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Excess worker turnover and fixed-term contracts: Causal evidence in a two-tier system

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Causal Evidence in a Two-Tier System**

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ABSTRACT

Excess Worker Turnover and Fixed-Term Contracts: Causal Evidence in a Two-Tier System^{*}

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 the employment protection gap between open-ended and fixed-term contracts. We explore a reform that increased the employment protection of open-ended contracts and generated a quasi-experiment. The causal evidence points to an increase in the share and in the excess turnover of fixed-term contracts in treated firms. The excess turnover of open-ended contracts remained unchanged. This result is consistent with a high degree of substitution between open-ended and fixed-term contracts. At the firm level, we also show that excess turnover is quite heterogeneous and quantify its association with firm, match, and worker characteristics.

JEL Classification: J21, J23, J63

Keywords: excess worker turnover, two-tier systems, quasi-experiment, fixed-term contracts

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1 Introduction

The simultaneity of separations and hirings at the firm level generates worker turnover in excess of what would be strictly necessary for a firm to achieve a given employment level. The theoretical basis for the existence of a continuous flow of hirings 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 hirings and separations.

This paper contributes to the characterization of excess worker turnover at the firm level within a two-tier system, an institutional framework in which protected open-ended contracts coexist with more flexible fixed-term arrangements. In 2004, a reform of the labor code increased the protection of open-ended employment for firms with 11 to 20 workers, but left it unchanged for all other firms. We explore this change as a quasi-experiment.

In the last decades, two-tier reforms characterized the development of labor market regulations in most European countries. Rather than flexing the rules governing open-ended contracts, labor market reforms increased the protection gap between incumbents (on open-ended contracts) and entry jobs (mostly on fixed-term contracts).

The short 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, fixed-term contracts play an important role in the initial stages of the matching process. The fixed-term contract is interpreted as an investment that, if successful, may be converted into an open-ended contract. A larger protection gap between open-ended and fixed-term contracts should be associated with a larger share of fixed-term contracts in employment and with a smaller conversion rate of fixed-term to open-ended contracts. This implies that the number of workers hired until a vacancy is filled permanently will be larger, resulting in higher turnover for fixed-term contracts and lower job destruction for open-ended contracts.

We use two administrative matched employee-employer datasets covering all private sector jobs and show that worker 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; the same 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 does [Bassanini \(2010\)](#) for a large number of OECD countries.

The data showed, however, a strong heterogeneity in the pattern of workers rotation across firm size. Furthermore, hirings and separations move symmetrically during periods of expansion and contraction of employment. [Burgess, Lane and Stevens \(2001\)](#) obtain akin results for a census of Maryland firms. We then ask: How is this employment variability achieved in Portuguese firms?

In order to answer this question, we resorted to the legislative reform that set more stringent requirements for fair dismissals of open-ended contracts for a subset of firms. This allowed us to identify causal relationships between the employment protection gap of open-ended and fixed-term contracts and two important labor market indicators: the composition of employment and the level of excess worker turnover. Treated firms increased the share of fixed-term contracts (1.7 percentage points), while overall excess worker turnover remained unchanged. More interestingly in the context of two-tier reforms, we obtained a significant increase in excess turnover of fixed-term contracts in treated firms (1.3 percentage points), whereas excess turnover for open-ended workers remained unchanged. This can be interpreted as a sign of a high substitution degree between open-ended and fixed-term positions in Portuguese firms, a result also found by [Cappellari, Dell'Aringa and Leonardi \(2011\)](#) for Italy.

In the spirit of [Burgess et al. \(2001\)](#), we also quantified the contribution of several worker, firm, and match characteristics to the excess worker turnover at the firm level. The results revealed that fixed-term contracts are positively associated with excess worker turnover. The substitution effect suggested in the quasi-experimental setting was confirmed in this analysis; a larger share of fixed-term contracts crowded-out turnover among open-ended contracts, and directed it towards fixed-term contracts.

Overall, our analysis contributes to the growing literature on two-tier labor markets ([Boeri 2010](#)), providing causal evidence of the role played by the interplay between open-ended and flexible contracts on the ability of firms to achieve a desired level of excess worker turnover.

2 Two-tier labor market: Reform and theory

Portugal's labor market is an extreme case of a two-tier system. In this section, we provide an overview of its characteristics, along with a description of a reform that provides a quasi-experimental setting to analyze the impact of an increase in the protection gap between open-ended and fixed-term contracts. We describe theoretical models that may help us understand the functioning of two-tier labor markets.

2.1 The 2004 reform: more employment protection for open-ended contracts

The Portuguese labor market evolved to a two-tier system in which different types of contracts are offered concurrently: fixed-term and open-ended contracts. According to the OECD employment protection legislation indicator, Portugal has one of the largest protection gaps between these two type of contracts. Furthermore, there is a widespread usage of fixed-term contracts – in 2002, they represented almost 20% of total salaried employment, increasing to more than 27% in 2008. These features make of Portugal one of the most extreme cases of two-tier systems in Europe, well suited to analyze and quantify the relationship between excess worker turnover and the employment protection gap.

