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

The simultaneity of separations and hires at the firm level generates worker turnover in excess to what would be strictly necessary for a firm to achieve a given employment level. The goal of this paper is to characterize this excess worker turnover in the context of a two-tier labor market. 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 fixed-term 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 an important 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 larger the protection gap between permanent and fixed-term contracts the smaller will be the conversion rate, and the larger will be the number of workers hired until a vacancy is filled permanently.

We use two administrative matched employee-employer datasets covering all private sector jobs and show that eorker flow 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 across firms. 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.

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 use a regression setup to quantify the contribution of fixed-term contracts to excess worker turnover. The broad picture revealed by simple bivariate relationships still holds true. In the long-run 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.

We are, however, able to take the simple association a step further. By taking advantage of two legislative reforms that took place in 2004, we identify causal relationships between the degree of flexibility of fixed-term contracts and the level of excess worker turnover. An increase in the potential duration of fixed-term contracts from 3 to 6 years caused a reduction in excess worker turnover attributable to fixed-term contracts; about half of that observed in the before period.

A second legislative reform increased the requirements (mostly paperwork involving unions and worker councils) to justify fair dismissals for a particular group of firms. With an appropriate control group, we find that a more stringent labor code decreased excess worker turnover, but that treatment firms shifted the burden of worker rotation towards those on fixed-term contracts.

Overall, our analysis contributes to the growing literature on two-tier labor markets, providing first-time causal evidence of the role played by flexible contracts on achieving the desired level of excess worker turnover.

2 Two-tier system flows and the Portuguese labor market

2.1 The framework of two-tier systems

Excess worker turnover can be seen as resulting from the reevaluation of job match quality. This process of mobility is the result of an investment decision with some characteristics of the match being "experience goods"; the only way to determine the quality of a particular match is to form the match and "experience it" as in Jovanovic (1979). The firm and the worker compare the costs and benefits of changing labor market partner, and these evolve over time and the match quality is revealed to both parties. If either side decides to change partner but not to change labor market state (the worker supplies labor; the firm keeps the same employment level) they will generate excess worker turnover. These decisions vary from firm to firm, as a result of the degree of heterogeneity of firms' personnel policies and the evolution of match value. For instance, some firms have higher turnover costs; some skills are easier to observe and, therefore, to evaluate prior to the match formation; and the frequency of technological changes varies across firms. All these factors affect the optimal degree of excess worker turnover, which in some cases may lead several firms to opt for a zero excess worker turnover.

The firm's decisions are nor made independently of the design of labor market institutions. Indeed, the perception in developed countries that there was a strong protection of permanent employment lead to the introduction of reforms aimed at increasing flexibility in the labor market. As surveyed in Boeri (2010), the most common reform was the introduction of fixed-term contracts, with lower dismissal costs (both 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.

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). However, it does not consider an explicit role for different contract types.

Abowd et al. (1999) extends the work of Davis and Haltiwanger (1990) 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. 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 fill permanently 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 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.

A similar approach is followed by Boeri (2010) in the context of two-tier labor markets. As above, all entry jobs are fixed-term contracts and the rate of conversion into permanent contracts depends on the gap of protection bewteen the two type of contracts. Boeri (2010) 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. More recently, Bentolila, Cahuc, Dolado and Le Barbanchon (2010) present a related approach and show that a larger protection gap lead to a more frequent destruction of matches under fixed-term contract, with similar impacts on excess worker turnover.

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).

From these models we obtain a positive association between excess worker turnover and fixed-term contracts. The key issue in two-tier labor markets in which different contracts are offered concurrently is not the optimal level of excess worker turnover at the firm level,

but the role played by fixed-term contracts in the ability of firms to reach their desired level of workers rotation. The main contribution of our paper will be to quantify how much fixed-term contracts contribute to the variation in excess worker turnover at the firm level. In doing so, we explore the institutional setting of the Portuguese labor market that gives a preeminent role to fixed-term contracts. Two reforms of the employment protection legislation that affected the gap of protection of the two types of contracts will be used to pinpoint the impact of different contracts on worker turnover.

