Employment Effects of Restricting Fixed-Term Contracts: Theory and Evidence

Preliminary draft*

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Abstract

This paper examines a labor law reform implemented in Portugal in 2009 which restricted the use of fixed-term contracts in establishments created by large firms above a specific size threshold, covering about 10% of total employment. Drawing on linked employer-employee longitudinal data and regression discontinuity methods, we find that, while the reform was successful in reducing the number of fixed-term jobs, it did not increase the number of permanent contracts and decreased employment in large firms. However, we find evidence of positive spillovers to small firms that may bias reduced form estimates. To evaluate general equilibrium effects, we build and estimate a directed search and matching model with endogenous number of establishments and jobs. We find spillover effects that induce small biases on reduced form estimates but that significantly change the evaluation of the overall impact of the reform because they diffuse to the whole economy. We estimate that the reform slightly reduced aggregate employment and had negative effects on the welfare of employees and unemployed workers.

Keywords: Directed search and matching, labor market segmentation, Regression discontinuity.

JEL Codes: J23, J41, J63.

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1 Introduction

High levels of unemployment and of protection of open-ended contracts in many European countries led to a number of reforms since the 1970s that sought to promote hiring in fixed-term contracts and other types of atypical work. However, these reforms left open-ended (or permanent) contracts largely unchanged, namely in terms of their legal protection against dismissals. This approach may have contributed towards segmented or two-tiered labor markets. In these cases, workers can experience limited mobility between contract types and be subject to significant churning across multiple fixed-term contracts (FTCs henceforth). In the end, the resulting labor market institutional framework may be characterised by suboptimal outcomes both from efficiency and equity points of view.

More recently, at least until the on-going Covid-19 recession, several governments have tried to roll back some of the reforms above with a view to reducing labor market segmentation. Specifically, FTCs or similar atypical contracts have been subject to a number of restrictions. These reforms sought to push firms towards hiring under permanent appointments workers that otherwise would have been hired under FTCs.

In this paper we investigate the merits of this policy approach. Specifically, we ask to what extent measures to address the negative effects of labor market segmentation should be based on reverting some of the reforms at the margin mentioned above. In the same way that segmentation increased following the opening up of FTCs, can segmentation be reduced by introducing restrictions on FTCs? More specifically, we focus on the potential effects of such FTC restrictions in terms of (overall) employment: is it that removing the FTC channel will lead to a direct and proportional change in employment contracts types or will such policy measure have effects on total employment levels as well?

Our empirical evidence is based on the evaluation of a labor law reform implemented in Portugal, a country where FTCs represent over one fifth of all employment relationships, the third largest percentage in the Europe. This large share of FTCs can be explained, at least in part, by the very stringent employment protection law applicable to permanent contracts. These restrictions involve not only expensive severance pay (in a context of largely binding statutory and collective bargaining minimum wages); the restrictions also involve a complex legal procedure in the case of dismissals for subjective reasons (related to the performance of the worker) and potentially very costly reinstatement requirements (where salaries must be paid by the firm for at least part of the period during which the court trial took place) or out-of-court settlements.

The reform we examine, implemented in 2009, sought to increase the hiring of workers under permanent contracts by reducing the range of circumstances when FTCs could be used by firms. The

reform targeted large firms (defined in the context of the reform as those that employed at least 750 workers). Unlike in the case of firms that employed fewer than 750 workers (including new firms), whose legal context regarding FTCs remained unchanged, the reform reduced significantly the scope for large firms to hire workers for their new establishments using FTCs.[1]

Drawing on linked employer-employee longitudinal data (including information on establishments and contract types) and regression discontinuity (Hahn et al. 2001) evaluation methods, we examine the causal effects of the reform in terms of different outcomes of interest. These outcomes are the number of new establishments launched by firms of different sizes and also the jobs created by firms in FTCs and in permanent contracts.

We find that the reform was successful in reducing the number of FTCs in the new establishments of large firms. However, this was partly because the number of new establishments also declined in large firms, which can be regarded as a negative effect of the reform on 'intrapreneurship'. Moreover, the number of permanent contracts in new establishments (again, in large firms) did not increase and, in some specifications, even decreased. When considering both FTC and permanent contracts together, we find that they declined significantly. These results indicate that the FTC restrictions did not encourage large firms to hire under permanent contracts instead. These results therefore indicate that there is a limited degree of substitutability between FTCs and permanent contracts. Some jobs that may be created under FTCs will not necessarily emerge if the FTC legal framework is not available, at least when the alternative involving permanent contracts may have undesirable properties from the perspective of firms.

However, we find evidence of spillovers to small firms, which were not directly targeted by the reform: we find that small firms more exposed to large firms (because of their geographical and or sectoral location) tend to benefit more from the reduced hiring of FTCs of the latter, as such small firms end up hiring more workers. If these small firms are generally less productive, the reform will have led to a form of worker downgrading opposite to that found in Dustmann et al. (2021) in the context of a different type of labour market reform.

In order to analyze these spillovers and their consequences, we build and estimate a directed search and matching model in which firms create establishments which hire temporary and permanent workers. To create establishments, firms look for production opportunities that arrive randomly. Small firms and large firms draw production opportunities in different distributions. Once establishments are created, firms hire workers either on temporary or on permanent contract, complying with the

[1] We discuss the law reform in more detail below. Large firms could still recruit under FTCs for new establishments but only long-term unemployed workers or individuals looking for their first jobs. Recently, in 2019, this aspect of the law was reformed again, with a further reduction of the size threshold, in this case from 750 to 250 employees, making the use of FTCs more restrictive. This recent change also highlights the policy relevance of this legal lever.

employment protection legislation. Permanent jobs destruction and conversion of temporary into permanent jobs are endogenous. The model shows that the reform induces large firms to raise the share of permanent contracts, which lowers job destruction. But the more stringent regulation reduces the creation of jobs and establishments by large firms. Small firms indirectly benefit from the reform: they create more jobs and more establishments. Beyond these qualitative results, the model is used to evaluate the bias in the reduced form estimates induced by the overlook of the general equilibrium effects. Compared to reduced form estimates of the impact of the reform on the employment of large firms, we find that equilibrium effects have a small impact on the firm-level employment of small firms. To the extent that reduced form estimates rely on the comparison of firm-level employment of small and large firms, this implies that the bias in the reduced form estimates of the impact of the reform on the employment of young establishments of large firms is small, at around 2%. However, since small firms account for 90% of total employment, their reaction has a strong effect on the changes in total employment induced by the reform: estimates of the impact of the reform on total employment which take into account the general equilibrium effects are about 13 times lower than those computed from reduced form estimates which assume that small firms are not impacted. Another interest of the structural model is to provide insights on welfare. We find that the restrictions on FTC creation are detrimental to the welfare of unemployed workers because they have fewer opportunities to find jobs when these restrictions are implemented. The drop in the welfare of unemployed workers reduces the outside option of all employees and consequently their welfare.

This paper contributes to two strands of the literature.

First, the literature on partial employment protection reforms (Booth et al. 2002, Blanchard & Landier 2002, Cahuc & Postel-Vinay 2002, Boeri & Garibaldi 2007, Boeri 2011, Bentolila et al. 2012, García-Pérez et al. 2018, Cahuc et al. 2016, Martins 2021*b*, Hijzen et al. 2017). We contribute to this literature by evaluating the impact of increases in the stringency of the regulation of temporary contracts targeted to large firms. This approach allows us to rely on a Regression Discontinuity Design to evaluate the direct impact of the reform on large firms and its spillover effects on other firms. In the process, we also shed light on the role of establishment creation in job and worker flows. Although theoretical models predict that employment protection has equilibrium effects, these effects have not been empirically evaluated, as far as we know. We do find that the reform had significant effects on firms whose regulation of temporary contracts remained unchanged. From a theoretical perspective, we elaborate and estimate a model with firms and establishments that comprises temporary and permanent jobs. This model is useful to evaluate the effects of employment protection legislation on temporary and permanent contracts that apply differently according to firm and/or establishment

size. Insofar as these features are found in the regulations of many countries (OECD 2020), this model can be used to analyze the consequences of many actual employment laws. From a methodological perspective, our results points to the importance of accounting for equilibrium effects to evaluate employment protection legislation, whether it applies to all firms or to a subset of firms. This means, in particular, that it is unlikely that reduced form estimates of the effects of employment protection legislation that rely on different groups of firms or workers and on SUTVA (Stable Unit Treatment Value Assumption) yield reliable evaluations.

Our analysis of equilibrium effects contributes to the literature that combines reduced form (experimental or quasi-experimental) and structural modeling approaches (see the recent survey of Todd & Wolpin (2021)). Most of this literature is focused on the analysis of selection problems in the program evaluation approach (Heckman 2010). We contribute to the analysis of spillover effects which is much less developed in this literature (Wise 1985, Wolpin & Todd 2006, Attanasio et al. 2012, Ferrall 2012, Galiani et al. 2015, Lise et al. 2015, Garicano et al. 2016, Gautier et al. 2018) and non-existent in the literature on employment protection legislation. We relate the outcomes of the structural model to the reduced form estimates to simulate the general equilibrium effects of the reform. We show that general equilibrium effects induce small biases in the estimates of the average effects of the reform on new establishments of large firms (the Average Treatment effects on Treated firms in the program evaluation approach terminology) because the reform has small spillover effects on the average outcomes of small firms in our context. However, as small firms are numerous and account for a large share of total employment, their reaction has a strong effect on the changes in overall employment induced by the reform. Hence, small spillover effects, induced by a small subset of the population, that may be very difficult to evaluate with reduced form strategies because they diffuse to the whole population, and thus may significantly change the overall impact of reforms. This conclusion, found in the context of employment protection legislation, is likely relevant in many other contexts (Cahuc & Le Barbanchon 2010) to the extent that economic analysis shows that equilibrium effects can diffuse to a large share of population even if they originate from a small subset of individuals.

The structure of the paper is as follows: Section 2 presents the FTC reform. Section 3 describes our data and their descriptive statistics. The main empirical results arising from regression discontinuity methods, as well as their robustness checks and the spillovers analysis, are presented in Section 4. Section 5 presents our structural model. Section 6 presents the calibration, the structural estimation of the model and the relations between the reduced form estimates and the simulation results of the structural model. Finally, Section 7 concludes.

2 The fixed-term contract reform

2.1 Institutional context

As in many other countries, FTCs in Portugal are subject to a number of restrictions in their use by firms. This is contrast to the supposedly general case of permanent (open-ended) employment contracts. Specifically, the Labor Code of Portugal (articles 140 and 148) indicates that FTCs can only be used to meet a 'temporary need' of the firm.[2] However, as we will discuss in more detail below, FTCs in Portugal can also be adopted by new firms or when a firm launches a new establishment, even if the need for such workers is permanent, i.e. if the jobs to be performed by such workers are expected to last for a long period. Furthermore, FTCs are subject to a maximum number of renewals (three) and a maximum duration of 36 months in total.[3]

Before the FTC reaches its maximum duration, the firm (and the worker) decide if the FTC is converted into a permanent contract or if the employment spell is to come to an end. Alternatively, if the maximum duration of the FTC is exceeded, then the contract is also legally converted to permanent, even if only implicitly.[4] When a conversion to permanent occurs, by decision of the parties or implicitly because of its duration or lack of suitable fixed-term motivation, the worker under a now permanent employment contract is automatically subject to much greater legal protection against individual dismissal. This increase in protection is driven by the judicial uncertainty involved in a termination and its cost implications if the worker challenges the dismissal in a court.[5] If the worker is successful, the firm may be obliged not only to reinstate the worker but also to pay her the salaries during at least part of the duration of the trial, which can last several months or even years.[6]

In striking contrast, a FTC involves little judicial uncertainty in terms of its termination costs. At worst, the employer will need to pay the salaries corresponding to the remainder of the duration of the contract of the worker or a percentage of that. The (judicial uncertainty) costs in the case of FTCs

[2] According to article 140, valid temporary needs in this context arise when the firm is replacing a worker that is temporarily absent, to conduct a seasonal activity, or to conduct an activity of a time-limited duration (including when the firm is facing a temporary and extraordinary peak in demand). Additionally, FTCs can also be used for 'employment policy reasons', namely when a firm hires a long-term unemployed individual or when the worker is searching for their first job, even if the firm's need is not necessarily of a temporary nature. FTCs can also only last for the period required to meet such specific temporary needs.

[3] The maximum total duration of FTCs in the case of motivations based on new firms or establishments is 18 months; in the case of the hiring of unemployed workers, the maximum duration is 24 months.

[4] One or both parties may not regard the contract as permanent, perhaps because they may not be aware of such provisions in employment law. However, the worker may involve the labor inspectorate or an employment tribunal to confirm the nature of the contract as permanent, if appropriate.

[5] For instance, if the court considers that the legal procedure established in the Labor Code for dismissals was not followed correctly by the firm or that the causes invoked by the firm for the dismissal are not sufficiently strong, then the court may rule the dismissal as void.

[6] Anecdotal evidence suggests that many trials are eventually settled out of court, in which case the firm pays the worker a multiple of the severance that would be due in the case of a lawful economic dismissal for economic reasons. During the period covered in our study, this type of severance corresponded to one month of salary per year of tenure, with a minimum of three monthly salaries.

come largely from the possibility that the worker challenges the nature of FTC in court, arguing that the FTC is in fact a permanent contract - perhaps because the employer's need underpinning the hire was not temporary or because the maximum legal duration was exceeded.

These large gaps in legal protection between FTCs and permanent contracts - and the resulting different costs for firms from choosing one or the other - apply in most countries but particularly so in Portugal, where individual dismissals of permanent contracts are the most restrictive across the OECD (OECD 2014). These circumstances - together with the relatively large size of seasonal or volatile sectors (such as tourism, construction and farming) and the low economic growth rates (or recessions) and resulting economic uncertainty over the last two decades - explain the very large percentage of workers under FTCs in Portugal (22%), the third largest in the European Union.[7]

2.2 The FTC reform

Given the large percentage of workers under FTCs in Portugal and the resulting concerns about labor market segmentation and its potential negative economic and social effects, the government decided to reform its FTC employment law regulations in 2009. Specifically, the government introduced a restriction on the range of cases under which firms could hire workers under FTCs. Law 7/2009, which was published and came into force in February 2009, established that the launching of new establishments could, from then on, only be invoked as a reason for hiring under FTCs for firms with fewer than 750 employees (article 140, number 4). This is in contrast with the previous version of that article, which was not subject to any restriction in terms of firm size or any other variable.[8]

In other words, up to February 2009, any firm that launched a new establishment (for instance a bank launching a new branch or a food retail chain launching a new restaurant) could hire workers for these establishments under FTCs simply invoking article 140 above. Moreover, from March 2009, firms with fewer than 750 employees could still do so, again simply invoking the same article. On the other hand, firms with 750 or more employees (which we refer to as 'larger firms') could still hire under FTCs, but no longer invoking that article. Larger firms could still hire under FTCs for their new establishments but only under the relatively narrow conditions which would qualify as 'temporary needs' and the particular case of hiring long-term unemployed workers (or workers searching for their first jobs). Note that most or all 'temporary needs' would not apply in the case of new establishments:

[7]From a flows perspective, these shares are even higher: of all the workers employed in October 2011 and hired in that year, 70% were employed under FTCs (own calculations, based on the 'Quadros de Pessoal' data described below). Moreover, over 40% of the registrations of newly-unemployed individuals with the public employment service in any month also arise from terminations (non renewals) of FTCs.

[8]See Martins (2009) for an evaluation of an employment law reform in 1989 that simplified dismissals for small firms and Martins (2021*b*) for an evaluation of an employment law reform in 2012 that extended the maximum duration of FTCs. Both evaluations use the same data set used in this paper.

for instance, firms would not be able to argue they would be hiring FTCs to replace sick workers or workers in maternity leave as new establishments, by definition, do not have any workers when they are launched; similarly, firms would not be able to argue they would be hiring FTCs to meet an exceptional increase in product demand. In summary, this reform sought to push firms to make greater use of permanent contracts by requiring larger firms to staff their new establishments mostly through permanent appointments when, before the reform, those firms could hire easily under FTCs.[9]

The labor reform of 2009 also introduced a number of other legal changes but none that had an impact at the same firm size threshold that we consider here or any other firm size threshold. One of the other legal changes involved a slight simplification of the judicial process when terminating permanent contracts, with the goal of promoting the hiring under permanent contracts.[10] Also note that a labor reform in 2019 changed again the firm size threshold examined in this study, lowering it from 750 to 250 employees. This more recent change highlights the perceived relevance and visibility of the original reform.

In the context of the impact evaluation literature, we regard firms that employ 750 or more workers before the reform as 'treated', as the conditions under which they could hire under FTCs in new establishments change (and, in particular, are made more restrictive). Firms with fewer than 750 workers are our 'control group' as the legal conditions under which FTCs could be hired are unchanged in their case.

3 Data and descriptive statistics

Our empirical analysis is based on the 'Quadros de Pessoal' data set. This is a comprehensive matched employer-employee panel, based on a compulsory annual survey, conducted by the Ministry of Employment, of all firms based in Portugal that employ at least one worker. The data covers all establishments and employees of each firm and includes time-invariant identifiers at the three levels (firms, establishments, and workers), thus allowing us to assign each worker to both her establishment and firm in each year. All worker information concerns the month of October of each year and includes variables such as gender, month and year of birth, schooling, occupation, salary, hours of work, etc. Critically for the purposes of our paper, 'Quadros de Pessoal' also includes information on the type of employment contract of each worker (namely permanent or FTC) as of October of each year and on the month

[9] Although theoretically possible, it is unlikely in practice that large firms would try to circumvent the reform by creating new, smaller firms that would be exempt from the novel restriction of new establishments. Such new firms would not be able to benefit from the advantages of the brand name of the older firm in terms of consumers' demand and workers' recruitment. There would also be additional costs in setting up the new firm and some uncertainty costs in case firm size (regarding the creation of new establishments) would still consider parent firm size.

[10] However, this change, which applied to firms of all sizes, was overruled in 2010 by the country's constitutional court.

and year when each employment contract started.[11]

Given the timing of the reform and the data available, we consider October 2008 as the main reference date for the purpose of establishing the type of firm in terms of its size (namely whether it is a large firm, with 750 or more employees, or not). For each firm, we identify its new establishments (those present in 2010 but not in 2008), as well as the workers employed in such new establishments.[12] We also compute the number of new hires in those new establishments by type of contract, permanent or FTC.[13] As the data is based on employment as of October of each year, we cannot consider shorter employment spells that started after October of one year and ended before October of the following year. However, for workers present in a given October (in particular in October 2010), we consider their months of employment in the firm, from the time span between appointment and October, the census month. Moreover, we also consider the number of hours worked per month by each worker to take into account possible part-time differences between contract types across firms. As mentioned above, it is important to take into account that a worker may be originally hired under a FTC but subsequently converted into a permanent contract: again, our measurement is based on the status of the worker as of October of 2010.[14]

Table 1 presents several descriptive statistics of the total of 2,875 firms that we consider in this study, those employing between 100 and 2,000 workers as of October 2008. We split this into the 150 of those employ 750 or more employees in 2008 (our treatment group), and the remaining 2,725 firms that employ between 749 or fewer employees at that time (our control group). We also consider the differences between the two groups in the last two columns. Panel A presents different characteristics of these two groups of firms before the law reform, in 2008. We find that larger firms have higher sales, higher capital equity, are more likely to be owned by foreign than domestic investors, and have more establishments. Larger firms tend to be younger but the difference is not statistically significant. The distributions of these firms across one-digit industries are also similar, except in two cases (both in the manufacturing sector). Their headquarters are more concentrated in the Lisbon region (and

[11] See Portugal & Varejao (2010), Centeno & Novo (2012), Damas de Matos & Parent (2016) and Silva et al. (2018) for previous studies using the FTC variable in QP. See also Martins (2021*a*) for an analysis of a different form of non-standard work, service providers, not available in QP.

[12] New establishments are defined as those firm/establishments identifiers that were not in operation as of October 2008 but are in operation as of October 2010. Legal experts consider that the definition of new establishments in this context is that of establishments that are not older than 24 months. New hires are defined as workers hired since March 2009, the first full month when the new law was in force, and employed in the new establishments.

[13] In some cases, some of the workers in a given new establishment in 2010 joined the firm before the establishment was created, as firms can reallocate experienced workers into new establishments. Those workers are excluded from our counts of new hires in new establishments as they are not subject to the provisions of the law reform.

