$E[y\|y>0]$	$E[y]$	$E[y\|y>0]$	$E[y]$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Excess worker turnover$_{t-1}$							0.091	0.130
							(0.001)	(0.002)
Fixed-term contracts (%)	0.390	0.491	0.147	0.209	0.055	0.079	0.050	0.071
	(0.001)	(0.001)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Average base (log) wage	-0.250	-0.314	-0.084	-0.120	-0.061	-0.087	-0.066	-0.094
	(0.001)	(0.001)	(0.003)	(0.004)	(0.006)	(0.008)	(0.005)	(0.007)
Blue collar (%)	0.035	0.044	0.033	0.048	0.012	0.017	0.015	0.022
	(0.001)	(0.001)	(0.003)	(0.004)	(0.004)	(0.006)	(0.004)	(0.005)
Education:								
9 or less years (%)	-0.119	-0.150	-0.019	-0.027	0.010	0.014	0.011	0.016
	(0.001)	(0.002)	(0.004)	(0.005)	(0.008)	(0.012)	(0.007)	(0.009)
College or more (%)	-0.051	-0.064	-0.027	-0.038	0.019	0.028	0.047	0.066
	(0.002)	(0.002)	(0.006)	(0.009)	(0.013)	(0.019)	(0.011)	(0.015)
Females (%)	-0.079	-0.099	-0.040	-0.057	-0.009	-0.013	-0.003	-0.005
	(0.001)	(0.001)	(0.003)	(0.004)	(0.009)	(0.013)	(0.007)	(0.010)
Foreigners (%)	0.342	0.431	0.218	0.310	0.009	0.013	0.027	0.039
	(0.002)	(0.002)	(0.008)	(0.011)	(0.014)	(0.020)	(0.009)	(0.013)
Worker average age:								
$[15, 30]$	0.024	0.029	0.057	0.081	0.035	0.050	0.029	0.041
	(0.001)	(0.001)	(0.004)	(0.006)	(0.005)	(0.006)	(0.004)	(0.006)
$[31, 40]$	-0.038	-0.047	0.029	0.041	0.035	0.050	0.031	0.044
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
$[41, 45]$	-0.030	-0.038	0.019	0.028	0.025	0.036	0.023	0.033
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)
Worker average tenure:								
$[1, 36]$	0.323	0.383	0.311	0.427	0.095	0.135	0.067	0.095
	(0.001)	(0.001)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)
$[37, 60]$	0.063	0.078	0.148	0.208	0.060	0.086	0.041	0.059
	(0.001)	(0.001)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
$[61, 120]$	0.019	0.023	0.064	0.090	0.030	0.042	0.022	0.031
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Firm size:								
$[5, 9]$	-0.158	-0.209	-0.185	-0.261	-0.068	-0.097	-0.066	-0.093
	(0.001)	(0.001)	(0.005)	(0.007)	(0.009)	(0.012)	(0.010)	(0.014)
$[10, 24]$	-0.116	-0.151	-0.121	-0.172	-0.057	-0.082	-0.060	-0.086
	(0.001)	(0.001)	(0.005)	(0.007)	(0.008)	(0.012)	(0.010)	(0.014)
$[25, 49]$	-0.073	-0.093	-0.066	-0.094	-0.040	-0.058	-0.042	-0.059
	(0.001)	(0.001)	(0.005)	(0.007)	(0.007)	(0.011)	(0.009)	(0.013)
$[50, 99]$	-0.071	-0.091	-0.045	-0.064	-0.029	-0.041	-0.027	-0.038
	(0.001)	(0.001)	(0.005)	(0.007)	(0.007)	(0.010)	(0.009)	(0.013)
$[100, 249]$	-0.053	-0.068	-0.027	-0.039	-0.011	-0.015	-0.010	-0.014
	(0.001)	(0.001)	(0.005)	(0.007)	(0.005)	(0.008)	(0.008)	(0.012)
Expansion			0.014	0.020	-0.027	-0.038	-0.028	-0.040
			(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Contraction			0.005	0.007	-0.048	-0.069	-0.050	-0.072
			(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
No of observations	71,355	71,355	411,708	411,708	411,708	411,708	340,353	340,353

Notes: *Quadros de Pessoal*, 2002-2008. The reported values are the marginal effects with the respective standard errors in parentheses. In particular, the odd-numbered columns report $\partial E[y|X, y > 0]/\partial x_i$ and the even-numbered report $\partial E[y|X]/\partial x_i$. We do not report the estimates of the firm age, time, sector, and region dummies and all the means of the time-varying variables. See also Table A1 and the notes to Table 7.

A Appendix

Table A1: Covariates used in regression model specifications

Variable		Cross-section	Panel	Dynamic
(i)	Proportion of fixed-term contracts per firm	✓	✓	✓
(ii)	Average (log) base wage	✓	✓	✓
(iii)	Proportion of blue-collar workers	✓	✓	✓
(iv)	Educational level:			
	Proportion of workers with 9 or less years	✓	✓	✓
	Proportion of workers with college	✓	✓	✓
(v)	Proportion of females	✓	✓	✓
(vi)	Proportion of immigrants	✓	✓	✓
(vii)	Dummies for the workforce average age (years):			
	$[15, 30]$	✓	✓	✓
	$[31, 40]$	✓	✓	✓
	$[41, 45]$	✓	✓	✓
(viii)	Dummies for the workforce average tenure (months):			
	$[1, 36]$	✓	✓	✓
	$[37, 60]$	✓	✓	✓
	$[61, 120]$	✓	✓	✓
(ix)	Firm size (dummy for the average number of employees):			
	$[5, 9]$	✓	✓	✓
	$[10, 24]$	✓	✓	✓
	$[25, 49]$	✓	✓	✓
	$[50, 99]$	✓	✓	✓
	$[100, 249]$	✓	✓	✓
(x)	Firm age dummies (years):			
	2	✓	✓	✓
	3	✓	✓	✓
	4	✓	✓	✓
	5	✓	✓	✓
	6	✓	✓	✓
	7	✓	✓	✓
	8	✓	✓	✓
	9	✓	✓	✓
	10	✓	✓	✓
	$[11, 15]$	✓	✓	✓
	$[16, 20]$	✓	✓	✓
(xi)	Year dummies	✓	✓	✓
(xii)	2-digit sectoral dummies	✓	✓	✓
(xiii)	Regional dummies (see Table 6)	✓	✓	✓
(xiv)	Expansion period dummy	✗	✓	✓
(xv)	Contraction period dummy	✗	✓	✓
(xvi)	Average value of time-varying covariates	✗	✓	✓
(xvii)	Lagged rate of excess worker turnover	✗	✗	✓
(xviii)	Initial value of lagged rate of excess worker turnover	✗	✗	✓

Notes: "Cross-section" refers to the specifications in Table 7 and columns (1) and (2) of Table 9. "Panel" refers to columns (3)-(6) and "Dynamic" to columns (7) and (8) of Table 9.