2.2 Portuguese labor market institutions

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. They are 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 (often 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.

The institutional setting and the widespread usage of fixed-term contracts – in 2002, they represented almost 20 percent of total salaried employment, increasing to more than 27 percent in 2008 – make of Portugal one of the most extreme cases of two-tier systems in Europe. Such setting is well suited to analyze and quantify the relationship between excess worker turnover and fixed-term contracts. We are, however, able to extend our analysis to quasi-experimental setting and obtain causal evidence based on two reforms of the Portuguese employment protection legislation introduced in 2004 (*Decreto-Lei 99/2003*).

On the one hand, the maximum duration of fixed-term contracts was extended from three to six years. Under the new law, we expect the turnover of fixed-term contracts to be

lower given that firms will be able to smooth their matching decisions over a longer period of time. This reform applied to all firms in Portugal motivating a *before-after* analysis as described in Heckman, LaLonde and Smith (1999).

The other reform changed the component of employment protection legislation related with fair dismissals requirements only for firms with 11 to 20 workers. Before the reform, firms with less than 21 workers were allowed to go through a less bureaucratic (and costly) process for fair dismissals; in brief, they were exempted from the obligation of involving the work council and unions in the dismissal process. The new law changed the firm size threshold, generating a quasi-experimental setting in which firms with 11 to 20 workers constitute the treatment group and firms with more than 20 workers constitute a natural control group since they were not affected by the reform.[1] The increase in the permanent-to-fixed-term protection gap for the treatment group should lead to a reduction in turnover and an increase in the importance of fixed-term contracts to achieve the firm's desired level of worker turnover.

In a similar context, but focusing on other outcomes at the firm level, Martins (2009) studied the introduction of the 21-worker threshold in 1989.

3 Aggregate job, worker, and excess worker turnover flows

We start our analysis by computing aggregate measures of job and worker flows in the Portuguese economy and compare them with stylized facts known for other economies. We explore possible source of heterogeneity at the firm level arising from periods of employment growth, reduction, and stability.

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.

[1] The legislation did not change the protection gap of firms with 10 or less workers. We could have used them as a control group, but in that case some firms that before the law change were in the 11-20 group could strategically reduce their size to keep the same protection gap generating some self-selection into the control group. This mover problem is not likely with the control group of firms with more than 20 workers.

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

Our analysis of labor market flows is based on the standard definitions laid down in Davis, Haltiwanger and Schuh (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 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 rates are

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

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, $EWT_t = WFR_t - |NEC_t|$. 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.

3.3 Aggregate 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 28)]

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.

We compare the flow rates of Portugal with those for the U.S.. using data from the Job Openings and Labor Turnover Survey (JOLTS) for worker flows, and the Business Employment Dynamics (BED) for job flows.[2]

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

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

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.

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. On average, for the overall economy, the employment level 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 28)]

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. 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. 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.

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).[3]

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 reported in Table 2 highlight three key facts.

First, for expanding firms separation rates increase monotonically with firm size, decreasing monotonically for contracting firms, while hiring rates have a less monotonic behavior. 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).

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. The behavior of large firms may be associated with the more stringent dismissals costs they face (see also Section 5.4), but that are common to other European countries (Kugler and Pica 2008, Martins 2009).

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

[3] 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.

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 26)]

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

4 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).[4] 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 29)]

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 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 29)]

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

5 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. As a measure of two-tier labor markets, we are going to focus on fixed-term contracts and quantify the role that they play in the firm's choice of the level 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. Finally, we will take advantage of quasi-experimental setting to draw causal inference.

5.1 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, but only since 2002.

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 30)]

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 27 percent. 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. Workers under a fixed-term contract represent, on average, 29% of each firm's workforce, although larger firms tend to use more fixed-term contracts (the weighted average increases to 32%).

5.2 Cross-section: Long-term evidence

We start our regression analysis of the rates of excess worker turnover by considering firm averages.[5] These 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). Therefore, first we start by establishing 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, such as, the firm size, the proportion of fixed-term contracts, the average (log) base wage, the educational level and average age of the firm's workforce. A comprehensive list of the variables used in the different regression specifications is presented in Table A1 in the Appendix (p. 34).