Fixed-term contracts were first introduced in 1976 and revised several times since. They are a legal instrument for all levels of qualifications and most tasks. The severance payment of open-ended contracts is slightly larger than for fixed-term contracts.¹ But the largest difference between the two contracts resides in the procedural costs to terminate a match. These are absent at the expiration of fixed-term contracts, but are rather significant for permanent positions. In 2003, the reform of the labor code increased even further these procedural costs for a subset of firms (*Decreto-Lei 99/2003*).

Beginning in 2004, to justify a fair dismissal, firms with 11 to 20 workers are obliged to a written procedure involving the workers council and, if the worker is an union delegate, the union itself. Then, the worker has 10 business days to reply to the firm's notification and may require further diligences, including interviewing witnesses indicated by the worker.

¹At the expiration of a fixed-term contract, 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.

The firm may dismiss these requests, but must provide written justification. Upon these diligences, the firm reaches a final decision and communicates it to the workers council (and union). Altogether, these procedures extend the process substantially (typically 2 months), involves legal counselors and administrative costs. To some extent this reform undid the 1989 reform analyzed in [Martins \(2009\)](#).

Before the reform, these firms did not have to comply with these additional procedures, benefiting from a simpler and less costly process to dismiss workers. After the reform, all firms with more than 10 workers share the same procedural costs and the less costly procedures are available only for firms with 10 or less workers. This generated a quasi-experiment where the protection gap between open-ended and fixed-term contracts widened for a subset of firms, but remained the same for other firms.

We explore this quasi-experiment to obtain causal evidence of the impact of employment protection legislation on the composition of employment and the level of excess worker turnover. Firms with 11 to 20 workers constitute the *treatment group*; those not affected by the reform, firms with 21 to 100 workers constitute the *control group*. The restriction in the maximum size of firms in the control group, follows among others [Kugler and Pica \(2008\)](#) and [Martins \(2009\)](#). We test extensively the sensitivity of our results to the specific choice of the treatment and control groups.

2.2 The theoretical 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 where the match is an “experience good”; as in [Jovanovic \(1979\)](#), the only way to determine its quality is to form the match and “experience it”. As the firm and the worker learn about the match quality, they assess the costs and benefits of changing labor market partner. 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 the 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 perception in several developed countries of a strong protection of open-ended contracts 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 open-ended contracts, which generated two-tier systems and affected the level and composition of job and worker flows.

The theoretical analysis of two-tier systems goes back to the work of [Abowd et al. \(1999\)](#), who in turn extend 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 fixed-term appointments required to generate a productive job is uncertain. It may involve the hiring and separation from several workers before a permanent vacancy is filled. However optimal, this chain of matches generates excess worker turnover at the firm level.

A similar approach is followed by [Boeri \(2010\)](#). As in [Abowd et al. \(1999\)](#), all entry-level jobs are fixed-term contracts and the rate of conversion into open-ended contracts depends on the protection gap between the two contract types. [Boeri \(2010\)](#) finds that an increase in the employment protection for incumbents (under open-ended contracts) decreases the conversion of temporary jobs into permanent ones. This implies an increase in the share of fixed-term contracts for entry-level jobs and in their turnover rates. This increase in the protection gap will also imply a reduction in the job loss rate of open-ended contracts, but will have an ambiguous impact on their excess worker turnover, as accessions into permanent jobs are also reduced. More recently, [Bentolila, Cahuc, Dolado and Le Barbanchon \(2010\)](#) present a related approach and study the French and Spanish labor markets. They 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 change in excess worker turnover for each type of contract in response to an

increase in the employment protection of open-ended contracts rests on the assumption of substitutability between them. If they are poor substitutes, then excess worker turnover of fixed-term contracts may not change. Note that the models above assume that the two types of contracts are perfect substitutes in production.

In the context of the quasi-experiment, these models provide a guide to interpret the causal relationships between excess worker turnover and the employment protection gap. The key issue in two-tier labor markets in which different contracts are offered concurrently (and are perfect substitutes) is not the optimal level of excess worker turnover at the firm level, but the role played by each type of contract in the ability of firms to reach their desired level of workers rotation. Our paper quantifies how much the share of fixed-term contracts contributes 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.

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 follow [Abowd et al. \(1999\)](#) and explore possible sources of heterogeneity at the firm level arising from differences in size and type of employment growth.

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% 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 because information on the type of contract is available only since 2002.

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,

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

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

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

The rate of net employment change (NEC) is equal to the difference between the hiring and separation rates, $NEC_t = HR_t - SR_t$. The rate of excess worker turnover is given by $EWT_t = HR_t + SR_t - |NEC_t|$. In the literature this concept is also known as churning (Burgess, Lane and Stevens 2000).

Excess worker turnover is the key concept in this study. Intuitively, it corresponds to worker flows in excess of those strictly necessary to achieve a given level 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.