[14] Workers are assigned to the contract type that they have at the end of the period, October 2010, which may not necessarily be the one that they have when they are first hired. In particular, some workers may be hired originally as fixed-term contracts and subsequently have their contract converted to permanent. However, the maximum duration of fixed-term contracts in Portugal over the period under analysis (and until very recently), including renewals, was of between 18 and 36 months, increasing to up to six years in particular cases.

less so in the Braga region). The percentage of FTC workers in the two groups of firms is also not statistically different.

In panel B of Table 1, we examine the four main outcome variables that we consider, namely the number of new establishments opened following the reform (in 2009 and 2010) and the number of new hires in such new establishments, depending on their type of employment contract. We find that, as could be expected from their size, larger firms open more new establishments in the post-reform period, an average of 7.8, compared to the case of smaller firms, which open an average of 1.8. When considering the contracts used to hire workers into these establishments, we find that permanent contracts are relatively much more widely adopted in the case of larger firms than in the case of smaller firms. In larger firms, permanent contracts in new establishments represent 41,300 worker-hours on average, while FTCs represent less than half, only 17,800.[15] In striking contrast, in smaller firms, permanent contracts in new establishments represent 5,400 worker-hours on average, while FTCs represent more, 6,900. The fact that fixed-term new hires exceed their permanent counterparts in smaller firms while they are less than half the permanent appointments in larger firms is consistent with a binding nature of the law reform, as the latter restricted FTCs in new establishments in larger firms alone.

Figure 1 presents the distribution of the size of the firms considered in our study, as measured by their numbers of employees in 2008. This variable establishes the assignment of firms into the control and treatment groups, given the size-dependent restriction introduced by the law reform. We observe as expected a decreasing number of firms as their size increases but no evidence of any relevance of the 750 threshold before the reform. Indeed, we could not find any other reference to this firm size threshold in the Labor Code or any other regulations in Portugal.[16]

Next, we examine the distribution of new establishments, created in 2009-2010 after the reform, across firm sizes, in particular between smaller and larger firms. Figure 2 presents this information using binned sample means according to Calonico et al. (2015).[17] When fitting separate polynomials at the left and right of the 750-employee threshold, we find evidence of a positive relationship between the size of the firm and the number of new establishments, but also of a drop in the expected value of new establishments at the firm size of the law reform. The latter result suggests that the reform may have had the unintended effect of reducing the creation of new establishments by larger firms. This

[15] As indicated above, we assume that the contract type that each worker exhibits in October 2010, when we compute these variables, is the same as the one used to hire that worker when they join the new establishment.

[16] The choice of this unusual threshold may have been driven by a 'social dialogue' process between the government and the social partners. Trade unions probably preferred a lower threshold, at 500, while employers may have pushed for a higher threshold, at 1000, and eventually the Government established a compromise at the average, 750.

[17] We also partial out one-digit industry effects, following the evidence above of some differences in the distribution of firms in some sectors, and winsorize the data at the 0.1% level.

may then have had a negative effect on the creation not only of FTCs (as desired by the government) but also regarding overall employment, of both FTCs and permanent contracts. We also find similar results when considering the total number of workers in 2010 in the new establishments - see Figure 3.

As to the employment effects of the reform, first we consider the case of FTCs. As indicated above, we compare the number of FTC new hires (weighted by their months with the firm and establishment and their hours worked) as of October 2010 across new establishments (those operating in 2010 but not in 2008, before the reform was introduced) of firms of different sizes. Again, we use binned sample means following Calonico et al. (2015). Firms that do not open new establishments are considered as well, with a value of new hires of zero. Our running variable (the total number of employees in each firm) is measured as of October 2008, before the reform, and covers the range 100-2000 (-650 to 1250 in its centered version, around 750, depicted in the Figure).[18] Figure 4 presents graphical evidence of an upward trend on the left-hand-side of the figure (allowing for a second-order polynomial), indicating that the number of new hires in new establishments tends to increase with firm size over that range. As in the previous case of the number of new establishments, we again find evidence that this present relationship is interrupted at the legal threshold: the average number of new FTC hires is reduced significantly for firms that employ 750 or more workers before the reform. This evidence again supports a negative effect of the law reform on the use of FTCs, as intended by the government and as suggested by our descriptive statistics.[19]

We now turn to a similar analysis, but considering only those new hires in new establishments under permanent contracts as of October 2010 (i.e., again new hires of new establishments between 2009 and 2010, in firms of different sizes as of October 2008). In contrast to the desired impact of the reform, but similarly to the case of FTCs, we obtain evidence - Figure 5 - of a negative effect on new permanent hires in larger firms between 2009 and 2010, even if of perhaps a more subdued size.

Finally, when considering the total (weighted) number of new hires in new establishments, regardless of their contract type, we again find evidence of negative effects on employment. Figure 6 presents the results, which indicate that, consistently with the cases of both FTCs and permanent new hires, the overall sum of these two types of contracts also declines at the firm size threshold at which the law reform imposed restrictions.

[18] As before, given the role of industry type in the relevance of multi-establishment firms, our graphical analysis also controls for one-digit industry fixed effects. We also implement a 0.1% winsorizing.

[19] Note that the results above hold even if the observation immediately to the left of the threshold already denotes a substantial drop in hirings. It may be possible that firms in this category have higher employment in the run up to the end of the year, between October and December, which would lead them to be assigned to out treatment group. In this case, the estimates from our econometric analysis may suffer from a downward bias (i.e., the true effects may be even more negative than our estimated effects).

In conclusion, the descriptive and graphical evidence presented here indicates that the law reform that sought to restrict FTCs was effective. However, the reduction in the number of FTCs does not appear to have led to a corresponding increase in the number of permanent contracts. If anything, the number of permanent contracts also dropped and certainly did not increase in such a way that would compensate the loss of FTCs. In the next section we test this result more formally using different econometric approaches.

4 Partial equilibrium results from reduced form estimates

4.1 Benchmark reduced form estimates

Our main empirical analysis is based on a regression discontinuity approach (Hahn et al. 2001, Lee & Lemieux 2010). Given the discussion above, we proceed to the pseudo-maximum-likelihood estimation of the following firm-level Poisson regression[20]:

$$Y_i = \exp\left(\alpha_0 + \alpha_1 D_i + \alpha_2 S(Z_i) + \delta_{j(i)} + \epsilon_i\right), \tag{1}$$

in which D_i is a dummy variable equal to one for firms employing 750 or more workers in the period before the reform, which we measure at October 2008. $S(Z_i)$ are different polynomials of the running variable (firm total employment before the introduction of the reform, in October 2008), centered at 750, including in some cases interactions with D_i. The main dependent variables considered, Y_i, are the numbers of new establishments created between 2009 and 2010 by each firm i, as well as the new hires in such establishments (if any). ϵ_i is an error term independent of exogenous variables. We consider fixed-term and or permanent contracts, in the new establishments (if any) of each firm, either separately or in total.

Our measurement of new hires is based on a period of two years following the introduction of the labor reform (up to October 2010). Given that a number of firms do not open up any new establishments, and therefore have zero new hires in new establishments, we use a Poisson model. Moreover, we weight each new hire by the months with the firm and the hours worked in October 2010.[21] In other words, our dependent variable captures the intensity of the employment choices of each firm in their new establishments (if any) by taking into account the timing of the hiring since the new law was in place and also the full- or part-time status of each appointment. We also add to our

[20] Poisson models are more appropriate than log-linear models when there are many observations equal to zero as in our context. See (Gourieroux et al. 1984, Cameron & Trivedi 2010)

[21] We assume that both the type of contract and the number of hours worked have not changed over time, although it may be the case that some workers under permanent contracts in October 2010 were originally hired under fixed-term contracts.

specification ten industry fixed effects ($\delta_{j(i)}$) to capture differences in industry practices regarding the relevance of multi-establishment firms, as indicated in Table 1. Standard errors are clustered at the firm size level. In our main sample of analysis, we consider all firms in Portugal employing between 100 and 2,000 workers as of October 2008 (the census month of our data set).

Table 2 presents our results regarding the creation of new establishments. We consider three specifications, based on different polynomials of the running variable: linear, linear with a spline on firm size, and quadratic. We find in all cases that a firm size above the 750-employee threshold is associated with a smaller number of new establishments, with an effect of between -.6 and -.7 log points, which corresponds to a drop around 50%. This effect is statistically significant at the 5% level in one specification and at the 10% level in two specifications. It compares to the estimated constants of between 1.8 and 2.1, which reflect the average number of new establishments for firms at the firm size threshold, and highlights the not only statistical but also economic relevance of the effect.[22] These findings are consistent with our graphical analysis from Figure 2 and indicate that the restriction on the use of FTCs in new establishments had the (unintended) effect of reducing the creation of new establishments.

We now turn our analysis to the hiring conducted by each firm for these new establishments. In Table 3, we examine the impact of the law reform in terms of fixed-term contracts only. In other words, our dependent variable measures exclusively the number of new hires employed as of October 2010 under fixed-term contracts in any new establishments of the different firms. As indicated above, each individual is weighted by the number of months they have been in the establishment and the number of hours that they work. Our dependent variable is therefore measured in terms of total hours worked by all new hires in new establishment since each individual's appointment. We find in all cases that a firm size above the 750-employee threshold is associated with a smaller number of new FTC hires in new establishments. The coefficients range between -1.96 (linear model) and -1.31 (spline) and are always statistically significant at the 1% level. These findings indicate that FTC hires in new establishments decreases by between one and two log points (corresponding to a 63%-86% interval) in firms above the size threshold. These results emphasise the success of the law reform as far as the restriction of FTCs is concerned.

In Table 4, we examine the extent to which the reduction of FTCs was associated with a corresponding increase in permanent contracts. Again, we consider the new hires in new establishments of the different firms (and applying the same weights regarding contract length and hours of work) but only those that are employed under permanent contracts. In contrast with the desired effects of the

[22]The firm size running variable is always positive and statistically significant, indicating that the number of new establishments tends to increase by .002 log points for each additional worker that the firm employs in 2008.

reform, we do not find any evidence of positive effects on the hiring under permanent contract. In all three specifications considered, the coefficients are negative; in two cases, they are even statistically significant, even if only at the 10% level.

These results are supported by our analysis of the two types of contracts together, i.e., when summing the total number of new hires. Table 5 presents the results for both FTCs and permanent contracts (as before, weighting each individual by the number of months they have been in the establishment and the number of hours that they work). We find in all four specifications that the effect from larger firms is negative and always statistically significant, with coefficients ranging between -0.9 and -1.2. These coefficients are also economically relevant, as they correspond to drops in employment from 59 to 70%.

In conclusion, we find that, while the law reform was successful in reducing the number of FTCs created by 'treated' firms, this was partly driven by a reduced number of new establishments. Moreover, we do not find any evidence of substitution between FTCs and permanent contracts, as the number of the latter also falls in larger firms that face the additional FTC restrictions.

4.2 Robustness

We present a number of robustness checks in Appendix A. First, we extend our main specification in equation (2) to control for additional variables, namely all those listed in Table 1 (capital equity, foreign ownership share, domestic private ownership share, sales, number of establishments, firm age, and three regional dummy variables). Tables 11, 12, 13, and 14 present our results, which are very similar to our benchmark evidence. They indicate small negative effects on both the number of new establishments and the number of new hires under permanent contracts in such new establishments - and large negative effects, both on the number of new hires under FTCs and on the total number of new hires.

Our second robustness check involves considering a shorter running variable range, namely between 250-1,250, instead of 100-2,000. This implies a significant change of our sample size (a drop from 2,875 to 758 firms) but not of our quantitative and qualitative results. Indeed, Figures 12 and 13 indicate a similar drop in hires in new establishments under FTCs and both types of contracts over such a restricted range as in our main sample. This is also reflected in the econometric analysis, presented in Tables 15 and 16: the coefficients on FTCs are of around -1.3 in all specifications and of between -1 and -1.2 in the case of all new hires.

We also conduct an analysis focused exclusively on the intensive margin, i.e., new establishments. In other words, we disregard the cases of firms that do not open any new establishments. Moreover,

we conduct the analysis at the establishment level, comparing the number of new FTCs in new establishments of larger firms and the equivalent number in the case of smaller firms. The results, presented in Table 17, indicate, a significantly smaller number of new FTCs in the new establishments of larger firms, consistently with the intended effects of the reform.

In our third set of robustness checks, we consider the case of existing establishments (instead of new establishments), comparing again firms of different sizes. While such establishments will not be directly affected by the reform, there may be indirect or spillover effects stemming from the restrictions imposed on larger firms. Existing establishments are defined as those that were already in operation by October 2008, just before the law reform was introduced. First, we compare treated and control firms in terms of their number of such establishments: Table 18 indicates that there are no significant differences at this threshold, which supports our identification approach. Second, we also analyse the potential effects of the reform on the new hirings in these existing establishments. Tables 19 and 20 present our results, which indicate that larger firms also reduced the new hirings under FTCs (and in total) in existing establishments but at a smaller level. These results are consistent with within-firm spillover effects whereby larger firms that faced increased restrictions in their hiring of FTCs in new establishments also did not expand existing establishments by as much.[23]

Finally, we conduct a complementary falsification test where we contrast 2007 and 2005 (as opposed to 2010 and 2008, as we do in our main results). If our main findings were driven by systematic differences between firms of different sizes along the 750-employee threshold, then we would expect similar results in earlier years, before the reform was in force. Tables 21 and 22 present our findings, which indicate no statistically significant differences between the two types of firms before the introduction of the reform, as expected in the context of a causal interpretation of our main results.

Our fourth robustness check involves a falsification test where we assume that the relevant firm-size threshold is at 500 instead of 750. If our results above are driven by a large-firm effect which is not necessarily related to the 750-employee threshold, then we would obtain similar results when considering the size threshold at a different level. Tables 23 and 24 present our results in this context, which indicate no significant effects (except in one specification, in the linear model, which could pick up the lower hires from the 750 threshold).[24]

[23] An additional explanation may involve uncertainty from firms as to the specific time threshold to define an establishment as 'new' or 'old' for the purposes of the law reform or lagged effects (e.g. some firms may consider that establishments launched in 2007 may still be considered as 'new' and therefore restrict their hirings; such establishments would in any case still be considered as 'new' in 2009 and diminished hirings then could translate into lower numbers in 2010).

[24] We also considered the possibility that larger firms could make greater use of temporary work agencies following the 2009 reform. Our data does not indicate where the workers of these agencies are placed but we found that: 1) temporary work agencies represent less than 3% of total employment in the country; 2) the employment of these agencies declined by 24% between 2008 and 2010. These two results indicate that this potential additional margin of adjustment was not relevant in our case.

4.3 Spillovers to smaller firms

We consider here the effects of the reform on the hires of establishments belonging to small firms. We ask if small firms more exposed to firms directly affected by the reform (through a common geographical and or sectoral location) tend to benefit more from the reduced hires of FTCs of the latter. In this case, such small firms may end up hiring more workers.

Our analysis of these potential spillovers from large to small firms is again based on a regression discontinuity approach. In our main specification, we follow **?** and Dechezleprêtre et al. (2020) and establish dyads corresponding to all pairs of firms with between 1 and 99 employees, on the one hand, and firms with between 100 and 2,000 employees that are based in the same region and in the same industry. We choose the 1-99 range because we want to ensure no overlap between the range of firms that may be affected by the spillovers and the range of firms where the spillover originates. Moreover, note that 1-99 firms corrrespond to 99.1% of all firms and 64.4% of all employment in 2008 in Portugal (our analysis of QP data). The region definition we consider in our benchmark results is 'concelho', of which there are 308 in the country; the industry definition is at the one-digit level. This approach leads to a total of 2.97 million observations, corresponding to 2,874 large firms (100-2,000 employees) and 165,547 small (1-99 employees) firms, paired across 735 region-industry domains.[25]

We then estimate a modified and extended version of our previous RDD equation, in which we explain the employment outcomes of small firms as a function of the presence of large firms (those that are above the key 750-employee threshold) in the same region-industry space and other variables:

$$Y_s = \exp\left(\alpha + \beta D_i + \lambda_1 S(Z_i) + \lambda_2 S(Z_s) + \epsilon_{is}\right) \tag{2}$$

in which D_i is a dummy variable equal to one if the large firm in the dyad (s, i) employs 750 or more workers in the period before the reform (October 2008). $S(Z_i)$ are different polynomials of the running variable (the large firm's total employment before the introduction of the reform, in October 2008), centered at 750, including in some cases interactions with D_i. We also consider a similar polynomial but referring to the small firm's employment in the same period ($S(Z_s)$), in which s denotes the small (1-99 employees) firm subscript. The main dependent variable considered, Y_s, is again the number of new hires from 2009 until 2010 by each firm s (both in fixed-term and permanent contracts). We cluster standard errors at the level of the baseline (large) firms (Dechezleprêtre et al. 2020).

Our main results are presented in Table 6. We find in all specifications that there is a positive effect from the presence of firms affected by the reform (firms with more than 750 employees) in the

[25]These region-industry domains arise only when there is both at least one firm with 1-99 employees and at least one firm with 100-2,000 employees.

same industry-region space. The coefficients are significant at least at the 5% level and range from 0.07 to .11 (except in the model with a spline, in which it is 0.05 and not significant). These results indicate that small firms increase their hiring by at least 7% when they share a labor market with a large firm that happens to be above the 750-employee threshold of relevance in the fixed-term contract reform analysed here.

We find similar results when considering a more aggregated definition of the local labor market, namely 'distritos' (of which there are 20 in the country, unlike the 308 'concelhos') and, again, one-digit industries. This approach leads to a total of 16.2 million observations, corresponding to 2,875 large firms (100-2,000 employees), 223,426 small (1-99 employees) firms, and 162 region-industry domains. Table 25 presents the results, which again indicate positive effects of above-750 large firms on the employment of 1-99-employee firms. Again, the results are very similar when we consider a wider range of smaller firms (1-249 instead of 1-99) and a larger firms range from 250 to 2000 employees - Table 26.

All in all, our findings indicate that the restrictions on the use of fixed-term contracts in establishments created by large firms impacted hires in those firms but also in small firms not directly concerned by the restrictions. This implies that the comparison of the outcomes of large firms targeted by the reform with the outcomes of small firms not directly concerned by the reform does not yield a reliable estimation of the actual impact of the reform. This comparison only shows that the reform had an impact, which was different for small and large firms, but it does not allow us to evaluate the size of the impact whether on large firms, small firms or on the overall economy. The next section presents a model which tackles this issue.

5 Model

The framework is a directed search and matching model with large establishments and endogenous job destruction. Time is discrete and the horizon of individuals is infinite. In every period, each establishment can create v job vacancies at instantaneous cost $C(v)$. $C(v)$ is an homogeneous function of degree $\alpha > 1$. Vacant jobs are filled at rate m, which depends on the labor market tightness in the labor pool of the establishment. Labor contracts are either fixed-term or open-ended. Fixed-term (or 'temporary') contracts have to be either destroyed at zero cost or transformed into open-ended (or 'permanent') contracts after one period. Permanent contracts can be destroyed at any date at red tape cost $F > 0$. When a job is created, it has to be permanent with probability π. π is a policy parameter which represents the stringency of regulation of temporary contracts. In order to match the Portuguese labor market regulation, it is assumed that π takes two values, π_ℓ for the less stringent

regulation and $\pi_h > \pi_\ell$ for the most stringent one.

In the benchmark situation, in place before the reform, the less stringent regulation applies to young establishments only, meaning that $\pi = \pi_h$ for old establishments, in principle older than two years. But there is some uncertainty about the way to precisely define what a young establishment is. Accordingly, we assume that the establishments become old with probability ρ in each period. When they become old, they have to comply with the more stringent regulation, which imposes to create the share π_h of permanent contracts. After the reform, establishments created by large firms, above 750 employees, had to comply with the stringent regulation from their date of creation. Henceforth, we present the model before the reform. The analysis of the impact of the reform will be discussed in a second stage.

Establishments are heterogeneous in two dimensions. First, young establishments can comply with the less stringent regulation π_ℓ, while old establishments must comply with the more stringent one, π_h. In what follows, the type-π of an establishment corresponds to the type-π of regulation to which it complies, meaning that an establishment changes its type when it becomes old. Second, establishments are also heterogeneous with respect to productivity. The ouput per job in a type-(z, π) establishment is equal to the product $z \times \varepsilon$, where $z > 0$ is establishment specific and constant over time, whereas ε is job specific, independent of z. Contrary to z, ε changes over time. For the sake of simplicity, it is assumed that $\varepsilon = \varepsilon_u$ on starting jobs. Then ε changes in each period with probability λ. A productivity change is a draw in a distribution with support $(-\infty, \varepsilon_u]$ whose cumulative distribution is denoted by G. All establishments are destroyed with probability μ per period.[26]

We start by presenting the behavior of establishments and workers to determine the effects of labor market regulation at the establishment level. Then, we analyze the properties of the labor market equilibrium, accounting for the effects of labor market regulations on establishment creation.