In Table 7, we use the same specification in least squares and in quantile regression (25th, 50th, and 75th quantiles).[6] 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).

[TABLE 7 (see page 31)]

[FIGURE 2 (see page 27)]

The first noteworthy fact is that qualitatively the results are the same across the two estimation methods (Table 7). The marginal effect of fixed-term contracts on excess worker turnover is 0.354, but the quantile coefficients expose a high degree of heterogeneity. The impacts on the 25th and 75th conditional quantiles are 0.274 and 0.396, respectively. The second plot of Figure 2 shows the set of estimates starting at the 10th quantile and ending at the 90th. It presents a clearly increasing and precisely estimated relationship, with point estimates ranging from 0.1 at the 10th quantile, to slightly more than 0.5 at the 90th quantile. In other words, higher degrees of excess turnover are increasingly 'caused' by fixed-term contracts. Indeed, this profile of the quantile coefficients is statistically compatible with not only a positive shift in the mean of the excess worker turnover distribution,

[5] 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.

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

but also with an increase in its dispersion, as measured by the variance.[7]

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 in terms of wages, education and other demographic characteristics (Topel and Ward 1992, Burgess et al. 2001, Haltiwanger, Jarmin and Miranda 2010).

5.3 Panel data: Dynamics and unobserved heterogeneity

In the previous section, we quantified 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 almost all firms incur in excess worker turnover in at least one period, a considerable proportion of the firm $\times$ year pairs – 27.5 percent – correspond to zero excess worker turnover, i.e., to firms that do not hire and separate simultaneously from workers in a period. In the most common econometric setting, there are data on y, a censored observation of the latent variable, y^*, for instance, due to top coding in survey data. Our empirical setting is conceptually different and the mass of zero turnover is the result of a "corner solution." This mass point can be addressed with tobit models.

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

[7] We tested formally for a location-and-scale shift by using Koenker and Xiao (2002)'s test. To preserve space, we omit a full discussion, but the results are available upon request from the authors.

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 (see Wooldridge (2002) for a full discussion).

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 marginal effect on the observed variable, formally, on the $\partial E[y|x]/\partial x_j$.

In Table 8, we present the marginal effects estimated with tobit models. We include the same set of covariates as in the previous estimations and additional control for whether the period in which excess worker turnover is observed corresponds to a period of expansion, contraction or stability in the firm's size. Qualitatively, the random effects model (column (1)) yields marginal effects that are the same as in the cross-section analysis; but, quantitatively, the marginal contributions are typically smaller. On the key measure of two-tier labor markets, the marginal effect of the share of fixed-term contracts on excess turnover is, 0.08, clearly smaller.[8]

There are two complementary interpretations for this reduction in the marginal effect. 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. Second, it also suggests that idiosyncratic factors play an important role in determining the personnel policy of firms. 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 8 (see page 32)]

Personnel policies of previous years may condition the policy of the following years (Burgess et al. 2001). To capture this (auto-)dependence, it is necessary to estimate dynamic models. The Chamberlain-like tobit model can be adjusted to account for dependence of the system on the initial value of the dependent variable to yield consistent

[8]This smaller impact is not due to the estimation of tobit models, because when we re-estimate the cross-section specification with tobit models, the coefficient on fixed-term contracts is 0.49, comparable with the other cross-section estimates.

estimates (Wooldridge 2002). Table 8, column (2), reports that the marginal effect of the lagged dependent variable is small, 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. This additional control variable does not affect the marginal effect of the share of fixed-term contracts on excess worker turnover, which still has a positive and statistically significant impact of 0.07.

Finally, in column (3) of Table 8, we abandon the tobit models in favor of a standard fixed-effects panel model. Similar to Burgess et al. (2001), at the cost of ignoring the mass of zeros, we account for the potential endogeneity of the choice of the share of fixed-term contracts and excess worker turnover. The point estimate are in general comparable with those presented hitherto. In particular, the impact of fixed-term contracts on churning shows a remarkable robustness to the choice of the estimation method yielding still a marginal effect of 0.08.