We apply these conventional definitions to the groups of workers defined by contract type. We considered as separations from open-ended contracts all workers who had an open-ended contract in $t - 1$, but are no longer with the firm in year t ; similarly, hirings are defined as all workers with an open-ended contract in t who were not in the firm in year $t - 1$. The rate of excess worker turnover for open-ended contracts is obtained by dividing these flows by the average number of open-ended contracts in the firm in the two periods.

The same computation is made with respect to fixed-term contracts. One note must be made, however, since some fixed-term contracts may be converted into open-ended contracts. We do not consider these conversions neither as separations from fixed-term contracts, nor as hirings into open-ended contracts. Thus, hirings and separations imply always a flow in or out of the firm, respectively.

Note that total excess worker turnover is not equal to the sum of excess worker turnover by contract type. A simple example makes this point clear. Consider a firm with 50 workers that decides to replace 10 open-ended jobs with 10 workers under fixed-term contracts. This will generate excess worker turnover because the firm engages in hirings

and separations simultaneously. In particular, it results in an excess turnover rate of 0.4. However, for each type of contract the turnover is zero. This results from the fact that the increase in level of fixed-term contracts equals the number of hirings and the reduction in open-ended contracts equals the number of separations.

3.3 Aggregate flows

Table 1 shows the rates of job creation and destruction, as well as the rates of hirings 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% and the destruction rate is 11.9%. 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%, on average).

[TABLE 1 (see page 25)]

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 hiring 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

²The 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

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% 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 and in both data frequencies. 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 \(2010\)](#) for a large number of OECD countries, using comparable datasets.

Excess worker turnover and firm 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 consecutive periods. We consider three groups of firms: (i) with net job creation; (ii) with net job destruction; and (iii) with zero net job creation, which we refer to as 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% of total employment. The remaining 17% of salaried workers are in firms that did not change their employment level.

[[TABLE 2](#) (see [page 25](#))]

There is a symmetric behavior of expanding and contracting firms, revealed by their different intensities of hirings and separations. Firms with expanding employment created, on average, 20.6 jobs per 100 workers. This expansion of employment is supported on the hiring of 36.4 workers and the separation from 15.8 workers (columns (1) and (2), bottom). As a result, the excess worker turnover in expanding firms is 31.5% (column (3)). The behavior of contracting firms is symmetric (columns (4)-(6)). To reduce their employment

(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.

level by 18.8 workers, they separate from 30.7 and hire 11.8 workers; the excess worker turnover rate is close to 24%. These results are in line with the ones obtained for a census of Maryland firms by [Burgess et al. \(2001\)](#).³

One interesting result is obtained for firms that have stable employment (columns (7)-(9)). 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% of their workforce each year. Firms with stable employment level are not lethargic.

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. We highlight three key facts from [Table 2](#).

First, for expanding firms separation rates increase monotonically with firm size (column (2)), decreasing monotonically for contracting firms (column (5)), while hiring rates have a less monotonic behavior (columns (1) and (4)). Secondly, regardless of the firm size, the hiring rates of firms in expansion are always clearly above the hiring rates of firms in contraction (columns (1) and (4)). 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, columns (2) and (5)). This implies that large firms shrinking their employment level rely on a reduction in entry and not on an increase in separations. This result is consistent with the behavior reported in [Abowd et al. \(1999\)](#) in their sample of French firms with 50 or more workers. Finally, excess worker turnover (columns (3), (6), and (9)) increases with firm size (except for stable firms). A good property for the firm size range used in the quasi-experiment (10-100 workers) is that among these firms excess turnover is similar. Choosing smaller or larger firms would result in less homogeneous groups; smaller firms (< 10 workers) have lower turnover and larger firms (> 100 workers) clearly higher churning.

³A 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.

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 3 presents the share of workers that preserve the 2002 match in the following years (from 2003 up to 2008), regardless of the number of years of tenure.⁴ The results show that there is a stable core of employment in Portuguese firms – around 40% 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% 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% were still on a fixed-term contract (column 2) and 14% had been converted to an open-ended contract (column 3). In 2006, only one quarter were still in the same firm, the majority with a permanent job, 19%, but 6% remained under a fixed-term contract.

[TABLE 3 (see page 26)]

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 4. The share of fixed-term contracts is larger in firms increasing employment (28.9% of employment) than in firms decreasing employment (20.5% of employment). However, fixed-term contracts are the most important port of entry into these two types of firms; 54% of all accessions in expanding firms and 53% for firms reducing their employment level. Around 40% of all exits come from separation of workers under fixed-term contracts; this share is larger for expanding firms, around 47%, than for shrinking firms, where only 37% of all

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

exits are from workers under fixed-term contracts.

[TABLE 4 (see page 26)]

Table 4 also shows that expanding firms rely more on hirings under fixed-term contract to expand their operations. Of a net growth rate of 21.5%, 12.7 percentage points correspond to hirings on fixed-term contracts (60% of net employment gains). Conversely, contracting firms separate from a much larger share of permanent workers. Almost three quarters of the net employment losses of 18.1% result from a reduction in the level of permanent positions (13.1 percentage points).