5.1 Behavior of establishments and workers

Each establishment has a labor pool where job vacancies and unemployed workers are matched together according to a matching function homogeneous of degree one. The mobility of workers between labor pools is perfect. On-the-job search is impossible. Unemployed workers are assumed to have perfect information on the situation in each labor pool. They observe, in each labor pool, the productivity parameter z of the establishment and its probability π to offer a permanent contract. The search activity of job seekers can be directed toward their preferred employment pool. In consequence, if

[26] In the empirical part we introduce a third dimension of heterogeneity: establishments created by large and small firms have different job vacancy cost functions $C(v)$, to account for potential differences in recruitment policies. We present the case without this heterogeneity in the main text for the sake of clarity. The general case with this heterogeneity is presented in appendix.

there are u unemployed persons and v vacant jobs in the labor pool of an establishment, the exit rate from unemployment and the rate at which vacancies are filled are respectively equal to $\theta m(\theta)$ and $m(\theta)$ where $\theta = v/u$ stands for the labor market tightness and $m(\theta)$, twice continuously derivable, satisfies the following conditions $m'(\theta) < 0, m''(\theta) < 0, m(0) = 0$. In each labor pool, the type-(z, π) employer posts labor contracts (permanent and temporary) that yield a promised inter-temporal expected utility $W(z, \pi)$ to workers hired in the establishment. These contracts are not renegotiable, and apply throughout the employer-employee relationship.

Workers

The hypothesis of directed search by workers and perfect mobility implies that the expected utility of an unemployed person is the same in all the labor pools, so it will simply be denoted by W_u. Let b denotes the instantaneous gains of an unemployed person, the expected utility W_u of a person in search of work satisfies the no-arbitrage condition:

$$W_u = b + \beta\theta(z,\pi)m(\theta(z,\pi))W(z,\pi) + \beta\left[1 - \theta(z,\pi)m(\theta(z,\pi))\right]W_u \quad \forall(z,\pi) \tag{3}$$

where β stands for the discount factor. The no-arbitrage condition defines a decreasing relation between the labor market tightness $\theta(z, \pi)$ and the promised utility $W(z, \pi)$. Differentiation of equation (3) with respect to $\theta(z, \pi)$ and $W(z, \pi)$ keeping W_u constant yields:

$$\frac{\partial\theta(z,\pi)}{\partial W(z,\pi)} = \frac{-\theta(z,\pi)}{(1-\eta)\left[W(z,\pi) - W_u\right]} \; ; \; \eta \equiv -\frac{\theta m'(\theta)}{m(\theta)} \tag{4}$$

Establishments

To analyze the optimal behavior of establishments, we start by computing the values of marginal filled jobs and vacant jobs in all type-(z, π) establishment. In each period t, the timing is as follows:

1/ Matches occur thanks to vacancies posted during period $t-1$; 2/ The match specific productivity parameter ε is observed, it is equal to ε_u for all new matches and it changes with probability λ from period $t-1$ to period t, in which case the new value of ε is drawn in the stationary distribution the CDF of which is denoted by G; 3/ Jobs whose productivity is considered as too small can be destroyed; 4/ Remaining and new workers produce and get their remuneration; 5/ The type of regulation that will apply in the next period, i.e. to jobs filled thanks to vacancies currently posted, is observed; 6/ Vacancies and contracts are posted; 7/ Establishments are destroyed with probability μ.

5.2 Partial equilibrium

We start by analyzing the partial equilibrium, conditional on the expected utility of unemployed workers W_u, which will be determined afterwards.

Let $V(z,\pi)$ stands for the value of the marginal vacant job in type-(z,π) establishments. For the sake of simplicity, and without loss of generality, the surpluses of filled jobs are written on the equilibrium path, where the value of marginal vacant jobs is equal to zero. Let us denote the surplus of a starting marginal permanent job by $S_p(z)$ and that of a marginal temporary job by $S_t(z)$. The surpluses of starting permanent and temporary marginal jobs in type-(z,π) establishments are

$$S_k(z) = W_k(z) - W_u + J_k(z), k = p, t. \tag{5}$$

The expected profit, value to the worker and surplus of matches between a worker and a job offer from type-(z,π) establishments are:

$$D(z,\pi) = \pi D_p(z) + (1-\pi)D_t(z), D = J, W, S \tag{6}$$

where J denotes the value of a marginal job to the establishment, S the surplus of a marginal job and W the expected utility of the worker on this job.

The surpluses of jobs are computed in Appendix B.1. The surplus of temporary jobs, which can be destroyed at not cost at the end of the first period of employment, is bigger than that of permanent jobs, meaning that firms always prefer to create temporary jobs. This implies that the regulatory constraint is binding, or to put it differently that the share of creation of permanent jobs is equal in equilibrium to π in type- π establishments.

The value of a marginal vacant job to type-(z,π) establishments is equal to its marginal cost plus its expected gains, or

$$V(z,\pi) = \max_{W} -C'(v) + \beta(1-\mu)\left[m(\theta)J(z,\pi) + [1-m(\theta)]\,V^{+}(z,\pi)\right] \tag{7}$$

where $V^{+}(z,\pi)$ denotes the future value of marginal job vacancies, which is equal to zero in equilibrium. The relation between θ and W is defined by equation (3). Maximization with respect to W using the fact that $J = S - (W - W_u)$, yields the Hosios condition

$$W(z,\pi) - W_u = \eta S(z,\pi). \tag{8}$$

Using the definition (3) of W_u, this condition defines a relation between the labor market tightness and the surplus of type-(z, π_ℓ) establishments:

$$\theta(z,\pi)m(\theta(z,\pi)) = \frac{(1-\beta)W_u - b}{\beta\eta S(z,\pi)} \tag{9}$$

The surplus of starting jobs (computed in Appendix B.1), which shows up at the denominator of equation (9), increases with the productivity parameter z and decreases with the stringency of regulation of temporary jobs π. This implies that the labor market tightness is lower in the labor pool of establishments with higher productivity parameter z. The labor market tightness is also lower in the labor pools of establishments subject to lower stringency of regulation of temporary jobs.

In equilibrium, the value of the marginal vacant job in type-(z, π) establishments, $V(z, \pi)$, is equal to zero for all (z, π), which implies, using equation (7):

$$C'(v) = \beta(1-\mu)m(\theta(z,\pi))J(z,\pi) \tag{10}$$

This condition, together with the Hosios condition (8), the definition of the surplus (equations (5) and (6)) and equation (9), implies that the number of vacant jobs in a type-(z, π) establishment is defined by

$$v(z,\pi) = \left\{ v | C'(v) = (1-\mu)\frac{1-\eta}{\eta}\frac{(1-\beta)W_u - b}{\theta(z,\pi)} \right\} \tag{11}$$

A this stage, we can define the partial (i.e. for given value of W_u) equilibrium values of $\theta(z, \pi)$ and $v(z, \pi)$, from equations (9) and (11) (using the definition of the surplus provided in Appendix B.1 which shows that the surplus increases with the productivity parameter z and decreases with the stringency of regulation of temporary jobs when W_u is constant.) It is easily checked that when productivity is higher, firms post more job vacancies which are more easily filled (i.e. $v(z, \pi)$ increases and $\theta(z, \pi)$ decreases with z) because more workers show up when the surplus of jobs is higher. For the same reason, the opposite occurs when the labor market regulation is more stringent. The surplus of jobs drops, which implies that $v(z, \pi)$ decreases and $\theta(z, \pi)$ increases with π. Still for the same reason, when the expected discounted utility of unemployed workers is higher, the surplus of jobs is smaller which implies less job vacancies and higher labor market tightness.

Partial equilibrium effects of the regulation of temporary contracts

The previous results allow us to shed light on the effects of the regulation of temporary contracts on the outcomes at the establishment level (i.e. for given value of W_u). This is useful to figure out the impact of changes in the regulation on an establishment – which becomes old and consequently

subject to more stringent regulation for instance– while the situation of other establishments remains unchanged.

1/ In each establishment, the duration of vacancies, $1/m(\theta(z,\pi))$, increases with the stringency of labor market regulation measured by the mandatory share of permanent contracts π. This comes from the fact that the stringency of the regulation reduces the surplus of filled jobs. The lower surplus decreases the value of the contracts offered by the establishment, which increases the labor market tightness because job seekers direct their search toward other establishments.

2/ The number of job vacancies decreases with the stringency of labor market regulation π. According to equation (11), the optimal number of vacancies in each establishment is determined by the equality between the marginal cost of vacant jobs and their marginal gain, which decreases with the labor market tightness. Since the marginal cost is increasing (C is convex) and the stringency of regulation increases the labor market tightness, the number of vacancies is lower when the regulation of temporary jobs is more stringent.

3/ From the two previous results, it is clear that more stringent regulations of temporary contracts reduce the number of hires.

4/ More stringent labor market regulation, corresponding to increases in π has an ambiguous impact on employment, because there is less job creation but also less job destruction when establishments must create a larger share of permanent jobs. Figure 7, which displays the effects of π on several outcomes of the establishment for arbitrary values of the parameters of the model, shows that total employment can decrease with π. In the situation displayed on this figure, a more stringent regulation of temporary jobs increases the number of permanent jobs, decreases the number of temporary jobs and the total number of jobs.

5.3 Labor market equilibrium before the reform

Now, we determine the equilibrium of the model accounting for the adjustment of the expected utility of unemployed workers and for establishment creation. The size of the labor force is equal to $\mathcal{N}$, which is an exogenous variable. Establishments are created either by large or by small firms. In each period, there are exogenous numbers of production opportunities, denoted by O_i, $i = s, b$, available to small and large firms respectively. Production opportunities are heterogeneous. A type-z production opportunity allows firms to create a type-z establishment, where z is the productivity parameter drawn in the cdf $\Gamma_i(z)$, $i = s, b$. All establishments are destroyed at exogenous rate μ once they have been created. Firms create an establishment only if the productivity z of the production opportunity is

above the threshold[27]

$$\bar{z}(\pi_\ell) = \{z|S(z,\pi_\ell) = 0\} \tag{12}$$

which implies that the number of establishments created by type-i firms, $i = s, b$, in each period is:

$$E_i = O_i \left[1 - \Gamma_i(\bar{z}(\pi_\ell))\right], i = s, b \tag{13}$$

Moreover, when they are transformed into old establishments facing the more stringent regulation, type-(z, π_h) establishments continue hiring workers only if z is larger than the reservation value:

$$\bar{z}(\pi_h) = \{z|S(z,\pi_h) = 0\} \tag{14}$$

In this context, W_u, $\bar{z}(\pi_\ell)$ and $\bar{z}(\pi_h)$ are determined by equations (12), (14) and the resource constraint:

$$\mathcal{N} - u(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h)) = L(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h)), \tag{15}$$

where $u(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h))$ is aggregate unemployment computed in Appendix B.4 and $L(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h))$ is aggregate employment computed in Appendix B.3.

Equation (15) displays the equality between labor supply, on the left hand side, and labor demand, on the right hand side. The labor supply function, displayed on Figure 8, depicts a positive relation between the expected value of unemployed workers W_u and employment, equal to $\mathcal{N} - u$, because higher employment rate increases the expected value of unemployed workers, whose probability to find jobs raises when employment increases.[28] The labor demand function displays a decreasing relation between employment and W_u because higher values of W_u reduce the surplus of jobs, then profits and the incentive to create jobs. Since labor supply increases with W_u and labor demand decreases with W_u, equation (15) defines a unique value of W_u if it exists, which is assumed.

The labor market equilibrium condition (15) determines the equilibrium value of the expected utility of unemployed workers W_u. This allows us to compute the equilibrium values of the labor market tightness and employment in each establishment, relying on previous results of Section 5.2, which derived the values of these variables conditional on W_u. The number of establishments is determined by the arrival of production opportunities O_i, $i = s, b$ and by the productivity thresholds $\bar{z}(\pi_\ell)$ and $\bar{z}(\pi_h)$ defined by equations (12) and (14).

In this setup, rises in the stringency of regulations of temporary contracts, corresponding to in-

[27] It is shown, in appendix B.2 that $\Pi(z,\pi_\ell) \geq 0 \Leftrightarrow S(z,\pi_\ell) \geq 0$.

[28] As stated by equation (3) which implies a positive relation between the job finding probability $\theta m(\theta)$ and W_u. See Appendix B.4 for more details.

creases in the share of permanent jobs in total job creation in young establishments (π_ℓ), in old establishments (π_h), or the rate ρ at which establishments become old, reduce job creation in each establishment where the regulation becomes more stringent. The more stringent regulation also increases the reservation productivity above which establishments are created, which contributes to lower establishment creation. These effects reduce labor demand, i.e. move the labor demand curve downwards in the (L, W_u) plane, as shown on Figure 8. On the other hand, the more stringent regulation decreases the value of the expected utility of unemployed workers at given employment level, as it can be deduced from equation (9) which shows that W_u decreases with π through the negative impact of π on the job surplus. Therefore, the labor supply curve shifts upwards, which dampens the negative impact of the regulation stringency on employment. Hence, the total effect of increases in the stringency of the regulation of temporary contracts moves the equilibrium values of W_u, the welfare of unemployed workers and employment L from points A to B on Figure 8. This indicates that the reform reduces the welfare of unemployed workers, whose probability to find job is reduced, but has an ambiguous impact on total employment because the drop in the share of temporary jobs in job creation reduces job destruction.

5.4 Labor market equilibrium after the reform

The model has clear qualitative predictions about the effects of the Portuguese reform of temporary contracts. Let us remind that this reform changed the situation of young establishments created by large firms, over 750 employees, which had to comply with the more stringent regulation from their date of creation, instead of after the date at which they became "old" before the reform. The situation of establishments created by small firms remained unchanged. Hence, this reform created a competitive advantage for small firms. If there were free entry for all firms and if all firms had the same production opportunities, whatever their size, establishments would have been created by small firms only, after the reform, because their competitive advantage would have allowed them to totally crowd out large firms. This is not what happened. Thus, there are some constraints on establishment creation. This can be due to limited access to financial markets, lack of opportunities, fewer managerial resources, less information... In our model, this is taken into account by the limited number of opportunities of creation of establishments, O_i, $i = s, b$, for small and large firms respectively. It is assumed that these numbers of opportunities to create new establishments are not affected by the reform, meaning that O_s and O_b remain constant before and after the reform. Since the reform is only about contract types, there is no reason to believe that it would affect opportunities for establishment creation.

Although the number of opportunities of creation of new establishments is not affected by the

reform, the creation of establishments is impacted because the productivity thresholds $\bar{z}(\pi_\ell)$ and $\bar{z}(\pi_h)$ (defined equations (12) and (14)) above which establishments are created depend on the labor market regulation. This dependency arises through two different channels. First, there is a direct effect on large firms: the more stringent regulation decreases the surplus of jobs created by large firms in their young establishments, which raises $\bar{z}(\pi_h)$, the reservation productivity of establishments created by large firms, and accordingly diminishes the number of establishments created by those firms. Second, there are indirect effects, which dampen the negative impact on establishment creation by large firms, because small firms benefit from the drop in market tightness induced by the drop in the profitability of large firms, which diminishes $\bar{z}(\pi_\ell)$ and then fosters the creation of establishments by small firms. The full impact of the reform is the sum of these direct and indirect effects.

6 Calibration, estimation and simulations of the structural model

We first present the calibration and estimation of the search and matching model before analyzing the impact of the reform with simulation exercises.

6.1 Calibration and estimation

The parameters of the model are evaluated before the reform, over the period 2003-2008. We first present the assumptions about functional forms before reporting the values of calibrated parameters. Finally, we present the estimation of the other parameters.

6.1.1 Assumptions about functional forms

We assume that the vacancy cost function is homogeneous of degree $\alpha > 1$: $C(v) = c_i v^\alpha$, $i = b, s$, where $c_i > 0$.[29] The matching function is homogeneous: $m(\theta) = m_0 \theta^{-\eta}$. The distribution of job-specific productivity ϵ is uniform on the interval $[1 - \bar{\epsilon}, 1 + \bar{\epsilon}]$. The establishment specific productivity z_i are drawn in generalized extreme value distributions, which are different for establishments created by large and small firms.

6.1.2 Calibration

Several parameters are directly calibrated. The discount factor $\beta = 1/(1.05)$ is set to match 5% annual discount rate. The elasticity of the matching function η equals 0.5, in line with standard calibration and estimates in the literature. The arrival rate of job-specific productivity shocks is equal to one, which

[29] We bring to the data a more complete version of the model presented in the previous section in which the vacancy cost function can differ across firm type. This version of the model is presented and solved in Appendix B.

implies that the job destruction rate depends on the variance of the job-specific productivity shocks ϵ, estimated from our data. The conversion rate ρ of young establishments into old establishments is equal to 0.5 to match the regulation according to which an establishment becomes old after about two years. The exogenous establishment destruction rate, μ, matches the empirical establishments annual death rate, equal to 0.17. Panel 1 of Table 7 presents the values of calibrated parameters.

6.1.3 Estimation

At this stage, one needs to estimate the following parameters: the parameters c_s, c_b and α of the vacancy cost function, the lay-off costs F, the value of unemployment W_u, the instantaneous utility of unemployment b, the scale parameter of the matching function m_0, the parameter $\bar{\epsilon}$ of job-specific productivity, the shares of permanent jobs in job creation, π_{ij}, $i = s, b; j = h, \ell$ and the parameters of the generalized extreme value distributions of small and large firms, denoted by $\gamma_{i1}, \gamma_{i2}, \gamma_{i3}$ for $i = s, b$. We estimate these 18 remaining parameters to minimize the objective function

$$\mathcal{G}(\Omega) = (\hat{g} - g(\Omega))' W^{-1} (\hat{g} - g(\Omega)) \tag{16}$$

With $\Omega = (F, W_u, \bar{\epsilon}, b, m_0, c_s, c_b, \alpha, \pi_{s\ell}, \pi_{sh}, \pi_{b\ell}, \pi_{bh}, \gamma_{s1}, \gamma_{s2}, \gamma_{s3}, \gamma_{b1}, \gamma_{b2}, \gamma_{b3})$.

In the objective function, $\hat{g}$ is the vector of empirical moments and $g(\Omega)$ is the model counterpart. W is the optimal covariance weighting matrix.[30] Two types of moment compose the vector of moments. We use information about the population and unemployment rate and about the use of temporary jobs. The parameters are jointly estimated using an iterative process described in Appendix C. Parameters b and m_0, the instantaneous utility of unemployment and the scale parameters of the matching function respectively, are informed by the size of the labor force and the unemployment rate: we compute total employment in the private sector– equal to 2.515 million –, the total number of unemployed – equal to 0.279 million – and the size of the labor force – equal to 5.486 million.[31] The remaining parameters are informed by the distributions of the number of FTCs for each type of establishment (young or old and belonging to a small or to an old firm). F, the firing cost applying to permanent contracts is informed by the distribution of FTCs because firing costs affect total job creation. W_u and $\bar{\epsilon}$ are informed by the number of FTCs because these parameters affect the surplus of new jobs and then job creation. The parameters of the vacancy posting cost functions, c_s, c_b and

[30] In practice, we proceed in two stages. First, we minimize $\mathcal{G}(\Omega)$ taking the identity for W and find a first optimum, $\hat{\Omega}_1$. Second, we compute $W = g(\hat{\Omega}_1)g(\hat{\Omega}_1)'$ and minimize $\mathcal{G}(\Omega)$ again using this new matrix.

[31] These values are obtained from OECD data by averaging over 2003-2008. To obtain the number of unemployed workers, we multiplied the average number of unemployed over the period by 0.7 (to take into account the fact that all workers are not looking for paid employment in the private sector).

α, determine the number of vacancies posted by firms and then the number of hires under both types of contracts. The productivity distribution parameters,$\gamma_{s1}, \gamma_{s2}, \gamma_{s3}, \gamma_{b1}, \gamma_{b2}, \gamma_{b3}$, are informed by the distribution of the number of jobs in the establishments, since we have a relation between establishment productivity z and the number of jobs at the establishment level. All these parameters are then informed by the distribution of the number of jobs. The four remaining parameters are specifically informed by the use of FTC. The regulations applying to the four types of establishments determining the share of new hires under permanent contracts, $\pi_{s\ell}, \pi_{sh}, \pi_{b\ell}$ and π_{bh}, tell to which extent an establishment can use FTCs and then relate to the distribution of FTCs.
Hence, despite the model being jointly identified, each parameter is informed by a particular mechanism which affects the selected moments: vacancy posting, job creation, distribution of employment in the economy, share of FTC in hires in all types of establishments. The number of FTCs, computed in Equation C43 in Appendix C combines these different mechanisms and hence is determined by the parameters we estimate.