5.4 Quasi-experimental evidence

Hitherto, we quantified a solid relationship between the level of excess worker turnover and the proportion of fixed-term contracts used by firms. Theoretical models elevated the association from a simple correlation to a more structural interpretation. In this section, we take advantage of the two legislative reforms described in Section 2.2, to gather quasi-experimental evidence of the impact of two-tier system, as measured by fixed-term contracts, on excess worker turnover.

Recall that, beginning in 2004, the maximum duration of fixed-term contracts was extended from 3 years to 6 years. However, simultaneously for firms with 11 to 20 workers there was an additional change that increased the legal requirements to justify fair dismissals. To isolate the impact of the maximum duration, we consider only firms with more than 20 workers and estimate a simple *before-after* model reported in column (1) of Table 9. We maintain the control variables reported previously, including additionally a dummy variable for the period after 2003 ($After$) and an interaction of this variable with the proportion of fixed-term contracts. The coefficient on the $After$ variable is prone to

capture effects other than the additional flexibility of fixed-term contracts. However, the interaction term should capture any change in the contribution of fixed-term contracts to churning in the after period, beyond the other (time) trends.

[TABLE 9 (see page 33)]

If we consider Jovanovic (1979)'s description of matches as experience goods, the longer potential duration of fixed-term contracts allows for a longer period to reveal the quality of the match. In such setting, firms may rotate a smaller number of workers in the same job vacancy until eventually filling it with a permanent contract. As such, we should expect a lower association of fixed-term contracts and excess worker turnover. Indeed, in the after period, an increase in fixed-term contracts causes a marginal increase in excess worker turnover (0.053) that is less than half the value observed up to 2003 (0.117). Note that the latter coefficient is slightly larger than the non-experimental ones, but that the after period impact is smaller. On average, the two-period estimates are close to the marginal effect of around 0.07 reported earlier.

The second reform increased the legal requirements to justify a fair dismissal and applied only to firms with 11 to 20 workers. This change generated a quasi-experimental setting appropriate to estimate a causal impact based on a difference-in-differences model. We start by considering as treatment units the firms with 11 to 20 workers; and as control units firms with more than 20 workers. In column (2), we report the estimates of a standard difference-in-differences model, where the interaction term between the $After$ variable and the treatment dummy indicator, $Treat$, identifies the impact of the policy change. The estimate indicates that the more stringent dismissals regulation lead to a reduction of 1.3 percentage points on the level of excess worker turnover for treated firms. Note that the change in the maximum duration of fixed-term contracts affected both treatment and control groups, and under the standard assumption of common trend, its effect is wiped-out by the double difference.

However, a more stringent legislation that increases the wedge between the firing costs of open-ended and fixed-term contracts may lead firms to seek refugee in the latter to rotate workers. To infer this possibility, we reestimate the difference-in-differences model but including interaction terms between the fixed-term contract variable and all of the

treatment variables ($Treat$, $After$, and $After \times Treat$); the results are presented in column (2'). The coefficient on the interaction term $After \times Treat \times FTC$ indicates, indeed, that the reform caused treatment firms to rely more on fixed-term contracts to achieve their desired level of excess worker turnover. A standard deviation increase in fixed-term contracts increases excess worker turnover by 0.5 percentage points.

The definition of treatment and control units based on the size of the firm opens the possibility of selection into treatment by the units themselves. It is likely that firms move between treatment and control groups often in an endogenous way. To prevent that such firms contaminate our estimates, we redefine the treatment group to include only firms with 13 to 17 workers and the control group to firms with 26 or more workers. Our point estimates of the causal effect are remarkably robust to the redefinition of treatment and control groups. The impact of the reform is still to cause less 1.3 percentage points on excess worker turnover (column (3)). The interaction of the reform with the usage of fixed-term contracts yields a slightly larger increase on the reliance on such type of contracts (column (3')); a standard deviation increase in its usage leads now to an increase of 0.8 percentage points on churning on the treated.