5 Quasi-experimental evidence

In this section, we take advantage of the legislative reform described in Section 2.1 to gather quasi-experimental evidence. The increase in the degree of employment protection that affected open-ended contracts in a subset of firms is explored to capture the differentiated impact on excess worker turnover by type of contract – open-ended and fixed-term, as well as on the share of fixed-term contracts.

Due to the focus on the relationship between worker turnover and the type of labor contracts, the analysis carried out is based exclusively on *Quadros de Pessoal*, which is the only database with information on the type of contract. The comprehensive nature of the data, covering more than 2 million salaried workers in over 300 thousand firms each year, works to our advantage in identifying the impact of the reform.

Recall that the reform increased the legal requirements needed to justify a fair dismissal for open-ended contracts and applied only to firms with 11 to 20 workers; similar requirements were already in place in 2004 for firms with more than 20 workers. Therefore, these larger firms were not affected by this new legislation. Each period, we consider as treatment units the firms with 11 to 20 workers and as control units firms with 21 to 100 workers. Later, we assess the sensitivity of the results to changes in the definition of the treatment and control groups.

Table 5 presents summary statistics for the sample of treatment and control firms, a total of 45,876 firms, resulting in an unbalanced panel with 181,131 observations (year \times

firm pairs). These firms employed each year an average of 610 thousand workers. In the before period, which corresponds to 2003, there were 14,170 treatment observations and 11,877 control observations. In the after period, 2004 to 2008, there were 81,439 treatment observations and 73,645 control observations. The average share of fixed-term contracts was 28.2%. Firms churned, on average, 24.6% of their workforce in annual terms. The churning of fixed-term workers was 34.7%, clearly larger than the churning of workers on open-ended contracts, 12.4%.

[TABLE 5 (see page 27)]

5.1 Difference-in-differences: More stringent employment protection

We identify the causal average treatment effect on the treated based on a standard difference-in-differences model:

$$y_{it} = \psi_1 Treat_{it} + \psi_2 After_{it} + \psi_3 After_{it} \times Treat_{it} + X_{it}\beta + \varepsilon_{it}, \quad (1)$$

where y_{it} is either the share of fixed-term contracts or the level of excess worker turnover in firm i in period t . $After_{it}$ is a dummy variable for the period after 2003. The treatment indicator, $Treat_{it}$, is defined for each period t , and equals 1 for the treatment group and 0 for the control group. Consequently, the interaction term, $After_{it} \times Treat_{it}$, identifies the impact of the policy change. 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 are included in X_{it} ; a comprehensive list of the variables used is presented in the note to Table 6. We opt to estimate this equation with the fixed-effects estimator, for which it is assumed that the error term $\varepsilon_{it} = \alpha_i + u_{it}$, where the unobserved component α_i is orthogonal to X_{it} and u_{it} is the idiosyncratic error.

[TABLE 6 (see page 28)]

We start by studying the impact that a more stringent employment protection legislation had on the share of fixed-term contracts. Churning is a natural process that involves simultaneous hirings and separations, which are more costly for workers in open-ended

contracts. Faced with an increase in the firing costs of these contracts, firms may have opted for increasing the share of fixed-term contracts. We test this hypothesis in the quasi-experimental setting, expecting ψ_3 to be positive. Column (1) of Table 6 reports the average treatment effect on the share of fixed-term contracts for the treated firms. The new legislation caused treated firms to increase by 1.6 percentage points their usage of fixed-term contracts.

In the mind of the legislator may have only been the intention of reducing churning by making it more expensive to justify fair dismissals. We have, however, seen that firms switched towards fixed-term contracts. But did they also used this type of contract to churn workers? In columns (2) and (3), we test how the new legislation affected the rate of excess worker turnover by type of contract. Churning among workers on fixed-term contracts in treated firms increased 1.3 percentage points, while no significant impact is observed among open-ended contracts (if anything, a reduction). These results are aligned with the models' predictions and corroborate the shift towards an extended usage of fixed-term contracts and suggest that there is a strong substitution between the two type of workers. This substitutability is in line with the results found in [Cappellari et al. \(2011\)](#) for Italian firms, providing additional support for such assumption in the model of [Boeri \(2010\)](#).

Finally, in column (4), we report the results of the difference-in-differences estimation for total excess worker turnover. The estimate indicates that the more stringent dismissals regulation did not change the level of excess worker turnover for treated firms. Although [Martins \(2009\)](#) did not study turnover, he also did not find any impact on total job and worker flows of a reduction in employment protection for Portuguese firms.

5.2 Robustness exercises

The definition of treatment and control units based on the size of the firm opens the possibility for firms to self-select into the treatment and control groups in response to the policy. The use of the fixed effects estimator should go a long way to obviate issues of endogeneity in the regressors ([Lee 2005](#)). Nonetheless, in columns (1)-(6) of Table 7, we redefine the treatment and control groups following, among others, [Kugler and Pica \(2008\)](#) and [Martins \(2009\)](#). First, we set the treatment status in the before period and

keep it unchanged in the after period, even if firms changed size (columns (1)-(3)). Second, we consider only firms that never changed status during the entire observation window (columns (4)-(6)).