The values of estimated parameters and standard errors are reported in Panel 2 of Table 7. Figure 9 shows that the model matches well the distributions of the number of temporary jobs in all types of establishment. We do not reject the null hypothesis of the Hansen test, meaning that the model is over-identified, which supports the validity of our structural model.

6.2 Simulation results

In order to clarify the logic of our simulation exercises, we start by explaining the relation between the reduced form estimates and the outcomes of the structural model. Then, we quantify the spillover effects of the reform on small firms, which correspond to the effect depicted by Arrow 2 in Figure 10. This allows us to evaluate the bias in the reduced form estimates of the impact of the reform on large firms due to the overlook of the reaction of small firms. The bias depends on the effects of the reform on small firms and on feedback effects on large firms induced by the reaction of small firms, as depicted by Arrow 3 in Figure 10. Third, we estimate the impact of the reform on the whole economy accounting for all direct and spillover effects.

6.2.1 Relation between the reduced form estimates and the structural model

To analyze the relation between the reduced form estimates and the structural model, it is useful to rely on the causal inference framework (Rubin 1974, Imbens & Rubin 2015) which distinguishes treated and non-treated agents and whether the treatment – the reform in our framework – is implemented. In

this framework, the *potential* outcome of firm i can be written as a function of two indicator variables:

$$y_i(T_i, I)$$

where $T_i \in \{0, 1\}$ is equal to one if firm i is treated and $I \in \{0, 1\}$ is equal to one if the treatment is implemented. In the absence of spillover effects on non-treated firms, $y_i(0, 1) = y_i(0, 0)$ for all i. But in general, there are between firm spillovers in market economies. In our model, when the reform has effects on a non-zero measure of firms, the change in their behavior has an impact on the expected utility of unemployed workers, which induces spillover effects on all firms.

By definition, the Average Treatment Effect on the Treated is equal to the average impact of the treatment on treated firms:

$$ATT = \mathbb{E}\left[y_i(1, 1)\right] - \mathbb{E}\left[y_i(0, 0)\right] \tag{17}$$

Now, let us denote by $A_i \in \{0, 1\}$ the indicator variable of *assignment* to treatment and assume that the assignment is independent of potential outcomes $y_i(T_i, I)$. In principle, the ATT should be evaluated from the difference in expected outcomes of firms assigned to treatment when the reform is implemented and firms not assigned to treatment when the reform is not implemented:

$$ATT = \mathbb{E}\left(y_i | A_i = 1, I = 1\right) - \mathbb{E}\left(y_i | A_i = 0, I = 0\right) \tag{18}$$

However since $I = 1$ and $I = 0$ cannot coexist at the same time, reduced form estimates evaluate the ATT from the formula

$$\widetilde{ATT} = \mathbb{E}\left(y_i | A_i = 1, I = 1\right) - \mathbb{E}\left(y_i | A_i = 0, I = 1\right) \tag{19}$$

This implies a bias in the reduced form estimate equal to the difference between equations (19) and (18):

$$Bias = \widetilde{ATT} - ATT = \mathbb{E}\left(y_i | A_i = 0, I = 0\right) - \mathbb{E}\left(y_i | A_i = 0, I = 1\right) \tag{20}$$

To put it differently, the bias is equal to the opposite of the impact of the treatment on non-treated firms. The structural model, which yields all potential outcomes of all firms allows us to evaluate this bias.

The model is also useful to evaluate the Average effects of the Treatment on the Whole economy:

$$ATW = \tau \mathbb{E}\left[y_i(1, 1)\right] + (1 - \tau)\mathbb{E}\left[y_i(0, 1)\right] - \mathbb{E}\left[y_i(0, 0)\right] \tag{21}$$

where τ stands for the share of treated firms.

Reduced form estimates of $\widetilde{ATT}$ using the Regression Discontinuity Design rely on formula (19) and select firms sufficiently close to the cutoff size to assume that:

1. Their expected potential outcomes are identical whether they are assigned to treatment or to control:

$$\mathbb{E}\left[y_i|A_i=1, I=1\right] = \mathbb{E}\left[y_i|A_i=0, I=1\right]$$

   where A_i is equal to 1 for firms assigned to treatment and to zero for the other firms.

2. The non-treated are not impacted by the treatment:

$$\mathbb{E}\left[y_i(0,0)\right] = \mathbb{E}\left[y_i(0,1)\right]$$

To be consistent with this approach, we use the structural model to compute the term $\widetilde{ATT}$ defined by equation (19) and we adjust parameter $\pi_{b\ell}$ –which determines the share of entries into temporary jobs in young establishments created by large firms – of the structural model in order to match the $\widetilde{ATT}$ estimated from the reduced form (See Appendix D).

6.2.2 Spillover effects and bias in reduced form estimates

The bias in reduced form estimates depends on the impact of the reform on the young establishments created by small – i.e non-treated – firms. It is shown in Appendix E that the reduced form estimates (i.e. coefficient α_1 of equation (2)) of the impact of the reform on employment outcomes can be decomposed as follows:

$$\hat{\alpha}_1 = \log\left(\frac{\sum\limits_{i|A_i=1} y_i(1,1)}{\sum\limits_{i|A_i=1} y_i(0,0)}\right) + \underbrace{\log\left(\frac{\sum\limits_{i|A_i=0} y_i(0,0)}{\sum\limits_{i|A_i=0} y_i(0,1)}\right)}_{\widehat{Bias}} \tag{22}$$

The first term on the right hand side stands for the unbiased estimator, when SUTVA is satisfied, whereas the second term is the bias induced by the impact of the reform on small firms.

Our evaluation of the spillover effects of the reform on small firms is reported in the top panel of Table 8, which displays percentage changes between the pre-reform and the post-reform steady states. The reform increases employment in the establishments created by small firms, because they benefit from a competitive advantage from the reform which limits the creation of temporary jobs for large firms. The restrictions on creation of temporary jobs for young establishments of large firms

induces unemployed workers to look for jobs more in other establishment types which can fill their vacancies at higher rate (as shown by Table 9). Small firms also benefit from the reform because it reduces the welfare of unemployed workers. This raises job surpluses, lowers job separation rates and raises the conversion rate of temporary jobs into permanent jobs. The increase in employment of the establishments of small firms arises from the increase in their size and from the rise in the number of establishments created by small firms, as shown by Table 27 in Appendix A. Table 8 shows that employment increased by about 1.2% in establishments of small firms, and the impact is of the same order of magnitude for temporary and permanent jobs.

However, the reform has a strong negative impact on the employment of new establishments created by large firms. Large firms created fewer establishments (see Table 27), fewer vacancies which are more difficult to fill because unemployed workers direct their job search towards other establishments than those created by large firms (see Table 9). Transitions from unemployment to temporary jobs created by young establishments of large firms drop by about 77% (Row "Large firm-Young" in Table 8). This drop is partly compensated by the hike in transitions from unemployment into permanent jobs of these establishments, which increase by 37%. But this hike is not sufficient to sustain the transitions from unemployment into jobs created by young establishments of large firms, which drop by 43%. Hence, employment dramatically drops by about 50%.[32] Overall, the reform is strongly detrimental to the young establishments of large firms.

The fact that the average employment change of establishments not directly impacted by the reform is much smaller – in absolute value – than that of those which are directly impacted implies that the bias in the reduced form estimates of the average treatment effect on the treated defined by equation (20) is small.Table 8, Row "bias", shows that neglecting the employment adjustment in young establishments created by small firms – which belong to the non-treated group in the reduced form approach – induces a bias that overestimates the effect of the reform on the percentage employment changes of young establishments of large firms by about 1.7% (as shown by Panel "Reduced form estimates for young establishments of large firms" of Table 8. And the bias is limited for all the outcomes of young establishments of large firms. The bias is much larger for old establishments of large firms (when the control group is the old establishments of small firms) because old establishments of large firms are mostly indirectly impacted by the reform.

It is clear that the bias of the reduced form estimates for the outcomes of young establishments of large firms is small because the spillover effects on small firms are small. Panel "Partial equilibrium" of Table 8 displays the impact of the reform at partial equilibrium, where it is assumed that W_u is

[32]Remark that this figure, estimated from the structural model, is in line with the reduced form estimates of Section 4.

fixed, which is equivalent to assume that the outcome y_{-i} of all firms different from i is unchanged. The comparison of panel "General Equilibrium" with panel "Partial Equilibrium" shows how general equilibrium effects of the reform affect small and large firms. The reform decreased the expected gains of unemployed workers W_u. This increased the job surplus and boosted job creation of both large and small firms. Hence, the reform has a less negative impact on large firms in general equilibrium than in partial equilibrium, once the adjustment of W_u is taken into account.[33]

6.2.3 Impact of the reform on the whole economy

The impact of the reform on aggregate employment is reported in Table 8, Rows "All". Panel "Impact computed from reduced from estimates assuming SUTVA" shows that aggregate employment decreases by 1.3% when employment effects are computed from the reduced form estimate (wrongly) assuming that small firms are not impacted by the reform. Accounting for general equilibrium effects divides this figure by about 13, since the impact of the reform on total employment drops to about minus 0.1%. Similar large differences arise for the stock of permanent and temporary jobs. Looking at flows leads to even striker results since the number of transitions from unemployment to employment increases at general equilibrium while it decreases at partial equilibrium.[34]

Actually, the large difference between the results obtained with and without accounting for the reaction of small firms arises from the large share of small firms in total employment. The reform is targeted to a small subset of firms, the share of which in total employment equals 10%. It has small spillover effects on the average outcomes of small firms. But since small firms are numerous and account for a large share of total employment, their reaction has a strong effect on the changes in total employment induced by the reform. These results show that small spillover effects, induced by a small subset of the population, that may be difficult to measure with reduced form strategies because they diffuse on a large share of the population, may significantly change the overall impact of reforms.

The model provides information about the welfare effects of the reform. The welfare of unemployed workers, W_u, is reduced by the reform because the restrictions on the creation of temporary jobs reduces the number of job vacancies and the exit rate from unemployment – Table 10. The average welfare of workers of small firms is lower after the reform for two reasons. First, their outside option W_u is lower. This means that, conditional on any productivity level, the welfare of workers is lower after the reform. Second, small firms create establishments with lower productivity (the threshold

[33]Remark that the difference between partial and general equilibrium in outcomes of young establishments of large firms, equal to $\mathbb{E}[y_i|A_i = 1, I = 0] - \mathbb{E}[y_i|A_i = 1, I = 1]$ (where $A_i = 1, I = 0$ means that firm i gets the treatment while no other firm gets it) is not the same as the bias defined equation (20).

[34]The total number of transitions from unemployment to employment increases at general equilibrium but there are less transitions from temporary jobs to permanent jobs implying a drop in permanent employment and in total employment.

value of z above which small firms create establishments drops). This induces a composition effect which contributes to decrease the average welfare of the employees of small firms. For large firms, the drop in W_u exerts the same negative effect on welfare. However, contrary to small firms, large firms create establishments with higher productivity after the reform (the threshold value of z above which large firms create establishments increases). This contributes to improve the average welfare of employees of large firms. The combination of these two effects raises the average welfare of permanent workers and reduces that of temporary workers in large firms. All in all, the average welfare of all workers is lower after the reform despite the positive impact of the reform on the share of permanent jobs.

7 Conclusion

The large share of atypical work observed in many countries may have negative effects on both efficiency and equity and raises questions about the appropriate policy responses. This paper examines a labor law reform implemented in Portugal in 2009 which sought to reduce labor market segmentation by restricting the use of fixed-term contracts by large firms when recruiting for their new establishments.

We conduct an evaluation of this reform by drawing on linked employer-employee longitudinal data and regression discontinuity methods, exploiting the sharp and distinctive threshold between large and small firms determined for the purpose of this particular law. We find that the reform was successful but only in the sense that it led to a decrease in the number of new FTCs. The reform had a significant cost as the number of new establishments declined and the number of permanent contracts did not increase. When considering these different margins together, the reform led to an overall reduction in the total number of new jobs.

From a more methodological perspective, our paper illustrates the importance of complementing reduced form estimations of reforms with structural models. Reduced form strategies, which evaluate reforms of employment protection legislation by comparing the treatment group, to which the reform applies, to the control group, to which the reform does not apply, are very powerful at identifying the direct causal impact of reforms. Nevertheless, our framework clearly shows that such non-structural methods cannot fully identify and quantify the effects of the reform under scrutiny insofar as job creation, job destruction and employment of establishments created by firms which belong to the control group are impacted by the reform. From this perspective, our approach complements these non-structural approaches by using a unified framework which reproduces the direct effect evaluated by the reduced form strategy and quantifies the indirect effects. It shows that the indirect effects may be quantitatively significant even for reforms that cover a small subset of individuals (10% of

employment in our case).

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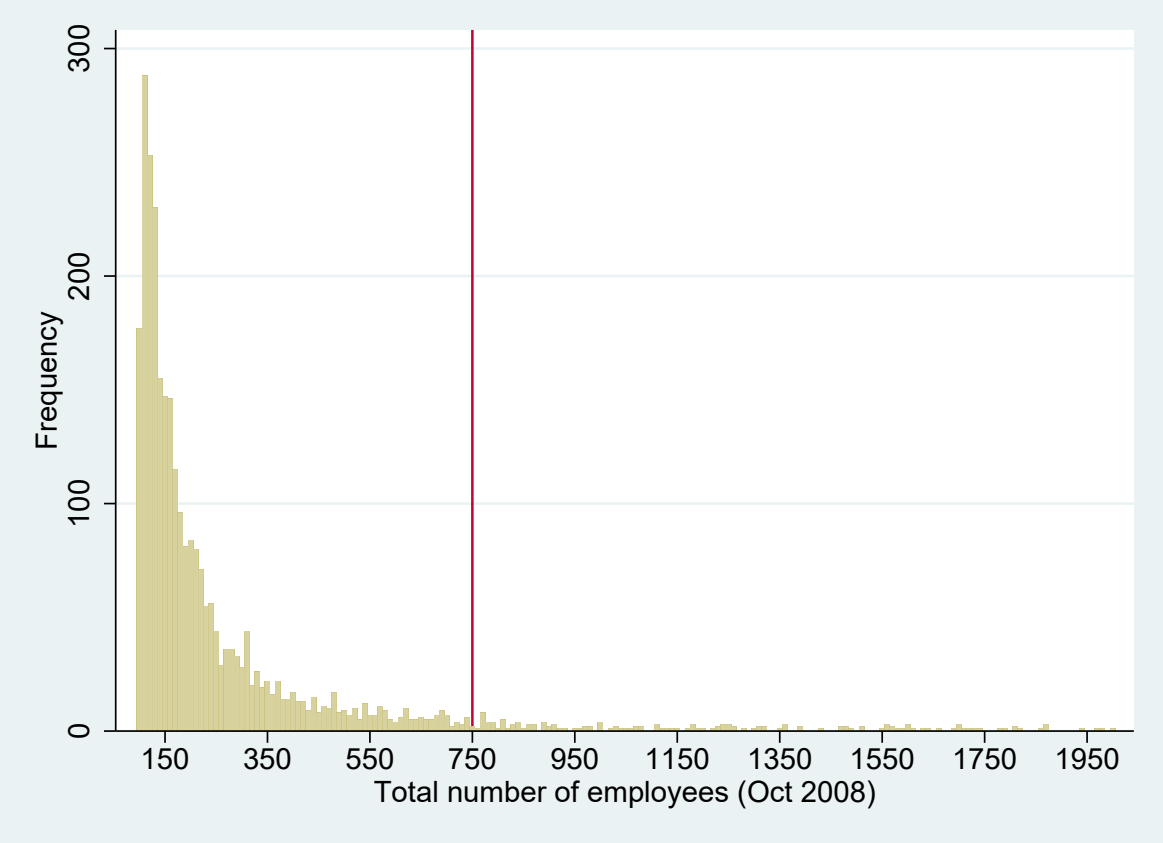
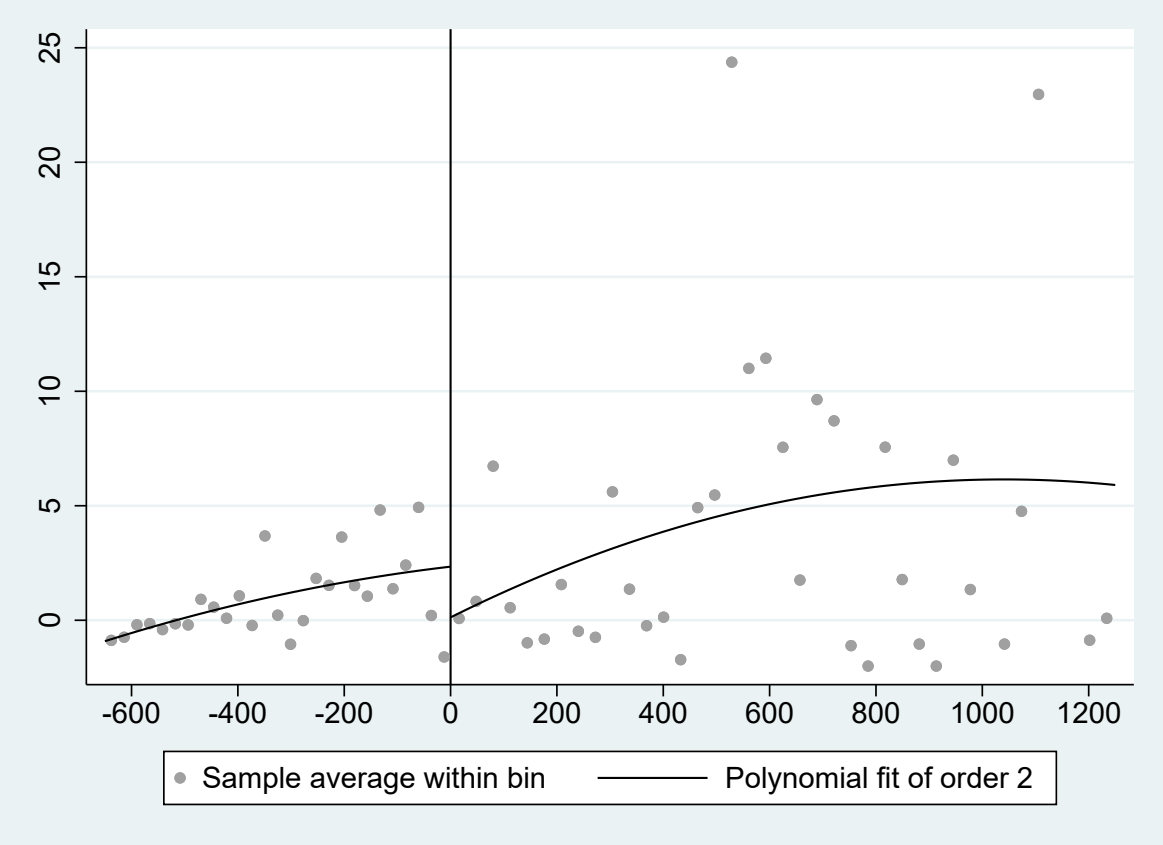
8 Figures

Figure 1: Distribution of (2008) firm sizes



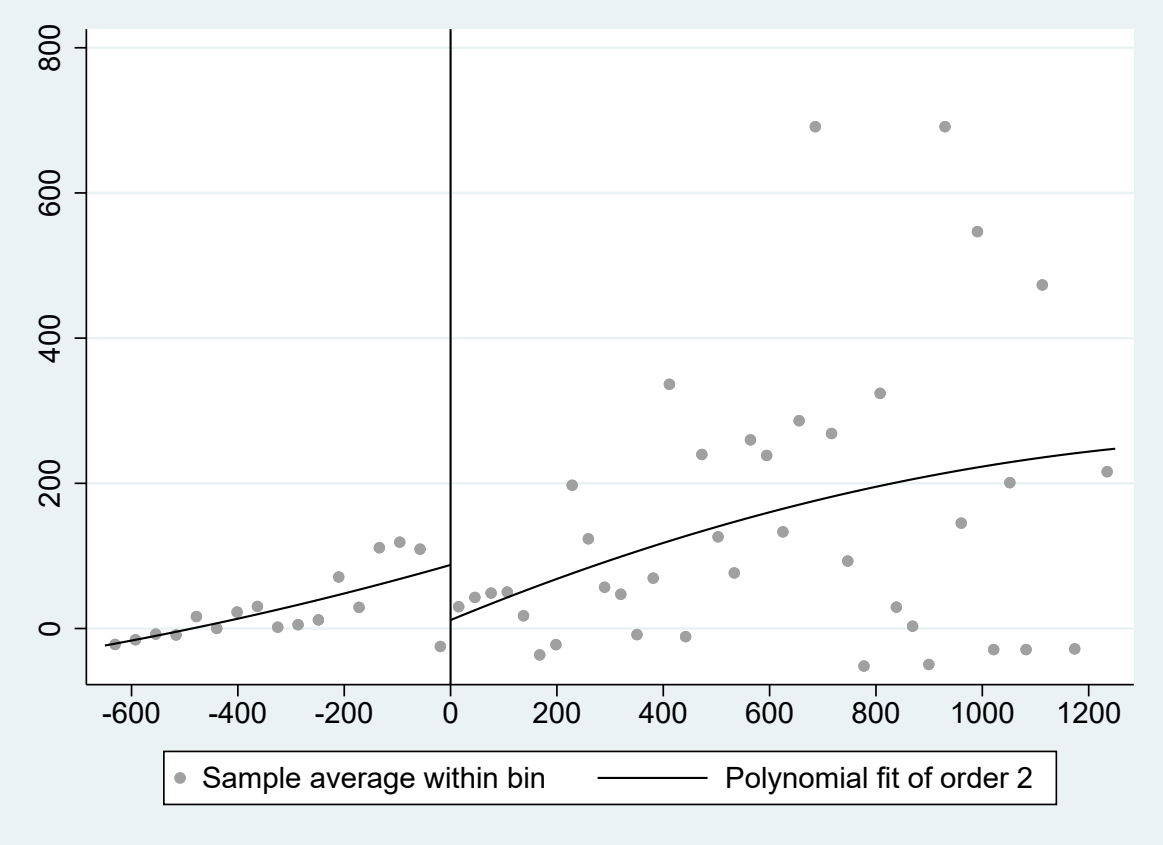
Notes: Firm size is measured by the total number of employees of each firm in (October) 2008. Own calculations based on the 'Quadros de Pessoal' data set.