The quasi-experimental nature of the our exercise renders these impacts a causal interpretation, aligning our empirical exercise with the theoretical interpretations of Abowd et al. (1999), Boeri (2010), and Bentolila et al. (2010).

6 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. 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), Boeri (2010), and Bentolila et al. (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. 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 availability of a quasi-experiment allowed us to present more conclusive evidence. Still in line with the previous results, we showed that a stringent employment protection legislation causes an increase in the reliance on fixed-term contracts by treated firms to achieve their desired level of worker turnover.

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 desirable 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

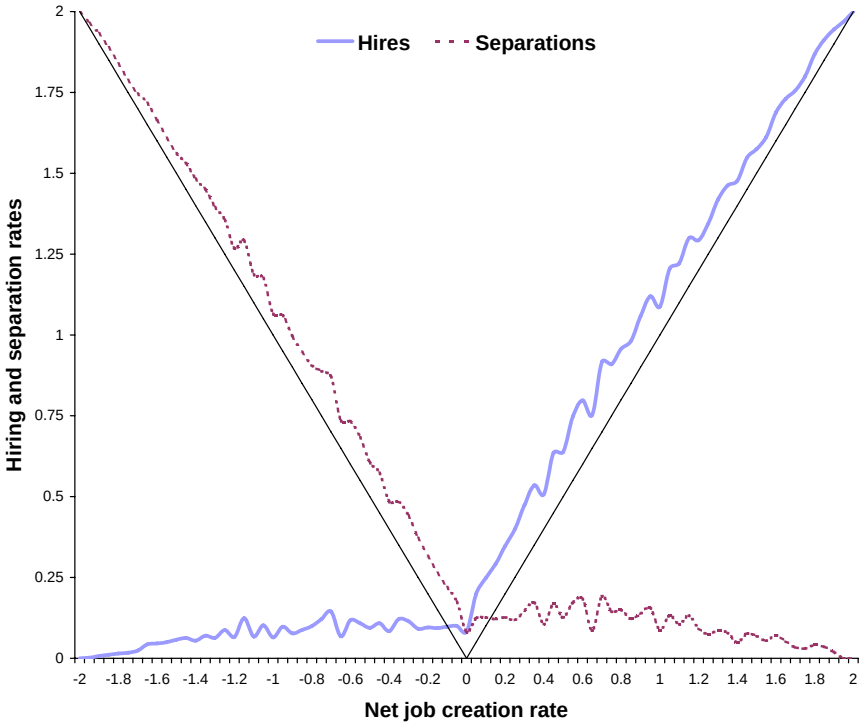

Figure 1: Firm level workers flows and net job creation rate, annual data, 2001-2006