[TABLE 7 (see page 29)]

Both definitions are fraught with shortcomings arising from the fact that they are selected samples of the targeted population. However, our point estimates of the causal effect are robust to these new definitions. In the case of the impact on the share of fixed-term contracts, the new estimates suggest a slightly larger impact with a treatment effect on the treated of around 2 percentage points (columns (1) and (4)), which compare with the previous point estimate of 1.6 percentage points. In terms of excess worker turnover, we still obtain only significant impacts on the turnover of fixed-term contracts. In column (2), where the treatment status is set in the before period, the point estimate is the same as initially, 1.3 percentage points. In column (5), for the sample with firms that have the same treatment status in the entire period, the impact stands at 2.1 percentage points.

An additional concern arises from the behavior of firms close to the size thresholds, as they may strategically choose a smaller size to minimize procedural firing costs. To address this issue, we remove from the data firms clustered around each period's threshold (columns (7)-(9)). In particular, in the before period, with a 20-worker threshold, firms with 18-25 workers are not considered and, in the after period, with a 10-worker threshold, firms with 11 or 12 workers are excluded. Again, all point estimates are in the range reported hitherto. Fixed-term contracts were more used, 1.8 percentage points, churning of fixed-term contracts increased 1.3 percentage points, and there is no treatment impact on the turnover of open-ended contracts.

Finally, in columns (10)-(12), we recover the original definition of the treatment group and extended the control group by including firms with 5 to 10 workers. Qualitatively the results are the same: increases in the share of fixed-term contracts and in the rate of excess turnover among such contracts and a reduction in the turnover of open-ended contracts. Quantitatively, we have a lower impact on the share of fixed-term contracts, 0.6 percentage points, a similar increase in fixed-term contracts churning, 1.2 percentage points, but we now have a statistically significant reduction in the churning of open-ended

contracts, -0.5 percentage points.

Taken together, these results allow us to draw some conclusions on the nature of the Portuguese two-tier labor market. Increasing the firing costs of open-ended contracts caused firms to optimally increase the share of workers on fixed-term contracts (0.6 to 2.1 percentage points); firms re-optimized their personnel policies against future dismissal costs due to the shielded nature of incumbents under open-ended contracts. We also saw an increase in churning among fixed-term contracts (1.2 to 2.1 percentage points), while the additional protection shielded open-ended contracts from churning (negative, but non-significant). The distinct impacts on the two types of contracts is suggestive of a strong substitutability among workers under different contracts. Increasing the protection gap between contract types in a two-tier system caused, as predicted theoretically, an increase in the adjustment burden shared by those on the more flexible contracts.

5.3 Falsification

The difference-in-differences exercise has shown a strong resilience to the definition of the treatment and control firms. Nonetheless, we test the robustness of the results by considering a simple falsification exercise.

We construct a placebo treatment group with firms sized 1 to 4 workers, which were not used in the estimation process and use as control group firms with 5 to 10 workers. All these firms were not affected by the new legislation. In a falsification exercise, there should be no difference in outcomes attributable to the treatment. The results in columns (13) to (15) of Table 7 confirm this; the coefficients on the *After* \times *Treat* variable are all statistically non-significant. Overall, the falsification exercise increase the confidence in the identification of the treatment effect.

6 Regression analysis

We have already presented the main characteristics of the Portuguese labor market flows and causal evidence on the relationship between firing costs of open-ended contracts in a two-tier system and the level of excess worker turnover. Now, we quantify the relationship between the rate of excess worker turnover and a set of covariates capturing firm, match,

and worker characteristics. This type of quantification is still missing by large in the literature. Therefore, it shall contribute to a better understanding of worker turnover in view of particular labor market characteristics. We will explore the panel of firms with 5 or more workers and estimate firm fixed-effects models (Table 8).⁵

[TABLE 8 (see page 30)]

In the dichotomy of two-tier labor markets, with a high substitutability between contract types, the most interesting association is the one established between (the share of) fixed-term contracts and the level of excess worker turnover. Our regression setup shows that fixed-term contracts have distinct impacts on the rates of excess worker turnover computed by contract type. While an increase of 10 percentage points (about one-third standard deviation) in fixed-term contracts is associated with an increase of 2.69 percentage points in the turnover of workers on fixed-term contracts, the same increase in the share of fixed-term contracts leads to a decrease of 1.89 percentage points in the turnover of workers on open-ended contracts. Again, we observe a substitutability of the two type of workers, which we had already hinted at in the quasi-experimental setting. Although the parts do not add up to the whole, in column (3), we see that more workers on fixed-term contracts result in higher levels of overall excess worker turnover. An increase of 10 percentage points in the share of fixed-term contracts is associated with a short-term increase in excess worker turnover of 0.72 percentage points. It may be hard to access the magnitude of this impact by itself, but the impact of other covariates on the level of turnover may help us grasp how significant this impact is.