Figure 2: **New establishments by 2010**



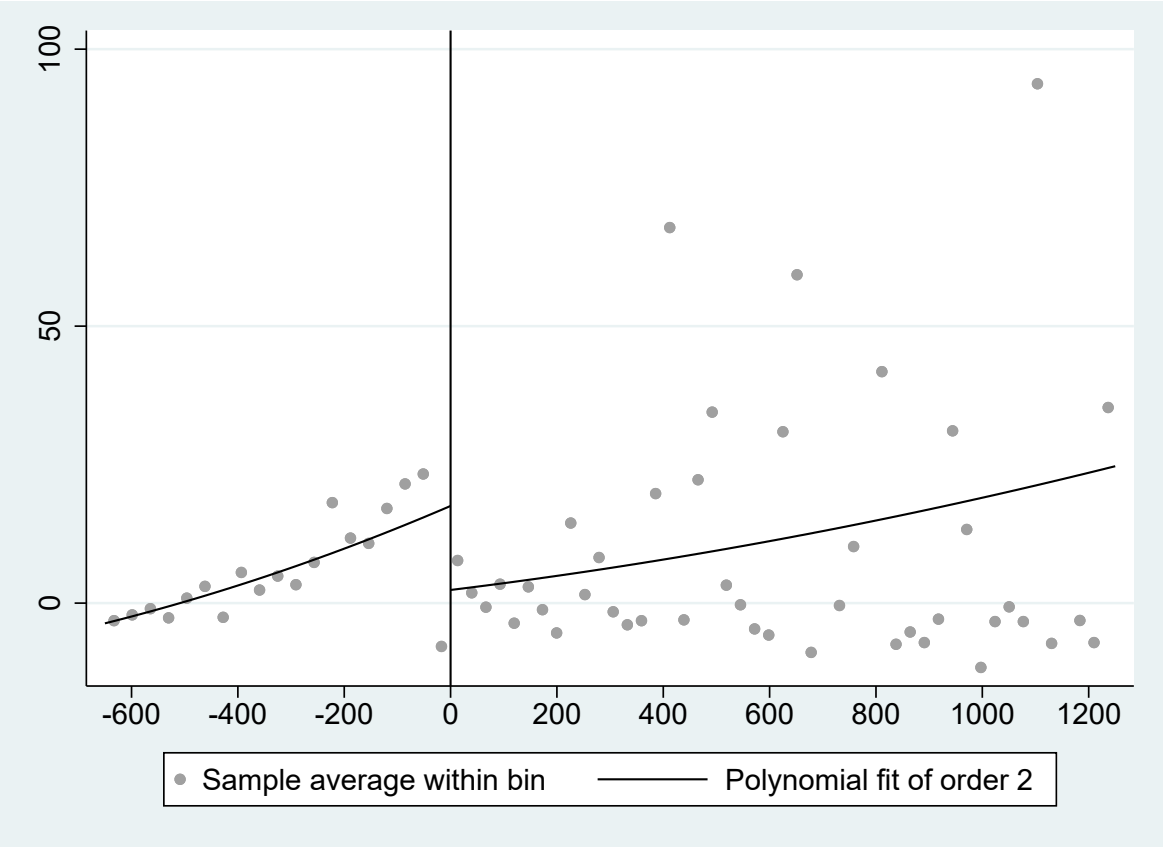
Notes: Dependent variable: number of new establishments (created in 2009 or 2010) by firms of different sizes (total number of employees) in 2008. Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 3: **Workers in new establishments in 2010**



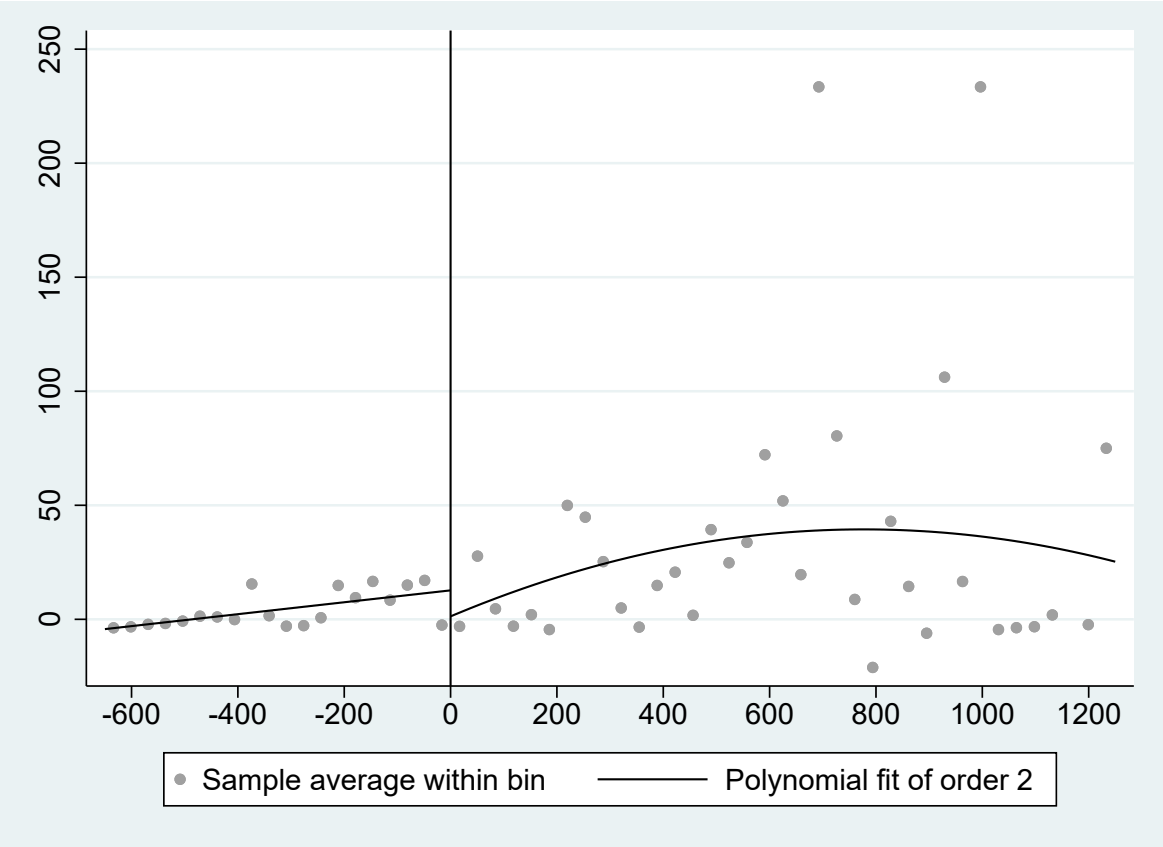
Notes: Dependent variable: number of workers in new establishments (created in 2009 or 2010) by firms of different sizes (total number of employees) in 2008. Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 4: **New hires in new establishments under fixed-term contracts**



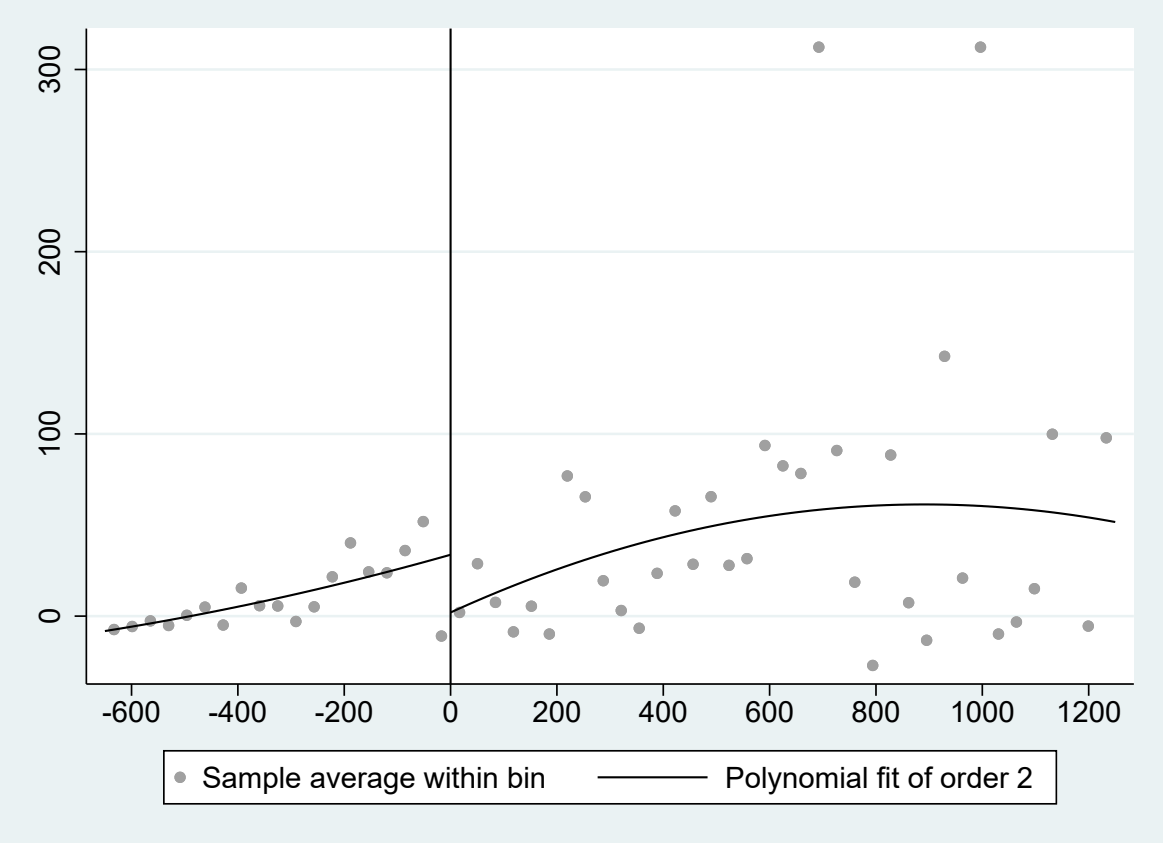
Notes: Dependent variable: total employment-month-hours (divided by 1,000) of new fixed-term contracts in new establishments. (New employment contracts are those created from March 2009.) Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 5: **New hires in new establishments under permanent contracts**



Notes: Dependent variable: total employment-month-hours (divided by 1,000) of new permanent contracts in new establishments. (New employment contracts are those created from March 2009.) Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 6: **New hires in new establishments under fixed-term and permanent contracts**



Notes: Dependent variable: total employment-month-hours (divided by 1,000) of new fixed-term and permanent contracts in new establishments. Firm size is centered at 750 employees. (New employment contracts are those created from March 2009.) Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Own calculations using 'Quadros de Pessoal' data.

Figure 7: **The effects of more stringent regulation of temporary contracts π on the outcomes at the establishment level.**

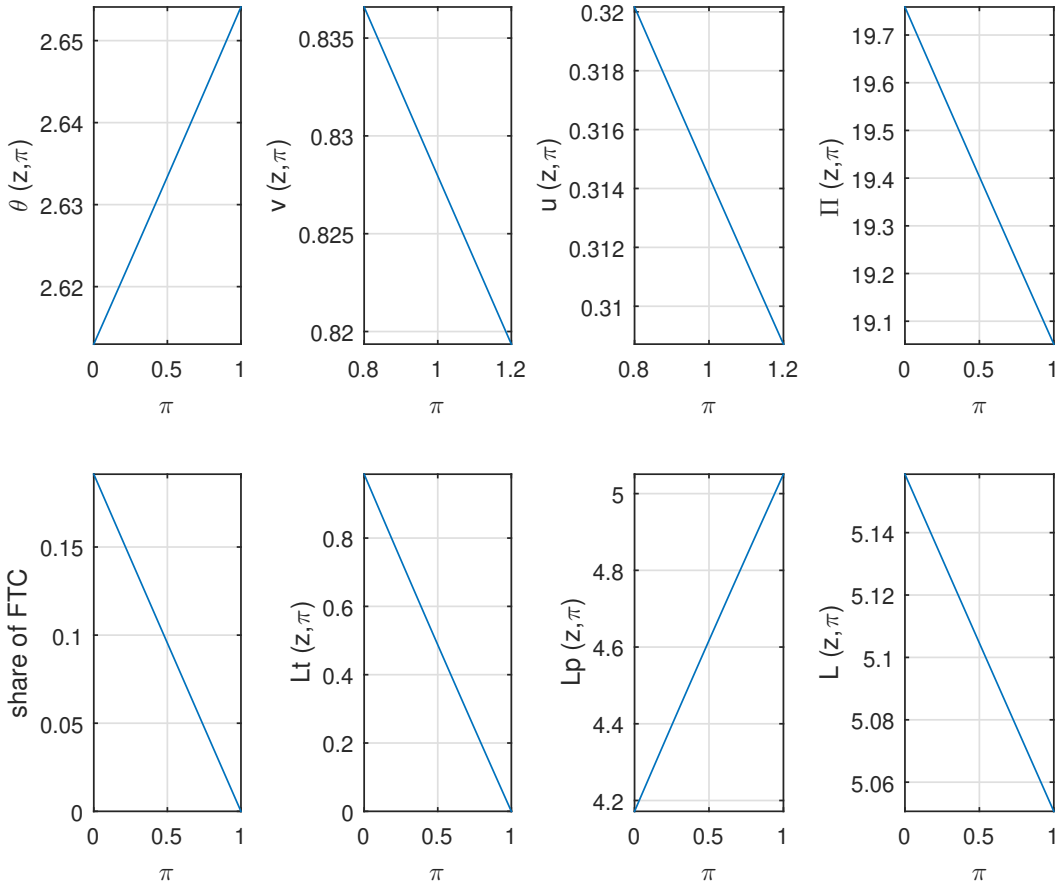
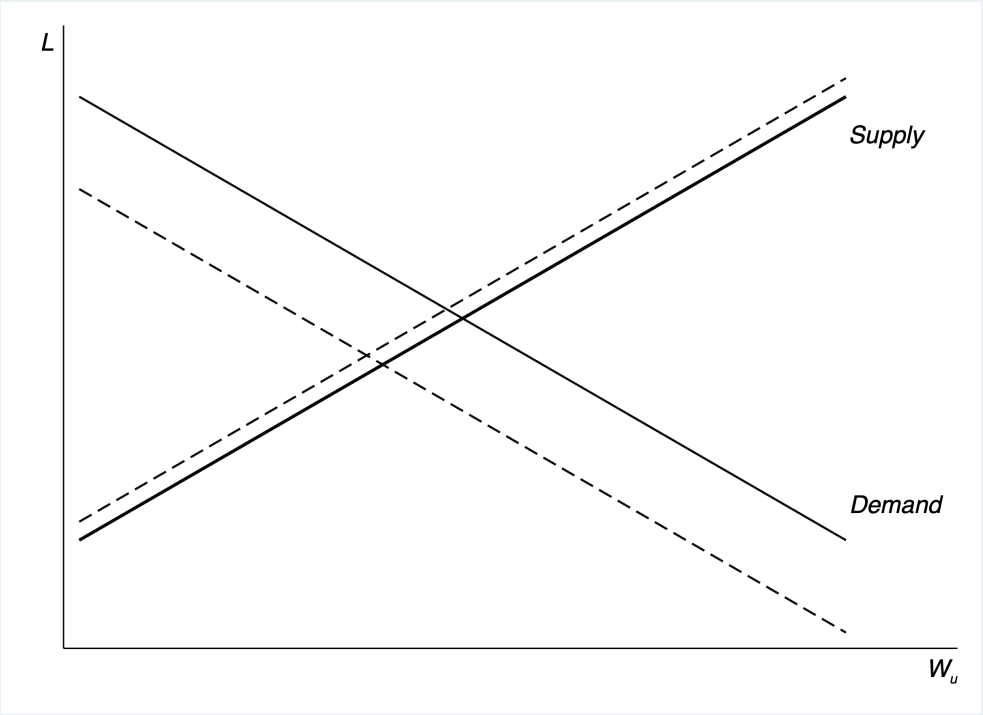
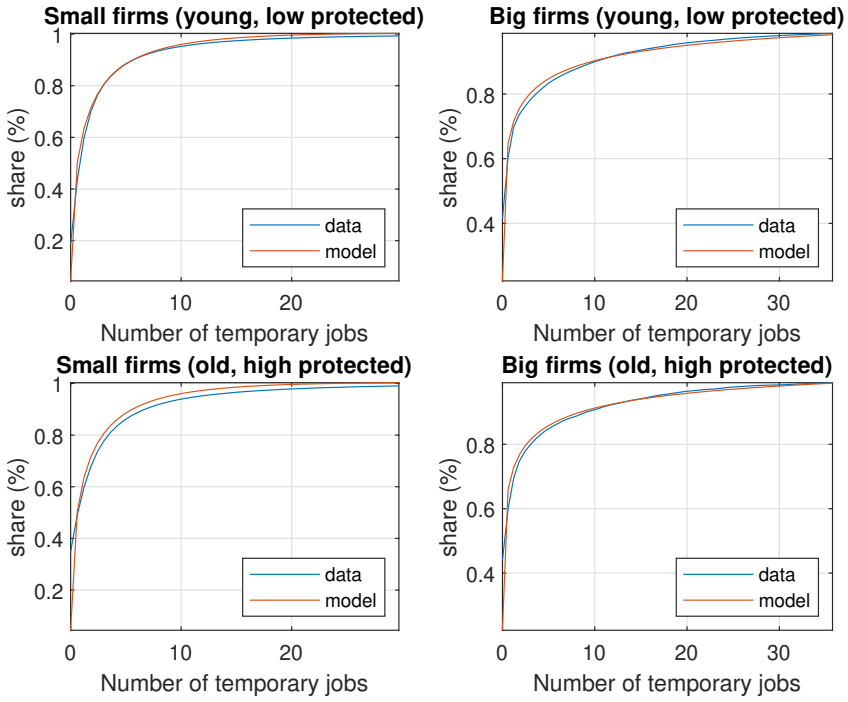


Figure 8: **Labor market equilibrium**



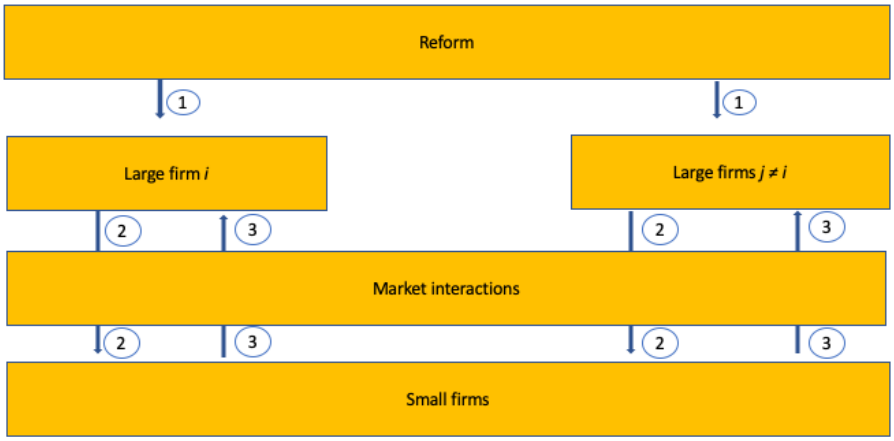
Notes: this Figure displays the labor market equilibrium in the employment (L) and welfare of unemployed workers (W_u) plane. Continuous lines stand for the initial equilibrium and dotted lines for the equilibrium after an increase in the stringency of labor market regulation.