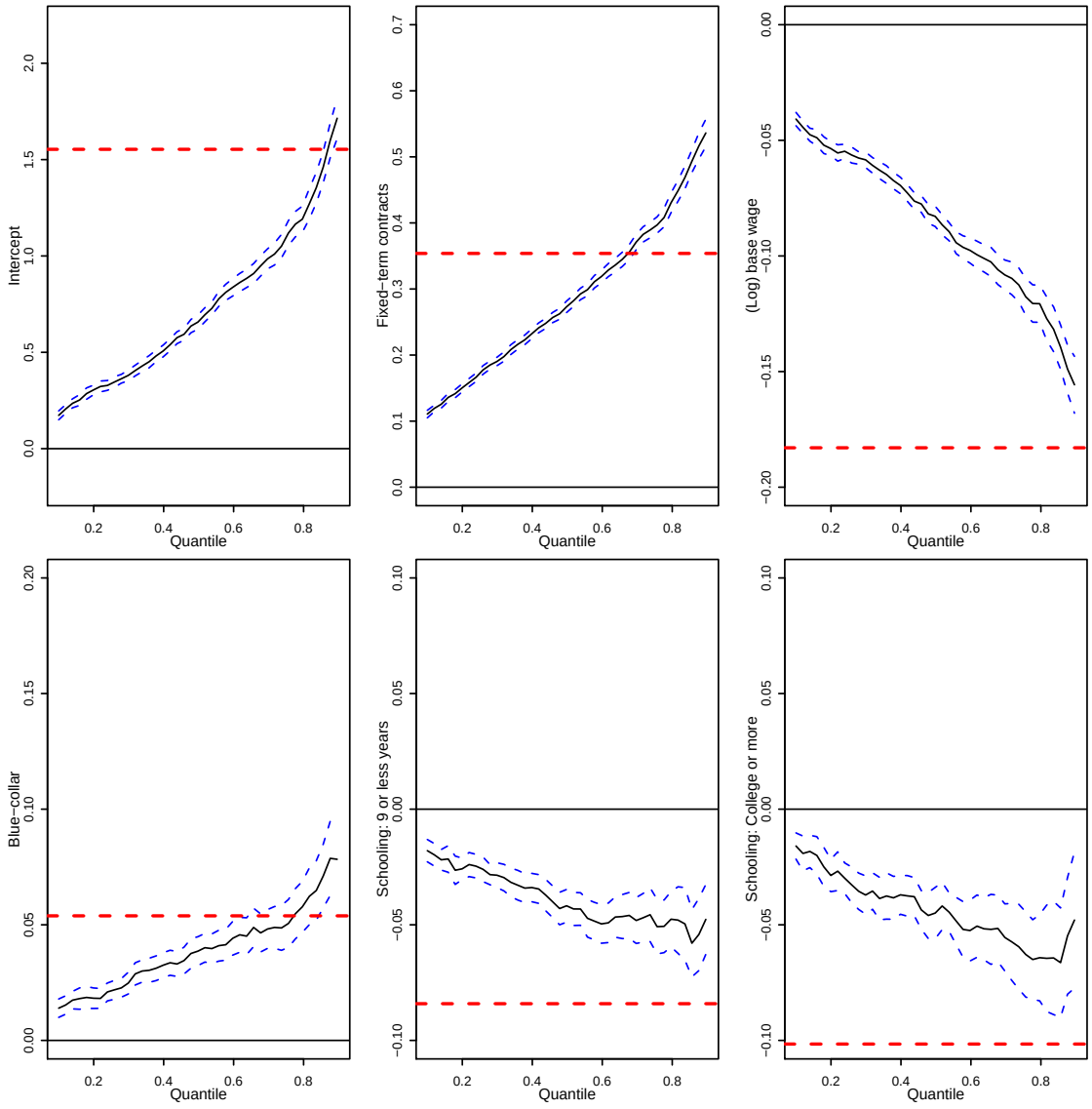

Figure 2: Rate of excess worker turnover: Quantile regression estimates. In each plot, the solid line represents coefficient point estimates of a particular covariate for each of the quantiles estimated (10th to 90th); the dashed lines around it are 90 percent confidence intervals. For convenience, the 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

	Net job creation	Firms with 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
Total	36.4	28.3	31.5	11.8	30.7	23.6	9.8	9.8	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 rates are computed by comparing the employment in the months of October of two consecutive years. 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 (%)	0.29	(0.28)	0.32	(0.29)
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: cross-section models

	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: Rates of excess worker turnover: panel data models