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). Among Portuguese firms, those with higher average wages have lower turnover. For instance, with everything else the same, a firm with average wages 10 percentage points

⁵In the panel, around one third of the observations (pairs year×firm) have zero excess worker turnover. From an econometric point of view, this mass point might be more appropriately addressed with tobit models. In a previous version of the paper, we also estimated tobit models. The need to retrieve the marginal effect on the expected value of the observed variable (as opposed to the latent variable) requires a parametric estimation method. Unfortunately, no such method is available for fixed-effects, only random-effects; the fixed effects estimator developed in Honoré (1993) is fully non-parametric, limiting its usefulness in our setting. However, because there are no substantive quantitative differences between the random-effects tobit model and the standard linear fixed-effects, we will follow the literature (Burgess et al. 2001) and stick with the latter, which has better properties to handle obvious concerns with the endogeneity of some of the regressors.

higher (about a quarter standard deviation) will have a level of total turnover 0.7 percentage points lower; a comparable magnitude in total excess turnover to decreasing by 10 percentage points the share of fixed-term contracts. Higher wages are more important to contain excess turnover among workers on fixed-term contracts than on open-ended contracts (columns (1) and (2)).

Following a similar rationale, if tasks associated with blue-collar matches require less-specific human capital or are more substitutable, one could expect a higher prevalence of such matches to be associated with higher churning. This hypothesis is confirmed in the data. An increase in the proportion of blue-collar matches results in slightly higher turnover, but not for open-ended contracts. The share of high-schoolers and the share of workers with 9 or less years of schooling affect almost identically the level of worker turnover. However, a higher share of college graduates is associated with higher levels of excess worker turnover.

While both females and immigrants tend to be associated with measures of discrimination, which could be reflected in higher rates of excess turnover, in our data, we do not find significant evidence of such an association. A higher share of female workers results in lower turnover. A higher share of foreigner workers reduces excess turnover among open-ended contracts, but increases among fixed-term contracts.

Two key characteristics of firms are highly correlated with the magnitude of job and worker flows: size and age (Haltiwanger, Jarmin and Miranda 2010). In terms of size, larger firms are the ones that “experiment” workers the most. Even though they do not exhibit high rates of expansion or contraction (Table 2), which could be attributed to the fact that they are closer to their steady state, these firms engage in more excess worker turnover than smaller firms.

In terms of firm age, there is a dichotomy of excess turnover by contract type. Turnover among fixed-term contracts seems to occur regardless of the firm age; none of the age dummy coefficients is statistically significant. However, that is not the case for open-ended contracts. In this case, turnover is the highest for 2-year-old firms, decreasing monotonically until age 6 and remains stable onwards. Overall, firm age is associated with higher turnover for firms aged 4 or less years.

Employment growth – expansion, contraction, or stability – may also influence 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 at the bottom of Table 8 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, but not for open-ended contracts. This suggests that a substantial part of the trial and error in expansion periods requires replacing a large fraction of open-ended contracts.

Overall, the associations of firm, worker, and match characteristics with total excess worker turnover are in line with results in the empirical job search literature (Topel and Ward 1992, Burgess et al. 2001, Haltiwanger et al. 2010). Our results on the excess turnover by contract type showed interesting differences, which adhere to theoretical explanations, but that were not yet explored in the empirical literature of worker flows.

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. 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 studied in greater detail the determinants of excess worker turnover.

We tested the predictions of the models in a quasi-experimental setting. We showed

that a more stringent protection of workers on open-ended contracts caused an increase in the reliance on fixed-term contracts by treated firms to achieve their desired level of worker turnover. In this context, we also showed that the same reform caused an increase in churning among workers on fixed-term contracts. Both results pointed to the substitutability of workers on the two type of contracts and the increased burden of adjustment placed on the more flexible contracts.

The political economy debate on the reduction of the employment protection gap through the creation of a unique contract, as discussed in [Blanchard and Tirole \(2008\)](#), 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 showed that the virtue of the unique contract would be to spread more uniformly the adjustment costs across all workers, without hindering the formation of long-term employment relationships

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Tables

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

	Job Creation (1)	Hiring (2)	Job Destruction (3)	Separation (4)	Hiring/ JC (5)	Separation/ JD (6)
	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 firm size, 2001-2009

Firm size	Net job creation			Firms with Net job destruction			Stable employment		
	Hiring (1)	Separation (2)	Turnover (3)	Hiring (4)	Separation (5)	Turnover (6)	Hiring (7)	Separation (8)	Turnover (9)
[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	15.8	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 3: Duration of matches by contract type

	Probability holding the	Fixed-term contract in 2002	
	same job as 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 4: Average worker flows by contract type, 2002-2008