Figure 9: **Empirical and predicted distributions of the number of temporary jobs in establishments**



Notes: this Figure displays the empirical and the predicted distributions of the number of temporary jobs in young and old establishments created by small and large firms before the reform.

Figure 10: **Direct and spillover effects of the reform**



Notes: this Figure illustrates the impact of the reform on large and small firms. Arrow 1 represents the direct effect of the reform on large firms, Arrow 2 the spillover effects on small firms which are mediated by market interactions and Arrow 3 the feedback effects on large firms, including interactions between large firm i and large firms $j \neq i$.

9 Tables

Table 1: Descriptive statistics, firms (2008)

	Larger firms		Smaller firms		Difference	
	Mean	SD	Mean	SD	Diff	t
Panel A: 2008 values						
Firm size (centered)	450.99	357.81	-536.54	133.79	-987.54***	(-33.67)
Annual sales (€million)	240.96	759.89	32.89	143.49	-208.07**	(-3.35)
Firm age	27.92	46.85	31.81	47.79	3.89	(0.99)
Number of establishments	22.45	40.51	5.02	9.38	-17.43***	(-5.26)
Capital equity (€million)	50.47	151.49	6.18	34.81	-44.30***	(-3.58)
Domestic private ownership (%)	60.59	47.70	71.64	44.03	11.05**	(2.77)
Foreign ownership (%)	20.00	38.57	15.80	35.32	-4.20	(-1.30)
Farming and extracting industries	0.01	0.08	0.01	0.11	0.01	(0.78)
Food, clothing	0.09	0.28	0.18	0.38	0.09***	(3.69)
Chemicals, metal, electrics	0.09	0.29	0.15	0.36	0.06*	(2.32)
Other manufacturing	0.05	0.21	0.04	0.20	-0.01	(-0.38)
Construction, trade	0.23	0.42	0.26	0.44	0.03	(0.82)
Hotels, restaurants	0.09	0.28	0.07	0.26	-0.02	(-0.67)
Information, financial, real estate	0.09	0.29	0.05	0.21	-0.05	(-1.92)
Administrative services	0.11	0.31	0.06	0.23	-0.05	(-1.88)
Education, health	0.24	0.43	0.16	0.37	-0.08*	(-2.20)
Other services	0.01	0.12	0.03	0.16	0.01	(1.47)
Lisbon headquarters	0.60	0.49	0.35	0.48	-0.25***	(-6.07)
Porto headquarters	0.15	0.36	0.18	0.38	0.02	(0.79)
Braga headquarters	0.04	0.20	0.09	0.29	0.05**	(2.96)
Percentage FTC	0.26	0.24	0.28	0.25	0.02	(1.22)
Panel B: 2010 values						
New establishments	7.76	20.07	1.78	4.84	-5.98***	(-3.64)
Fixed-term new hires	17.84	40.16	6.85	22.37	-11.00**	(-3.33)
Permanent new hires	41.31	102.03	5.42	27.01	-35.89***	(-4.30)
Fixed-term and perm new hires	59.16	117.23	12.27	41.07	-46.89***	(-4.88)
Observations	150		2,725		2,875	

Notes: 'Larger firms' are those that employed between 750 and 2,000 employees in 2008. 'Smaller firms' are those that employed between 100 and 750 employees in 2008. Panel A concerns the characteristics of the two types of firms as of 2008, before the reform, while Panel B presents the main outcomes of interest following the reform, in 2010. 'Firm age' is measured in years since the creation of the firm. 'Percentage FTC' indicates the percentage of all employees that have fixed-term contracts. 'New establishments' indicates the number of new establishments created in 2009 and 2010. 'Fixed-term (permanent) new hires' indicates the number of workers in fixed-term (permanent) contracts in 2010 as hired by new establishments (created between 2009 and 2010) of each type of firms ('smaller' or 'larger'). The number of workers is weighted by hours worked and months with the firm and divided by 1,000. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Own calculations based on the 'Quadros de Pessoal' data set.

Table 2: Effects on the number of new establishments per firm

	(1)	(2)	(3)
Large firm	-.695	-.654	-.589
	(.395)*	(.312)**	(.313)*
Firm size (centered)	.002	.002	.003
	(.0003)***	(.0002)***	(.0003)***
Firm size^2		-7.32e-07	
		(2.64e-07)***	
Firm size*Large firm			-.001
			(.0005)***
Const.	1.779	2.052	2.084
	(.246)***	(.244)***	(.258)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2,000 workers in October 2008. Poisson regression of the number of new establishments (created in 2009 and 2010) of each firm, as measured in October 2010. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 3: Effects on fixed-term contracts in new establishments

	(1)	(2)	(3)
Large firm	-1.961	-1.461	-1.314
	(.476)***	(.337)***	(.315)***
Firm size (centered)	.003	.002	.003
	(.0003)***	(.0003)***	(.0003)***
Firm size^2		-1.12e-06	
		(3.34e-07)***	
Firm size*Large firm			-.002
			(.0006)***
Const.	3.062	3.298	3.412
	(.386)***	(.380)***	(.388)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in fixed-term contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. Tenure- and hours-weighted employment measure. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 4: Effects on permanent contracts in new establishments

	(1)	(2)	(3)
Large firm	-.680	-.863	-.713
	(.641)	(.444)*	(.427)*
Firm size (centered)	.002	.003	.004
	(.0005)***	(.0004)***	(.0005)***
Firm size^2		-1.43e-06	
		(3.94e-07)***	
Firm size*Large firm			-.002
			(.0007)***
Const.	2.008	2.646	2.735
	(.354)***	(.344)***	(.362)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 5: Effects on both fixed-term and permanent contracts in new establishments

	(1)	(2)	(3)
Large firm	-1.203	-1.065	-.931
	(.480)**	(.331)***	(.316)***
Firm size (centered)	.002	.003	.004
	(.0003)***	(.0003)***	(.0004)***
Firm size^2		-1.26e-06	
		(2.95e-07)***	
Firm size*Large firm			-.002
			(.0005)***
Const.	3.296	3.735	3.838
	(.339)***	(.330)***	(.340)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in both fixed-term and permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 6: Spillover effects on the number of fixed-term and permanent contracts in small firms

	(1)	(2)	(3)	(4)
Large firm	.070	.080	.111	.049
	(.034)**	(.033)**	(.041)***	(.284)
Firm size	-1.00e-05	-.00002	-.0001	.00002
	(.00003)	(.00003)	(.00007)	(.00003)
Firm size^2		-8.77e-08	-1.08e-07	
		(2.92e-08)***	(3.78e-08)***	
Firm size^3			1.14e-10	
			(8.33e-11)	
Firm size*Large firm				-.0001
				(.00006)*
Firm (1-99) size	.040	.098	.158	.040
	(.0001)***	(.0004)***	(.0006)***	(.0001)***
Firm (1-99) size^2		-.0007	-.003	
		(5.31e-06)***	(.00002)***	
Firm (1-99) size^3			1.00e-05	
			(1.46e-07)***	
Firm (1-99) size*Large firm				-.00005
				(.0004)
Const.	7.107	6.673	6.354	7.124
	(.016)***	(.016)***	(.019)***	(.019)***
Obs.	2972680	2972680	2972680	2972680

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all dyads of firms in Portugal employing between 100 and 2000 workers in October 2008 and firms employing between 1 and 100 workers that operate in the same one-digit industry and region ('concelho'). Poisson regression of new hires in both fixed-term and permanent contracts in each 1-99 firm by October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the 100-2000 firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for 100-2000 firms employing 750 or more workers in 2008. Standard errors clustered at the 100-2000 firm identifierr. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 7: Estimated values of parameters of the search and matching model

Parameter		Value	
1. Calibrated parameters			
			Target
Discount factor	β	1/1.05	5% annual interest rate
Matching function elasticity	η	0.5	Petrongolo and Pissarides (2001)
Arrival rate of job-specific productivity shocks	λ	1	Normalization
Conversion rate into old establishment	ρ	0.5	Labor Code
Establishment destruction rate	μ	0.17	Empirical annual death rate
2. Estimated parameters			
			Standard error
Firing costs	F	16.1107	0.0008
Value of unemployment	W_u	430.2893	7.9161e-05
Bounds of the job specific productivity parameter $[1-\bar{\varepsilon}, 1+\bar{\varepsilon}]$	$\bar{\varepsilon}$	1.0310	0.0352
Instantaneous value of unemployment	b	-54.2632	
Scale parameter of the matching function	m_0	0.4657	
Vacancy cost parameter of establishments created by small firms	c_s	2.8081	0.0004
Vacancy cost parameter of establishments created by large firms	c_b	0.3786	0.0030
Elasticity of the vacancy cost function	α	1.3921	0.0121
Share of permanent jobs created in young establishments created by small firms	$\pi_{s\ell}$	0.1226	0.0068
Share of permanent jobs created in old establishments created by small firms	π_{sh}	0.2080	0.0787
Share of permanent jobs created in young establishments created by large firms	$\pi_{b\ell}$	0.2914	0.0430
Share of permanent jobs created in old establishments created by large firms	π_{bh}	0.3304	0.0572
Location parameter of the productivity distr. of establisments created by small firms	γ_{s1}	-0.2760	0.0327
Scale parameter of the productivity distr. of establisments created by small firms	γ_{s2}	20.4001	0.0008
Shape parameter of the productivity distr. of establisments created by small firms	γ_{s3}	31.0728	0.0004
Location parameter of the productivity distr. of establisments created by large firms	γ_{b1}	-0.3032	0.0285
Scale parameter of the productivity distr. of establisments created by large firms	γ_{b2}	14.1732	0.0018
Shape parameter of the productivity distr. of establisments created by large firms	γ_{b3}	13.2708	0.0044

Notes: See Section 6.1.3 for explanation.

Table 8: Reform impact computed from general equilibrium, partial equilibrium and reduced form estimates assuming SUTVA

	Stock			Inflows			Ouflows		Conversions
	L	L_p	L_t	$U \to L$	$U \to L_p$	$U \to L_t$	$L_p \to U$	$L_t \to U$	$L_t \to L_p$
Establishment									
	General equilibrium								
Small firm-Young	1.2218	1.2210	1.2232	1.2232	1.2232	1.2232	-5.0121	1.2424	1.2207
Small firm-Old	1.1922	1.1929	1.1840	1.1840	1.1840	1.1840	-1.9374	1.2018	1.1817
Large firm-Young	-50.0649	-37.9874	-76.5191	-43.2119	37.7872	-76.5191	-28.7067	-76.3287	-76.5644
Large firm-Old	-9.7032	-10.5125	1.5029	1.5029	1.5029	1.5029	-9.4557	1.5308	1.4963
All	-0.0977	-0.0774	-0.3016	0.2430	2.3879	-0.3016	-10.5177	-1.1456	-0.1848
	Partial equilibrium								
Small firm-Young	0	0	0	0	0	0	0	0	0
Small firm-Old	0	0	0	0	0	0	0	0	0
Large firm-Young	-50.6065	-38.6600	-76.7740	-43.8283	36.2916	-76.7740	-22.4489	-76.5897	-76.8178
Large firm-Old	-10.9923	-11.7861	0	0	0	0	0	0	0
All	-1.2969	-1.2769	-1.4981	-0.9625	1.1468	-1.4981	-7.2003	-2.3626	-1.3784
	Impact computed from reduced form estimates assuming SUTVA								
Small firm-Young	0	0	0	0	0	0	0	0	0
Small firm-Old	0	0	0	0	0	0	0	0	0
Large firm-Young	-50.6676	-38.7354	-76.8028	-43.8981	36.1222	-76.8028	-24.9448	-76.6192	-76.8470
Large firm-Old	-10.7671	-11.5674	0.3152	0.3152	0.3152	0.3152	-7.6668	0.3250	0.3109
All	-1.2765	-1.2566	-1.4771	-0.9383	1.1834	-1.4771	-8.5748	-2.3283	-1.3593
	Reduced form estimates for young establishments of large firms								
$\hat{\alpha}_1$	-0.7066	-0.4900	-1.4611	-0.5780	0.3084	-1.4611	-0.2869	-1.4533	-1.4630
$\widehat{Bias}$	-0.0121	-0.0121	-0.0122	-0.0122	-0.0122	-0.0122	0.0514	-0.0123	-0.0121
	Reduced form estimates for old establishments of large firms								
$\hat{\alpha}_1$	-0.1142	-0.1232	0.0028	0.0028	0.0028	0.0028	-0.0479	0.0028	0.0027
$\widehat{Bias}$	-0.0119	-0.0119	-0.0118	-0.0118	-0.0118	-0.0118	0.0196	-0.0119	-0.0117

Notes: This table displays the impact of the reform estimated from the structural model and from the reduced form estimates assuming SUTVA. All figures are variations in percentage between the pre-reform and the post-reform steady states except for rows $\hat{\alpha_1}$ and $\widehat{Bias}$ which report values defined equation in (22). L is total employment, L_p is permanent employment, L_t is temporary employment. $U \to X$ is the percentage change in the number of entries from unemployment to $X = L, L_p, L_t$. A similar notation applies to outflows from employment. "Small firm-Young" stands for the young establishments created by small firms. A similar notation applies to other establishment types. Figures account for the variation in the number of establishments of firms. Hence, 1.2218 in the first row, first column, means that total employment of all young establishments of small firms increased by 1.2218% on average. $\hat{\alpha_1}$ is the reduced form estimate assuming SUTVA computed from equation (22) and $\widehat{Bias}$ is the bias in the estimate defined in the same equation (cf Appendices D and E). Panel "Impact computed from reduced from estimates assuming SUTVA" reports the evaluation of the impact of the reform computed by applying $\hat{\alpha_1}$, assuming that the control group for young establishments of large firms are the young establishments of small firms and that the control group for old establishments of large firms are the old establishments of small firms. Row "All" of this panel, which reports the evaluation of the impact of the reform on aggregate outcomes, is computed by adding the reaction of old and young establishments of large firms reported in this panel.

Table 9: Impact of the reform on worker flows

	Unemployment exit rate			Vacancy filling rate			Separation rate		Conversion rate
	$U \to L$	$U \to L_p$	$U \to L_t$	$V \to L$	$V \to L_p$	$V \to L_t$	$L_p \to U$	$L_t \to U$	$L_t \to L_p$
Establishment									
	General equilibrium								
Small firm-Young	-1.7493	-1.7493	-1.7493	1.7804	1.7804	1.7804	-3.9604	-1.5193	3.4746
Small firm-Old	-1.8720	-1.8720	-1.8720	1.9077	1.9077	1.9077	-3.9604	-1.5193	3.4746
Large firm-Young	17.0456	183.9925	-51.6036	-14.5632	107.2986	-64.6734	-3.9604	-1.5193	3.4746
Large firm-Old	-2.0624	-2.0624	-2.0624	2.1058	2.1058	2.1058	-3.9604	-1.5193	3.4746
	Partial equilibrium								
Small firm-Young	0	0	0	0	0	0	0	0	0
Small firm-Old	0	0	0	0	0	0	0	0	0
Large firm-Young	20.3988	192.1283	-50.2172	-16.9427	101.5253	-65.6572	0	0	0
Large firm-Old	0	0	0	0	0	0	0	0	0

Notes: This table displays the impact of the reform estimated from the structural model on worker flows. All figures are variations in percentage between the pre-reform and the post-reform steady states flow rates. $U \to X$ is the percentage change in the exit rate from unemployment to $X = L, L_p, L_t$. A similar notation applies to separation rates. $V \to X$ is the percentage change in the vacancy filling rate with any type of job ($X = L$), a permanent job ($X = L_p$) or a temporary job ($X = L_t$). "Small firm-Young" stands for the young establishments created by small firms. A similar notation applies to other establishment types. To avoid complexities in the interpretation of the results due to composition effects induced by the reallocation of jobs across establishment types, changes in vacancy rates, separation rates and conversion rates are reported for a single value of the establishment productivity parameter z, equal to the median value of z of the young establishments of large firms.

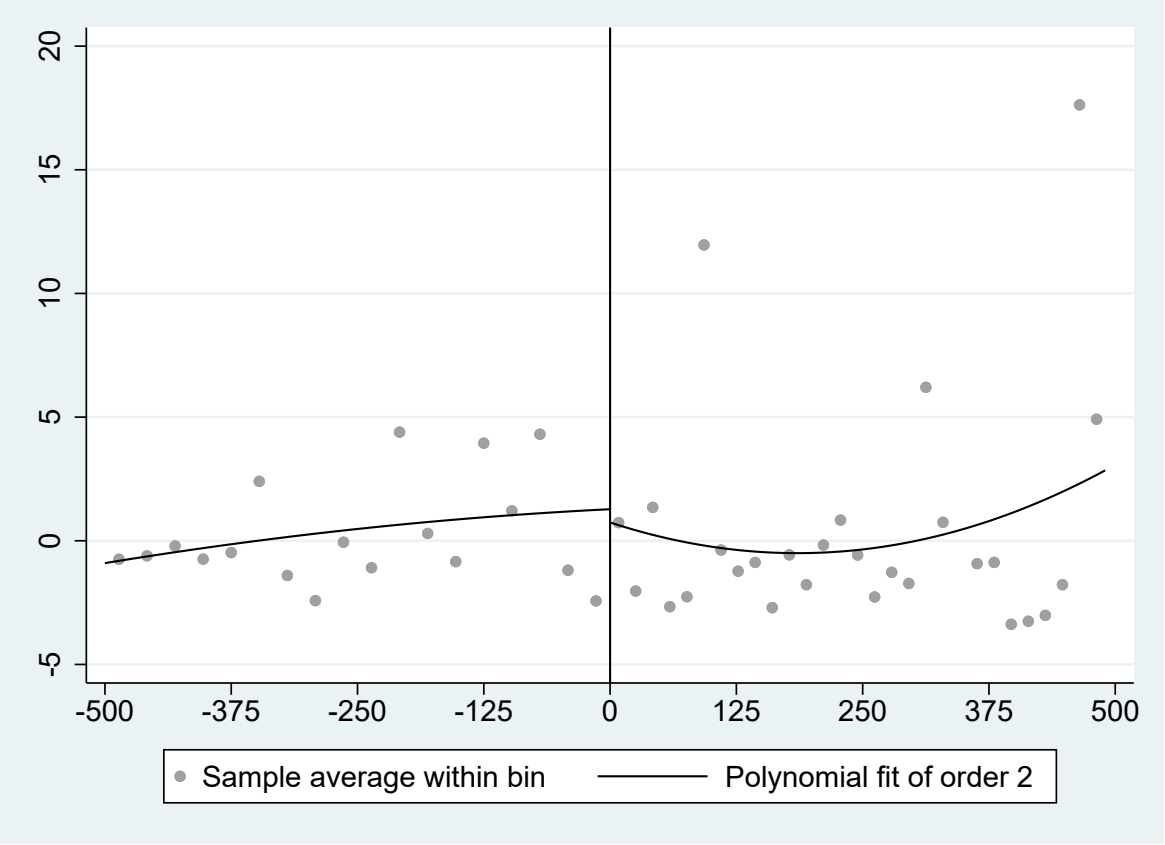
Table 10: Welfare effects of the reform

	W_p	W_t	W_u
Establishment type			
Small firm-Young	−1.14	−0.60	
Small firm-Old	−0.44	−0.60	
Large firm-Young	13.27	−0.73	
Large firm-Old	0.18	−0.65	
Total	−0.07	−0.80	−0.73

Notes: This table displays the welfare impact of the reform estimated from the structural model. Figures report the changes in the average welfare of different categories of workers by establishment type. All figures are variations in percentage between the pre-reform and the post-reform steady states. W_u stands for the discounted expected utility of unemployed workers defined equation (3), W_p is the welfare of permanent workers and W_t denotes the welfare of temporary workers. W_p and W_t are defined in Appendix B.7.1. "Small firm-Young" stands for the young establishments created by small firms. A similar notation applies to other establishment types.