Excess worker turnover	**Tobit** (1)-(2) Random effects (1)	Dynamic r. effects (2)	**Linear** (3) Fixed effects (3)
Excess worker turnover$_{t-1}$		0.130	
		(0.002)	
Fixed-term contracts (%)	0.079	0.071	0.079
	(0.004)	(0.004)	(0.004)
Average base (log) wage	-0.087	-0.094	-0.087
	(0.008)	(0.007)	(0.006)
Blue collar (%)	0.017	0.022	0.010
	(0.006)	(0.005)	(0.005)
Education:			
9 or less years (%)	0.014	0.016	0.014
	(0.012)	(0.009)	(0.009)
College or more (%)	0.028	0.066	-0.003
	(0.019)	(0.015)	(0.145)
Females (%)	-0.013	-0.005	-0.016
	(0.013)	(0.010)	(0.010)
Foreigners (%)	0.013	0.039	0.011
	(0.020)	(0.013)	(0.013)
Worker average age:			
[15, 30]	0.050	0.041	0.027
	(0.006)	(0.006)	(0.005)
[31, 40]	0.050	0.044	0.025
	(0.004)	(0.004)	(0.004)
[41, 45]	0.036	0.033	0.017
	(0.004)	(0.003)	(0.003)
Worker average tenure:			
[1, 36]	0.135	0.095	0.102
	(0.005)	(0.005)	(0.005)
[37, 60]	0.086	0.059	0.044
	(0.004)	(0.004)	(0.004)
[61, 120]	0.042	0.031	0.013
	(0.003)	(0.003)	(0.003)
Firm size:			
[5, 9]	-0.097	-0.093	-0.041
	(0.012)	(0.014)	(0.015)
[10, 24]	-0.082	-0.086	-0.060
	(0.012)	(0.014)	(0.015)
[25, 49]	-0.058	-0.059	-0.056
	(0.011)	(0.013)	(0.015)
[50, 99]	-0.041	-0.038	-0.048
	(0.010)	(0.013)	(0.014)
[100, 249]	-0.015	-0.014	-0.020
	(0.008)	(0.012)	(0.013)
Expansion	-0.038	-0.040	-0.030
	(0.002)	(0.002)	(0.002)
Contraction	-0.069	-0.072	-0.059
	(0.002)	(0.002)	(0.002)
No of observations	411,708	340,353	417,106

Notes: *Quadros de Pessoal*, 2002-2008. The reported values are the marginal effects, $\partial E[y|X]/\partial x_i$, with the respective standard errors in parentheses. 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.

Table 9: Quasi-experimental evidence: Before-After and Difference-in-Differences estimates

	Before-After	Difference-in-differences			
		T:[11, 20] C:[21, ∞]		T[13, 17] C:[26, ∞]	
	(1)	(2)	(2')	(3)	(3')
After	-0.123	-0.132	-0.134	-0.122	-0.124
	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Treat		0.006	0.006	-0.001	-0.002
		(0.003)	(0.003)	(0.006)	(0.006)
After × Treat		-0.013	-0.015	-0.013	-0.015
		(0.003)	(0.003)	(0.004)	(0.004)
FTC	0.117	0.087	0.125	0.085	0.125
	(0.006)	(0.004)	(0.007)	(0.005)	(0.007)
After × FTC	-0.064		-0.077		-0.074
	(0.006)		(0.007)		(0.007)
Treat × FTC			-0.002		-0.010
			(0.009)		(0.013)
After×Treat×FTC			0.020		0.029
			(0.010)		(0.013)
No of observations	133,366	254,650	254,650	156,914	156,914

Standard errors in parentheses. Columns (2)-(2') present estimates for treatment firms with 11 to 20 workers and control firms with 21 or more workers. In columns (3)-(3'), the treatment firms are constrained to have 13 to 17 workers and the control firms to 26 or more workers. See Table A1 for a list of all variables included in the regressions.

A Appendix

Table A1: Covariates used in the model specifications

Variable		CS	RE	DRE	FE	BA	DinD
(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	✗	✗	✓	✗	✗	✗
(xix)	After	✗	✗	✗	✗	✓	✓
(xx)	Treat	✗	✗	✗	✗	✗	✓
(xxi)	After × Treat	✗	✗	✗	✗	✗	✓
(xxii)	After × Fixed-term contracts	✗	✗	✗	✗	✓	✓
(xxiii)	Treat × Fixed-term contracts	✗	✗	✗	✗	✗	✓
(xxiv)	After × Treat × Fixed-term contracts	✗	✗	✗	✗	✗	✓

Notes: "CS" refers to the cross-section specifications in Table 7. "RE" refers to column (1), "DRE" to column (2), and "FE" to column (3) of Table 8. "BA" refers to column (1) of Table 9 and "DinD" to columns (2)-(3').