	Net job creation	Firms with	
		Net job destruction	Stable employment
	(1)	(2)	(3)
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
Net growth rate	21.5	-18.1	0.0
Contribution by			
open-ended	8.8	-13.1	-1.1
fixed-term	12.7	-5.0	1.1
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 5: Summary statistics: Firm-level data, 2003-2008

Variable (firm level)	Mean	Std. Deviation
Fixed-term contracts per firm (in %)	28.2	27.93
Total excess worker turnover (in %)	24.6	25.71
Excess worker turnover by contract type:		
Fixed-term contract	34.7	36.89
Open-ended contract	12.4	19.75
(Log) base wage	6.39	0.38
Blue-collar workers (in %)	36.3	25.19
Educational level, percentage of workers with:		
9 or less years	69.9	27.31
10-12 years	19.7	18.97
College	10.4	16.56
Females (in %)	42.7	32.67
Immigrants (in %)	5.6	13.23
Firm size (average number of workers)	27.1	18.86
Firm age (in years)	21.2	25.47
Workforce average age (in years)	37.7	5.28
Workforce average tenure (in months)	79.8	57.08
Worker-firm matches (2003-2008)	4 903 529	
Number of firms	45 876	
Number of observations (firm \times year)		
Before		
Treatment	14 170	
Control	11 877	
After		
Treatment	81 439	
Control	73 645	
Total	181 131	

Notes: Quadros de Pessoal, firm-level values 2003-2008. The “before” periods corresponds to 2003 and the “after” period to 2004-2008. Each period, a treatment firm has 11 to 20 workers and a control firm has 21 to 100 workers.

Table 6: Quasi-experimental evidence: Difference-in-Differences

Treatment units Control units Dependent variable	Difference-in-Differences			
	T:[11, 20] C:[21, 100]			
	SFTC	EFTC	EOEC	EWT
	(1)	(2)	(3)	(4)
After	0.445	-1.213	-1.422	-0.622
	(0.139)	(0.444)	(0.190)	(0.211)
Treat	-1.180	-0.710	0.309	0.153
	(0.232)	(0.800)	(0.319)	(0.353)
After × Treat	1.629	1.306	-0.105	0.292
	(0.182)	(0.649)	(0.250)	(0.277)
Control variables	– Yes. See notes –			
Average of dependent variable	28.2	34.7	12.4	24.6
Number of firms	45 876	34 049	43 708	45 876
Number of observations				
Before				
Treatment	14 170	6 030	13 396	14 170
Control	11 877	7 138	11 236	11 877
After				
Treatment	81 439	41 871	76 779	81 439
Control	73 645	52 729	69 844	73 645
Total	181 131	107 768	171 255	181 131

Notes: Standard errors in parentheses from firm fixed-effects estimates. SFTC stands for the share of fixed-term contracts (in %); EFTC stands for excess worker turnover among fixed-term contracts (in %); EOEC stands for excess worker turnover among open-ended contracts (in %); and EWT stands for excess worker turnover (in %) among all workers. The “before” periods corresponds to 2003 and the “after” period to 2004-2008. Each period, a treatment firm has 11 to 20 workers and a control firm has 21 to 100 workers. The control variables included in the regressions are: (i) Log base wage; (ii) Blue-collar workers (in %); (iii) Educational level, percentage of workers with: 9 or less years or college (omitted 10-12 years); (iv) Females (in %); (v) Immigrants (in %) (vi); Log firm size (average number of workers); (vii) Firm age (in years) dummies: 2, 3, . . . , 10 years, 11-15 years, and 16-20 years (omitted 21 or more years); (viii) Workforce average age (in years) dummies: 15-30, 31-40, and 41-45 (omitted 46 or more years); (ix) Workforce average tenure (in months) dummies: 1-36, 37-60, and 61-120 (omitted 121 or more months); (x) Expanding and contracting employment dummies (omitted stable employment).

Table 7: Quasi-experimental evidence: Robustness exercises

Treatment assignment Treatment units Control units Dependent variable	Robustness: Treatment definition												Falsification		
	In 'before' period			Always the same			Period-by-period			Period-by-period			Period-by-period		
	SFTC (1)	EFTC (2)	EOEC (3)	SFTC (4)	EFTC (5)	EOEC (6)	SFTC (7)	EFTC (8)	EOEC (9)	SFTC (10)	EFTC (11)	EOEC (12)	SFTC (13)	EFTC (14)	EOEC (15)
After	0.305 (0.140)	-1.350 (0.440)	-1.371 (0.185)	0.057 (0.153)	-1.709 (0.483)	-1.412 (0.210)	0.507 (0.140)	-1.178 (0.446)	-1.394 (0.188)	1.252 (0.096)	-0.925 (0.357)	-1.084 (0.141)	1.200 (0.318)	-3.458 (1.454)	-0.703 (0.539)
Treat	.	.	.	.	.	.	-1.657 (0.254)	-1.344 (0.873)	0.147 (0.342)	-0.579 (0.204)	-0.308 (0.736)	0.842 (0.303)	2.303 (3.921)	-4.606 (18.090)	0.543 (7.552)
After × Treat	1.782 (0.178)	1.278 (0.620)	-0.173 (0.236)	2.083 (0.198)	2.145 (0.723)	-0.036 (0.272)	1.805 (0.202)	1.264 (0.724)	-0.052 (0.272)	0.592 (0.155)	1.159 (0.591)	-0.518 (0.227)	0.994 (4.635)	14.465 (21.515)	-3.350 (8.912)
Control variables															
Avg. dependent variable	25.6	31.2	12.3	28.8	35.5	12.3	25.6	33.6	11.8	27.1	34.0	12.0	28.269	11.235	26.300
Number of observations	157 446	90 436	151 452	142 636	84 519	135 325	153 662	95 179	145 438	300 576	149 522	283 098	28 269	11 235	26 300