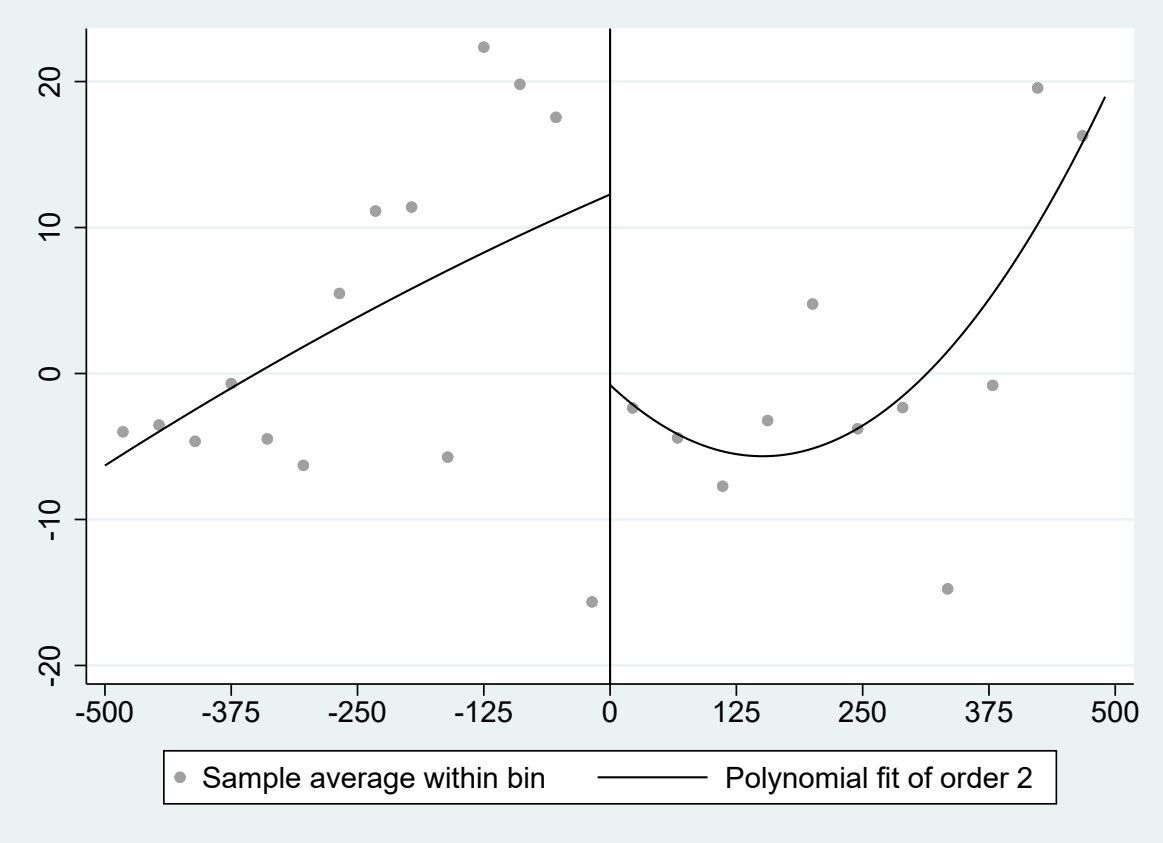
A Appendix: Supplementary figures and tables

Figure 11: **New establishments by 2010, shorter range**



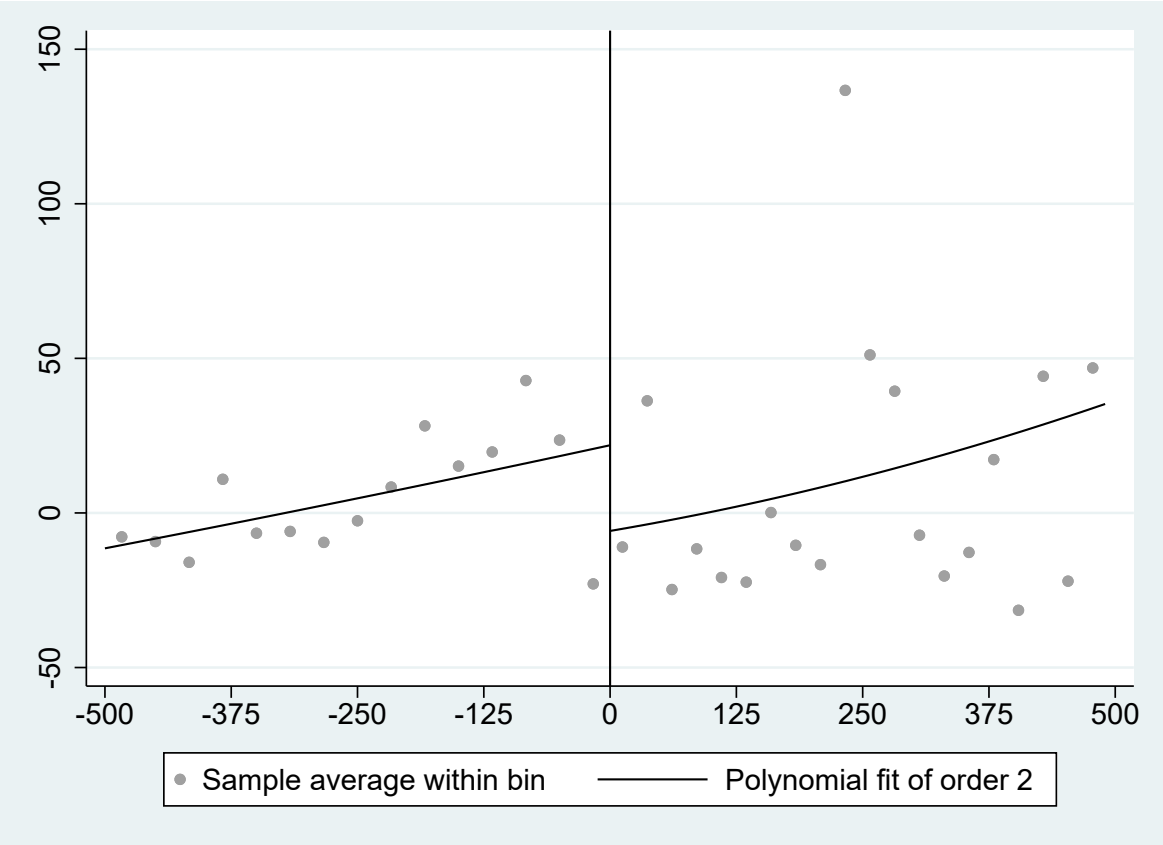
Notes: Dependent variable: number of new establishments (created in 2009 or 2010) by firms of different sizes (total number of employees) in 2008. Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 12: **New hires in new establishments under fixed-term contracts, shorter range**



Notes: Dependent variable: total employment-month-hours (divided by 1,000) of new fixed-term contracts in new establishments. (New employment contracts are those created from March 2009.) Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Firm size is centered at 750 employees. Own calculations using 'Quadros de Pessoal' data.

Figure 13: **New hires in new establishments under fixed-term and permanent contracts, shorter range**



Notes: Dependent variable: total employment-month-hours (divided by 1,000) of new fixed-term and permanent contracts in new establishments. Firm size is centered at 750 employees. (New employment contracts are those created from March 2009.) Data obtained following controlling for ten one-digit industry effects and 0.1% winsorizing. Own calculations using 'Quadros de Pessoal' data.

Table 11: Robustness: Effects on the number of new establishments per firm (additional controls)

	(1)	(2)	(3)	(4)
Large firm	-.653	-.609	-.807	
	(.441)	(.361)*	(.286)***	
Firm size (centered)	.0007	.0008	-.0002	
	(.0004)	(.0004)*	(.001)	
Firm size^2		-1.05e-06	-2.21e-06	
		(4.12e-07)**	(1.62e-06)	
Firm size*Large firm			.002	
			(.003)	
Const.	.706	1.069	.926	
	(.296)**	(.251)***	(.326)***	
Obs.	2875	2875	2875	

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2,000 workers in October 2008. Poisson regression of the number of new establishments (created in 2009 and 2010) of each firm, as measured in October 2010. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects, capital equity, foreign ownership share, domestic private ownership share, sales, number of establishments, firm age, and three regional dummy variables (Lisbon, Porto and Braga). Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 12: Robustness: Effects on fixed-term contracts in new establishments (additional controls)

	(1)	(2)	(3)
Large firm	-1.796	-1.343	-1.300
	(.445)***	(.367)***	(.346)***
Firm size (centered)	.002	.002	.002
	(.0004)***	(.0004)***	(.001)**
Firm size^2		-1.02e-06	-7.59e-07
		(3.65e-07)***	(1.34e-06)
Firm size*Large firm			-.0005
			(.002)
Const.	2.613	2.815	2.843
	(.424)***	(.423)***	(.447)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in fixed-term contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. Tenure- and hours-weighted employment measure. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects, capital equity, foreign ownership share, domestic private ownership share, sales, number of establishments, firm age, and three regional dummy variables (Lisbon, Porto and Braga). Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 13: Robustness: Effects on permanent contracts in new establishments (additional controls)

	(1)	(2)	(3)
Large firm	-.756	-.841	-.954
	(.606)	(.443)*	(.514)*
Firm size (centered)	.002	.003	.002
	(.0005)***	(.0004)***	(.002)
Firm size^2		-1.24e-06	-2.35e-06
		(4.02e-07)***	(2.01e-06)
Firm size*Large firm			.002
			(.004)
Const.	1.673	2.224	2.087
	(.416)***	(.418)***	(.515)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects, capital equity, foreign ownership share, domestic private ownership share, sales, number of establishments, firm age, and three regional dummy variables (Lisbon, Porto and Braga). Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 14: Robustness: Effects on both fixed-term and permanent contracts in new establishments (additional controls)

	(1)	(2)	(3)
Large firm	-1.180	-1.021	-1.084
	(.438)***	(.332)***	(.372)***
Firm size (centered)	.002	.003	.002
	(.0003)***	(.0003)***	(.001)**
Firm size^2		-1.08e-06	-1.56e-06
		(2.97e-07)***	(1.36e-06)
Firm size*Large firm			.0009
			(.002)
Const.	2.938	3.308	3.253
	(.369)***	(.367)***	(.410)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in both fixed-term and permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects, capital equity, foreign ownership share, domestic private ownership share, sales, number of establishments, firm age, and three regional dummy variables (Lisbon, Porto and Braga). Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 15: Robustness: Effects on fixed-term contracts in new establishments, shorter range

	(1)	(2)	(3)
Large firm	-1.370	-1.280	-1.285
	(.413)***	(.401)***	(.651)**
Firm size (centered)	.002	.002	.002
	(.0006)***	(.0008)***	(.0007)***
Firm size^2		-4.48e-07	
		(1.47e-06)	
Firm size*Large firm			-.0002
			(.002)
Const.	2.467	2.465	2.476
	(.558)***	(.558)***	(.566)***
Obs.	758	758	758

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 250 and 1,250 workers in October 2008. Poisson regression of new hires in fixed-term contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. Tenure- and hours-weighted employment measure. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 16: Robustness: Effects on both fixed-term and permanent contracts in new establishments, shorter range

	(1)	(2)	(3)
Large firm	-1.152	-1.051	-.994
	(.453)**	(.483)**	(.765)
Firm size (centered)	.003	.002	.003
	(.0006)***	(.0008)***	(.0007)***
Firm size^2		-6.33e-07	
		(1.41e-06)	
Firm size*Large firm			-.0004
			(.002)
Const.	2.767	2.772	2.790
	(.514)***	(.515)***	(.523)***
Obs.	758	758	758

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 250 and 1,250 workers in October 2008. Poisson regression of new hires in both fixed-term and permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 17: Robustness: Effects on both fixed-term contracts in new establishments, establishment-level analysis

	(1)	(2)	(3)
Large firm	-3.009	-2.726	-2.346
	(1.190)**	(1.148)**	(1.087)**
Firm size (centered)	.003	.003	.005
	(.0009)***	(.0009)***	(.001)***
Firm size^2		-2.38e-06	
		(8.45e-07)***	
Firm size*Large firm			-.005
			(.002)***
Const.	3.546	4.366	4.839
	(.920)***	(1.013)***	(1.106)***
Obs.	7610	7610	7610

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all (2009-2010) new establishments of all firms in Portugal employing between 250 and 1,250 workers in October 2008. Poisson regression of new hires in fixed-term contracts in each new establishment of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 18: Robustness: Existing establishments, 2008

	(1)	(2)	(3)
Large firm	-.469	-.461	-.383
	(.348)	(.281)	(.273)
Firm size (centered)	.002	.002	.002
	(.0003)***	(.0002)***	(.0002)***
Firm size^2		-7.74e-07	
		(2.77e-07)***	
Firm size*Large firm			-.002
			(.0005)***
Const.	2.504	2.805	2.907
	(.193)***	(.174)***	(.182)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2005. Poisson regression of existing establishments of each firm in October 2008. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 19: Robustness: Falsification test, fixed-term contracts, existing establishments

	(1)	(2)	(3)
Large firm	-.604	-.533	-.387
	(.331)*	(.190)***	(.184)**
Firm size (centered)	.002	.002	.003
	(.0002)***	(.0002)***	(.0002)***
Firm size^2		-1.69e-06	
		(1.96e-07)***	
Firm size*Large firm			-.003
			(.0003)***
Const.	3.864	4.457	4.603
	(.225)***	(.198)***	(.201)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2005. Poisson regression of new hires in fixed-term contracts in all existing establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 20: Robustness: Falsification test, fixed-term and permanent contracts, existing establishments

	(1)	(2)	(3)
Large firm	-.432	-.571	-.428
	(.266)	(.165)***	(.153)***
Firm size (centered)	.002	.002	.003
	(.0002)***	(.0002)***	(.0002)***
Firm size^2		-1.46e-06	
		(1.47e-07)***	
Firm size*Large firm			-.003
			(.0003)***
Const.	4.379	4.999	5.134
	(.174)***	(.164)***	(.172)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in both fixed-term and permanent contracts in all existing establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 21: Robustness: Falsification test, fixed-term contracts, 2007 instead of 2010

	(1)	(2)	(3)
Large firm	.358	-.094	.073
	(.637)	(.343)	(.335)
Firm size (centered)	.001	.002	.004
	(.0004)***	(.0003)***	(.0004)***
Firm size^2		-2.55e-06	
		(2.99e-07)***	
Firm size*Large firm			-.004
			(.0005)***
Const.	3.218	4.250	4.431
	(.478)***	(.423)***	(.437)***
Obs.	2876	2876	2876

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2005. Poisson regression of new hires in fixed-term contracts in all new establishments of each firm in October 2007. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2005) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2005. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 22: Robustness: Falsification test, fixed-term and permanent contracts, 2007 instead of 2010

	(1)	(2)	(3)
Large firm	.214	-.256	-.058
	(.506)	(.287)	(.278)
Firm size (centered)	.001	.002	.004
	(.0003)***	(.0003)***	(.0003)***
Firm size^2		-2.31e-06	
		(2.63e-07)***	
Firm size*Large firm			-.004
			(.0004)***
Const.	3.451	4.450	4.605
	(.403)***	(.357)***	(.369)***
Obs.	2876	2876	2876

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2005. Poisson regression of new hires in both fixed-term and permanent contracts in all new establishments of each firm in October 2007. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2005) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 750 or more workers in 2005. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 23: Robustness: Falsification test, fixed-term contracts, 500-worker threshold

	(1)	(2)	(3)
Large firm (500)	.865	.267	.175
	(.313)***	(.370)	(.273)
Firm size (centered)	.0006	.002	.004
	(.0003)*	(.0005)***	(.0006)***
Firm size^2		-1.18e-06	
		(4.84e-07)**	
Firm size*Large firm			-.004
			(.0007)***
Const.	1.766	2.244	2.641
	(.367)***	(.401)***	(.384)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in fixed-term contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 500, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 500 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 24: Robustness: Falsification test, fixed-term and permanent contracts, 500-worker threshold

	(1)	(2)	(3)
Large firm (500)	.863	.252	.210
	(.290)***	(.355)	(.255)
Firm size (centered)	.0009	.002	.004
	(.0003)***	(.0005)***	(.0005)***
Firm size^2		-1.05e-06	
		(3.71e-07)***	
Firm size*Large firm			-.003
			(.0006)***
Const.	2.183	2.643	2.967
	(.305)***	(.339)***	(.322)***
Obs.	2875	2875	2875

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all firms in Portugal employing between 100 and 2000 workers in October 2008. Poisson regression of new hires in both fixed-term and permanent contracts in all new establishments of each firm in October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the firm in 2008) is centered at 500, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for firms employing 500 or more workers in 2008. Control variables are 10 industry fixed effects. Standard errors clustered at the firm size level. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 25: Robustness: spillover effects, different region definition

	(1)	(2)	(3)	(4)
Large firm	.032	.044	.057	.673
	(.020)	(.022)**	(.029)**	(.238)***
Firm size	.00003	.00002	-4.00e-06	.00004
	(.00002)	(.00002)	(.00005)	(.00002)**
Firm size^2		-4.82e-08	-5.96e-08	
		(2.17e-08)**	(2.60e-08)**	
Firm size^3			3.66e-11	
			(6.27e-11)	
Firm size*Large firm				-.00005
				(.00004)
Firm (1-99) size	.042	.097	.163	.042
	(.0001)***	(.0003)***	(.0004)***	(.0001)***
Firm (1-99) size^2		-.0007	-.003	
		(4.06e-06)***	(9.59e-06)***	
Firm (1-99) size^3			.00002	
			(7.93e-08)***	
Firm (1-99) size*Large firm				.0009
				(.0003)***
Const.	7.051	6.635	6.307	7.060
	(.010)***	(.011)***	(.014)***	(.011)***
Obs.	1.62e+07	1.62e+07	1.62e+07	1.62e+07

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all dyads of firms in Portugal employing between 100 and 2000 workers in October 2008 and firms employing between 1 and 100 workers that operate in the same one-digit industry and region ('distrito'). Poisson regression of new hires in both fixed-term and permanent contracts in each 1-99 firm by October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the 100-2000 firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for 100-2000 firms employing 750 or more workers in 2008. Standard errors clustered at the 100-2000 firm identifier. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 26: Robustness: spillover effects, wider small firm definition

	(1)	(2)	(3)	(4)
Large firm	.072	.069	.098	-.125
	(.035)**	(.033)**	(.040)**	(.131)
Firm size	-.00002	-4.51e-06	-.00008	1.00e-05
	(.00003)	(.00003)	(.00007)	(.00003)
Firm size^2		-9.03e-08	-1.11e-07	
		(2.95e-08)***	(3.66e-08)***	
Firm size^3			1.08e-10	
			(8.17e-11)	
Firm size*Large firm				-.00009
				(.00006)
Firm (1-99) size	.019	.050	.083	.019
	(.00005)***	(.0002)***	(.0002)***	(.00005)***
Firm (1-99) size^2		-.0002	-.0006	
		(1.12e-06)***	(2.06e-06)***	
Firm (1-99) size^3			1.38e-06	
			(5.90e-09)***	
Firm (1-99) size*Large firm				-.0003
				(.0002)
Const.	7.471	7.088	6.787	7.485
	(.016)***	(.017)***	(.019)***	(.020)***
Obs.	3020002	3020002	3020002	3020002

Notes: The columns present different specifications of a (sharp) regression discontinuity model. The sample used is composed of all dyads of firms in Portugal employing between 250 and 2000 workers in October 2008 and firms employing between 1 and 249 workers that operate in the same one-digit industry and region ('concelho'). Poisson regression of new hires in both fixed-term and permanent contracts in each 1-249 firm by October 2010. Employment is weighted by the months with the firm and the hours worked of each new hire. The running variable (total number of workers of the 250-2000 firm in 2008) is centered at 750, when it takes value zero. The key regressor (Large firm) is a dummy variable taking value one for 250-2000 firms employing 750 or more workers in 2008. Standard errors clustered at the 250-2000 firm identifier. Own calculations based on the 'Quadros de Pessoal' data set. Significance levels: * 0.10, ** 0.05, *** 0.01.