– Yes. See Table 6 –

Notes: Standard errors in parentheses from firm fixed-effects estimates. SFTC stands for the share of fixed-term contracts (in %); EFTC and EOEC stand for excess worker turnover among workers on, respectively, fixed-term contracts and open-ended contracts (in %). In columns (1)-(3), the treatment and control status are defined in the before period and kept the same each year throughout the after period regardless of the firm size. In columns (4)-(6), consider only firms that never changed treatment status during the entire sampling period, i.e., it excludes movers by considering treatment firms that always had 11 to 20 workers and similarly control firms that always had 21 to 100 workers. Columns (7)-(9) present estimates for treatment firms with 11 to 20 workers and control firms with 5 to 10 workers or 21 to 100 workers; treatment status is defined each period. Finally, in columns (10)-(12), firms that clustered around the size thresholds are eliminated from the sample. In particular, in the before period, firms with 18 to 25 workers are excluded and, in the after period, firms with 11 or 12 workers are also excluded; treatment status is defined each period. See Table 6 for a list of all variables included in the regressions.

Table 8: Rates of excess worker turnover: Fixed effects estimation

Dependent variable	Fixed effects		
	EFTC (1)	EOEC (2)	EWT (3)
Fixed-term contracts (%)	0.269 (0.007)	-0.189 (0.003)	0.072 (0.003)
Average (log) base wage	-10.481 (1.126)	-1.988 (0.461)	-6.671 (0.506)
Blue collar (%)	0.056 (0.009)	0.003 (0.004)	0.012 (0.004)
Educational shares (%):			
9 or less years	0.035 (0.016)	0.004 (0.007)	0.019 (0.007)
College or more	0.152 (0.026)	0.051 (0.011)	0.081 (0.012)
Female (%)	-0.079 (0.019)	-0.024 (0.008)	-0.041 (0.008)
Immigrants (%)	0.046 (0.020)	-0.024 (0.010)	0.028 (0.010)
Firm size (log)	23.315 (1.640)	7.095 (0.722)	6.850 (0.789)
Firm size (log) squared	-1.566 (0.237)	-0.531 (0.114)	-0.053 (0.125)
Firm age (in years):			
2	2.094 (1.745)	3.353 (0.739)	2.617 (0.809)
3	1.719 (1.576)	2.281 (0.665)	3.165 (0.735)
4	-0.434 (1.482)	1.866 (0.628)	1.517 (0.696)
5	-0.832 (1.395)	1.140 (0.589)	0.204 (0.656)
6	-1.555 (1.307)	0.988 (0.551)	0.361 (0.615)
7	-1.828 (1.223)	0.708 (0.516)	0.413 (0.576)
8	-1.101 (1.146)	0.545 (0.483)	0.349 (0.540)
9	-0.875 (1.075)	0.171 (0.454)	0.280 (0.508)
10	-0.744 (1.012)	0.729 (0.428)	0.309 (0.480)
[11, 15]	-0.885 (0.789)	0.352 (0.328)	0.022 (0.369)
[16, 20]	-0.147 (0.548)	0.142 (0.225)	-0.017 (0.253)
Expansion period	-5.359 (0.257)	0.780 (0.103)	-1.081 (0.115)
Contraction period	-0.723 (0.260)	-0.224 (0.102)	-1.782 (0.115)
Other covariates	– Yes. See notes. –		
Average excess turnover	32.3	12.2	23.1
Number of firms	48 702	66 455	69 738
Number of observations	162 767	297 346	315 104
Fraction of unobserved variance	0.46	0.44	0.51

Notes: *Quadros de Pessoal*, 2003-2008. Standard errors in parentheses from firm fixed-effects estimates. EFTC stands for excess worker turnover among fixed-term contracts (in %); EOEC stands for excess worker turnover among open-ended contracts (in %); and EWT stands for excess worker turnover (in %) among all workers. The regression models controlled additionally for: (i) Workforce average age (in years) dummies: 15-30, 31-40, and 41-45 (omitted 46 or more years); (ii) Workforce average tenure (in months) dummies: 1-36, 37-60, and 61-120 (omitted 121 or more months); and (iii) Year dummies, 2004-2008 (omitted 2003).