Table 27: Effect of the reform on the number of establishments

Var.	Partial eq. after reform	General eq. after reform
Small firm - Young	0.00	0.09
Small firm- Old	0.0000	0.09
Large firm - Young	-10.27	-9.97
Large firm - Old	-10.28	-9.9703

Notes: This table displays the impact of the reform estimated from the structural model on the number of establishments of different types of firm. All figures are variations in percentage between the pre-reform and the post-reform steady states. "Small firm-Young" stands for the young establishments of small firms. A similar notation applies to other establishment types.

B Appendix: Theoretical model

This appendix presents the solution of the theoretical model. We start by presenting the computation of the surplus of jobs before presenting the value of establishments. Then, we derive the aggregate labor demand $L(W_u)$ and aggregate labor supply.

B.1 Job surplus

This appendix presents the computation of job surpluses. In all what follows, for the sake of simplicity, and without loss of generality, it is assumed that the value of vacant jobs is equal to zero, which holds true in equilibrium.

B.1.1 Surplus of continuing permanent jobs

Let us compute the value of the surplus of continuing permanent marginal jobs of productivity εz in a type-(z,π) establishment. The value for workers and firms are (assuming that there are no dismissal costs when the firm is destroyed):

$$\begin{aligned} W_p^c(\varepsilon,z) &= w_p^c(\varepsilon,z) + \beta(1-\mu)\lambda \int \max\left[W_p^c(\varepsilon,z), W_u\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)W_p^c(\varepsilon,z) + \beta\mu W_u \\ J_p^c(\varepsilon,z) &= \varepsilon z - w_p^c(\varepsilon,z) + \beta(1-\mu)\lambda \int \max\left[J_p^c(\varepsilon,z), -F\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)J_p^c(\varepsilon,z) \end{aligned}$$

Therefore, from the definition of the surplus:

$$S_p^c(\varepsilon,z) = W_p^c(\varepsilon,z) - W_u + J_p^c(\varepsilon,z) + F$$

and the 2 previous equations we get

$$S_p^c(\varepsilon,z) = \varepsilon z - (1-\beta)\left(W_u - F\right) + \beta\mu F + \beta\lambda \int \max\left[S_p^c(\varepsilon,z), 0\right] dG(\varepsilon) + \beta(1-\lambda)S_p^c(\varepsilon,z) \tag{B1}$$

B.1.2 Surplus of starting permanent jobs

The relation between the surplus of a starting permanent jobs $S_p(z)$, which starts with productivity ε_u by assumption, and a continuing permanent job is

$$S_p^c(\varepsilon_u,z) = S_p(z) + F \tag{B2}$$

This relation together with the definition (B1) of $S_p^c(\varepsilon,z)$ yields

$$S_p(z) = z\varepsilon_u - (1-\beta)W_u - \beta(1-\mu)F + \beta(1-\mu)\lambda \int \max\left[S_p^c(\varepsilon,z), 0\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)S_p^c(\varepsilon_u,z)$$

B.1.3 Reservation productivity

The expression of the surplus of continuing job implies that continuing permanent jobs are destroyed when the productivity drops below the reservation value R

$$R(z) = \left\{R | S_p^c(R,z) = 0\right\} \tag{B3}$$

which implies, from equation (B1):

$$R(z) = \frac{1}{z}\left[(1-\beta)\left(W_u - F\right) + \beta\mu F\right] - \frac{\beta(1-\mu)\lambda}{1-\beta(1-\mu)(1-\lambda)} \int_{R(z)}^{\infty} \left(\varepsilon - R(z)\right) \mathrm{d}G(\varepsilon) \tag{B4}$$

It can be easily checked that this equation defines a positive relation between the reservation value $R(z)$

and the expected value of unemployed workers, W_u. Using once again equation (B1) and the definition of the reservation productivity (B3) we can also write the surplus of a continuing job as follows

$$S_p^c(\varepsilon, z) = \frac{z\left[\varepsilon - R(z)\right]}{1-\beta(1-\mu)(1-\lambda)} \tag{B5}$$

Therefore, the relation (B2) between the surplus of starting and continuing jobs yields

$$S_p(\varepsilon, z) = \frac{z\left[\varepsilon - R(z)\right]}{1-\beta(1-\mu)(1-\lambda)} - F \tag{B6}$$

Since the reservation value $R(z)$ increases with W_u, the two previous equations imply that the surpluses of permanent jobs decrease with the expected value of unemployed workers, W_u.

B.1.4 Surplus of temporary jobs

Temporary jobs are destroyed instead of transformed if the productivity is below the threshold value

$$T(z) = \{T | S_p(T, z) = 0\}$$

Using equations (B1) and (B4), this implies that

$$T(z) = R(z) + \frac{F}{z}\left[1-\beta(1-\mu)(1-\lambda)\right] \tag{B7}$$

Now, let us compute the value of the surplus of starting temporary jobs in a type-(z, π) establishment. The value for workers and firms are respectively

$$\begin{aligned} W_t(z) &= w_t(z) + \beta(1-\mu)\lambda \int \max\left[W_p(\varepsilon, z), W_u\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)W_p(\varepsilon_u, z) + \beta\mu W_u \\ J_t(z) &= z\varepsilon_u - w_t(z) + \beta(1-\mu)\lambda \int \max\left[J_p(\varepsilon, z), 0\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)J_p(\varepsilon_u, z) \end{aligned}$$

Therefore, the surplus of a temporary job

$$S_t(z) = W_t(z) - W_u + J_t(z)$$

can be written as follows:

$$\begin{aligned} S_t(z) &= \beta(1-\mu)\lambda \int \max\left[S_p(\varepsilon, z), 0\right] \mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)S_p(\varepsilon_u, z) \\ &\quad + \beta(1-\mu)F - \beta(1-\mu)\lambda \int \max\left[S_p^c(\varepsilon, z), 0\right] \mathrm{d}G(\varepsilon) - \beta(1-\mu)(1-\lambda)S_p^c(\varepsilon_u, z) \end{aligned}$$

From this equation and from equation (B1), we can show that the surplus of temporary jobs is bigger than the surplus of permanent starting jobs. We get:

$$\begin{aligned} S_t(z) - S_p(z) = \beta(1-\mu)F + \beta(1-\mu)\lambda \int_{T(z)}^{\infty} S_p(\varepsilon, z)\mathrm{d}G(\varepsilon) + \beta(1-\mu)(1-\lambda)S_p(\varepsilon_u, z) \\ -\beta(1-\mu)\lambda \int_{R(z)}^{\infty} S_p^c(\varepsilon, z)\mathrm{d}G(\varepsilon) - \beta(1-\mu)(1-\lambda)S_p^c(\varepsilon_u, z) \end{aligned}$$

Using the relation

$$S_p^c(\varepsilon, z) = S_p(\varepsilon, z) + F,$$

we can writte the difference $S_t(z) - S_p(z)$ as follows

$$S_t(z) - S_p(z) = \beta(1-\mu)\lambda \left[- \int_{R(z)}^{T(z)} S_p(\varepsilon, z)\mathrm{d}G(\varepsilon) + G(R)F \right] \tag{B8}$$

Since, by definition $S_p(T(z),z)=0$ and $S_p(\varepsilon,z)$ increases with ε, and $T(z)>R(z)$, the integral $\int_{R(z)}^{T(z)} S_p(\varepsilon,z)\mathrm{d}G(\varepsilon)$ is negative, which implies that $S_t(z)-S_p(z)>0$. Thus, the surplus of temporary jobs is larger than the surplus of starting permanent jobs.

Equation (B8) together with equation (B2) implies that

$$S_t(z)=S_p^c(\varepsilon_u,z)+\beta(1-\mu)\lambda\int_{T(z)}^{R(z)}\left[S_p^c(\varepsilon_u,z)\right]\mathrm{d}G(\varepsilon)-F\left[1-\beta\lambda(1-\mu)\left[1-G(T(z))\right]\right] \tag{B9}$$

Since the surplus of continuing permanent jobs $S_p^c(\varepsilon_u,z)$ decreases with W_u, and R increases with W_u, as shown above, this last equation implies, together with equation (B7) that the surplus of temporary jobs decreases with W_u.

Finally, we get a simple expression of the surplus of starting job in a type-(z,π) establishments:

$$S(z,\pi)=(1-\pi)S_t(z)+\pi S_p(z)$$

which can be written, using the previous equations:

$$S(z,\pi)=\frac{z\left(\varepsilon-R(z)\right)}{1-\beta(1-\mu)(1-\lambda)}+(1-\pi)\beta(1-\mu)\lambda\int_{T(z)}^{R(z)}\frac{z\left(\varepsilon-R(z)\right)}{1-\beta(1-\mu)(1-\lambda)}\mathrm{d}G(\varepsilon)$$
$$-F\left[1-(1-\pi)\beta(1-\mu)\lambda G(T(z))\right] \tag{B10}$$

This expression of the surplus shows that it can be expressed as function of the single endogenous variable W_u by using the expressions of $R(z)$ (from equation (B4)) and $T(z)$ (from equation (B7)). Moreover, since we have shown that the job surplus of permanent and temporary jobs decrease with W_u (see equations (B6) and (B9)) the job surplus of starting jobs also decreases with W_u.

B.2 The value of type-(z,π) establishments

Let us analyze the properties of type-(z,π) establishments. As indicated in footnote XX, we assume that establishments created by large and small firms can have different vacancy cost functions, which are homogeneous of degree $\alpha>1$:

$$C_i(v)=c_i v^{\alpha}, i=s,b$$

where $c_i>0$ can be different for small firms ($i=s$) and large firms ($i=b$). We also assume that the stringency of regulation of temporary contracts can be different in establishments managed by large and small firms, because firms of different size can have different abilities to cope with the regulation. Therefore, we denote by π_{ih} and $\pi_{i\ell}$ the minimum share of permanent jobs created by old and young establishments respectively created by type-i firms.

From above, we know that the value of marginal jobs $J(z,\pi_{ij})$ does not depend on the number of jobs in the establishment. Therefore, the optimality condition for the number of vacancies

$$C_i'(v_{ij})=\beta(1-\mu)m(\theta(z,\pi_{ij}))J(z,\pi_{ij}), i=s,b; j=h,\ell \tag{B11}$$

does not depend on the number of jobs in the establishment: it is constant over time if the environment of the establishment is stationary. In this setup, it is easy to compute the steady state value of a type-(z,π) establishments. Note also that function $\theta(z,\pi)$, which is determined by equation (9), which stems from the Hosios condition and the non-arbitrage condition of unemployed workers, depends on the establishment type-(z,π) but does not depend of the properties of the vacancy cost function of the establishment.

Let us first compute the net values of type-(z,π_{ih}) establishments created by large and small firms, which are defined, at any date t, as the present value of profits induced by the hires from date $t+1$, net of creation costs of job vacancies from date t. By definition, this value is net of the present value of profits induced by past

job vacancies. Establishments are destroyed with probability μ at the end of every period $t \geq 0$.

At each date $t \geq 1$, there are $v_i(z, \pi_{ih})m(\theta(z, \pi_{ih}))$ job creations in type-(z, π_{ih}) establishment created by type-i firms, and each job creation yields an expected gain equal to $J(z, \pi_{ih})$. Therefore, the present value of all job creations, that will occur from date 1 to infinite in a type-(z, π_{ih}) establishment created by type-i firm, is equal to

$$v_i(z, \pi_{ih})m(\theta(z, \pi_{ih})) \sum_{t=1}^{\infty} [\beta(1-\mu)]^t J(z, \pi_{ih}) = \frac{v(z, \pi_{ih})m(\theta(z, \pi_{ih}))\beta(1-\mu)J(z, \pi_{ih})}{1-\beta(1-\mu)}$$

The present cost of job vacancies (created from date 0) is equal to $\sum_{t=0}^{\infty} [\beta(1-\mu)]^t C_i [v_i(z, \pi_{ih})]$. Thus, we get

$$\Pi_i(z, \pi_{ih}) = \frac{v(z, \pi_{ih})m(\theta(z, \pi_{ih}))\beta(1-\mu)J(z, \pi_{ih}) - C_i [v_i(z, \pi_{ih})]}{1-\beta(1-\mu)}$$

The homogeneity of degree α of the vacancy cost function C_i implies that $C_i'(v) = \alpha C_i(v)/v$. Using this condition together with the previous equation, the optimality condition (10) and the Hosios condition, which implies that $J(z, \pi_{ih}) = (1-\eta)S(z, \pi_{ih})$, we get

$$\Pi_i(z, \pi_{ih}) = \frac{(\alpha-1)v_i(z, \pi_{ih})m(\theta(z, \pi_{ih}))\beta(1-\mu)(1-\eta)S(z, \pi_{ih})}{\alpha [1-\beta(1-\mu)]}, i = s, b. \tag{B12}$$

Using equation (9) we get

$$\Pi_i(z, \pi_{ih}) = \frac{(\alpha-1)(1-\mu)(1-\eta)}{\alpha [1-\beta(1-\mu)] \eta} u_i(z, \pi_{ih}) [(1-\beta)W_u - b] \tag{B13}$$

This equation implies that $\Pi_i(z, \pi_h)$ increases with z because when z is higher, the surplus of jobs is also higher and it is possible to attract more unemployed workers, $u_i(z, \pi)$, in the labor pool of the establishment. Equation (B12) implies that $\Pi_i(z, \pi) > 0$ for all z such that $S(z, \pi) > 0$ because equation (9) implies that the labor market tightness is positive, and goes to infinite when $S(z, \pi)$ goes to zero. This means that if $S(z, \pi) \leq 0$, the establishment cannot promise a utitly $W(z, \pi) > W_u$ which implies that it cannot recruit workers. This implies that type-(z, π_{ih}) establishments whether they are created by small of large firms, are created (or continue to hire from the date at which they have to be transformed from type-$\pi_{i\ell}$ to type-π_{ih}) only if their productivity type z is above the threshold

$$\bar{z}(\pi_{ih}) = \{z | S(z, \pi_{ih}) = 0\}. \tag{B14}$$

These reservation productivities can be defined as function of the single endogenous variable W_u. To do so, we use the definition of the job surplus (B10) together with its properties decribed below equation (B10). Since job surpluses decrease with W_u and increase with z, equation (B14) implies that $\bar{z}(\pi_{ih})$ increases with W_u.

Now, let us compute the net value of type-$(z, \pi_{i\ell})$ establishments. Let us start to remark that the threshold value of productivity z above which establishments are created is identical for type-$\pi_{i\ell}$ and type-π_{ih} establishments because $S(z, \pi_{ih}) < S(z, \pi_{i\ell})$ and all establishments need to have permanent jobs created by large and small firms.

In type-$(z, \pi_{i\ell})$ establishments created by type-i firms, at each date $t \geq 1$, there are $v_i(z, \pi_{i\ell})m(\theta(z, \pi_{i\ell}))$ job creations and each job creation which yields an expected gain equal to $J(z, \pi_{i\ell})$. It is assumed that establishments can be transformed into type-(z, π_{ih}) establishment from the end of period $t = 1$, i.e. young establishments are young at least one period. For all dates $t > 1$, the per period probability that type-$(z, \pi_{i\ell})$ establishments are transformed into type-(z, π_{ih}) establishments is equal to ρ and the probability of destruction is equal to μ. Therefore, the present value of all job creations, that will occur from date 1 to infinite in type-$(z, \pi_{i\ell})$

establishements created by type-i firms is equal to

$$v_i(z,\pi_{i\ell})m(\theta(z,\pi_{i\ell}))J(z,\pi_{i\ell})\sum_{t=1}^{\infty}(1-\rho)^{t-1}\left[\beta(1-\mu)\right]^t+v_i(z,\pi_{ih})m(\theta(z,\pi_{ih}))J(z,\pi_{ih})\sum_{t=2}^{\infty}\left[1-(1-\rho)^{t-1}\right]\left[\beta(1-\mu)\right]^t.$$

Since

$$\begin{aligned}\sum_{t=1}^{\infty}(1-\rho)^{t-1}\left[\beta(1-\mu)\right]^{t-1} &= \frac{1}{1-\beta(1-\mu)(1-\rho)}\\ \sum_{t=1}^{\infty}\left[1-(1-\rho)^{t-1}\right]\left[\beta(1-\mu)\right]^{t-1} &= \frac{\rho\beta(1-\mu)}{\left[1-\beta(1-\mu)\right]\left[1-\beta(1-\mu)(1-\rho)\right]}\end{aligned}$$

we get the present value of all job creations:

$$\frac{\beta(1-\mu)}{1-\beta(1-\mu)(1-\rho)}\left[v_i(z,\pi_{i\ell})m(\theta(z,\pi_{i\ell}))J(z,\pi_{i\ell})+\frac{\rho\beta(1-\mu)}{1-\beta(1-\mu)}v_i(z,\pi_{ih})m(\theta(z,\pi_{ih}))J(z,\pi_{ih})\right]$$

The present cost of job vacancies (created from date 0) is equal to

$$\frac{1}{1-\beta(1-\mu)(1-\rho)}\left(C_i\left[v_i(z,\pi_{i\ell})\right]+\frac{\rho\beta(1-\mu)}{\left[1-\beta(1-\mu)\right]}C_i\left[v_i(z,\pi_{ih})\right]\right)$$

Therefore, we get

$$\begin{aligned}\Pi_i(z,\pi_{i\ell}) &= \frac{v_i(z,\pi_{i\ell})m(\theta(z,\pi_{i\ell}))\beta(1-\mu)J(z,\pi_{i\ell})-C_i\left[v_i(z,\pi_{i\ell})\right]}{1-\beta(1-\mu)(1-\rho)}\\ &\quad+\beta\rho(1-\mu)\max\left[\frac{v(z,\pi_{ih})m(\theta(z,\pi_{ih}))\beta(1-\mu)J(z,\pi_{ih})-C_i\left[v_i(z,\pi_{ih})\right]}{\left[1-\beta(1-\mu)\right]\left[1-\beta(1-\mu)(1-\rho)\right]},0\right]\end{aligned}\tag{B15}$$

since C_i is homogeneous of degree $\alpha>1$, the first order condition for the creation of type-j, $j=h,\ell$, establishments created by type-i, $i=s,b$ firms, the optimality condition for vacancies (B11) can be written

$$C_i'\left[v_i(z,\pi_{ij})\right]=\frac{\alpha}{v_i(z,\pi_{ij})}C_i\left[v_i(z,\pi_{ij})\right]=m(\theta(z,\pi_{ij}))\beta(1-\mu)J(z,\pi_{ij})$$

Substituting in (B15) yields

$$\Pi_i(z,\pi_{i\ell})=\frac{(\alpha-1)\beta(1-\mu)}{\alpha\left[1-\beta(1-\mu)(1-\rho)\right]}\left[v_i(z,\pi_{i\ell})m(\theta(z,\pi_{i\ell}))J(z,\pi_{i\ell})+\frac{\rho\beta(1-\mu)v_i(z,\pi_{ih})m(\theta(z,\pi_{ih}))\max\left[J(z,\pi_{ih}),0\right]}{\left[1-\beta(1-\mu)\right]}\right]$$

and, with the Hosios condition, which implies that $J=(1-\eta)S$, we get

$$\Pi_i(z,\pi_{i\ell})=\frac{(\alpha-1)(1-\eta)\beta(1-\mu)}{\alpha\left[1-\beta(1-\mu)(1-\rho)\right]}\left[v_i(z,\pi_{i\ell})m(\theta(z,\pi_{i\ell}))S(z,\pi_{i\ell})+\frac{\rho\beta(1-\mu)v_i(z,\pi_{ih})m(\theta(z,\pi_{ih}))\max\left[S(z,\pi_{ih}),0\right]}{1-\beta(1-\mu)}\right]$$

Since $S(z,\pi_{ih})$ increases with z, this expression of $\Pi_i(z,\pi_{i\ell})$ implies that type-(z,π_{ih}) establishments, whether they are created by small of large firms, are created only if their productivity type z is above the threshold

$$\bar{z}(\pi_{i\ell})=\left\{z|S(z,\pi_{i\ell})=0\right\}.\tag{B16}$$

with $\bar{z}(\pi_{i\ell})<\bar{z}(\pi_{ih})$ because $\pi_{i\ell}<\pi_{ih}$ and $S(z,\pi)$ decreases with π. For the same reasons as for $\bar{z}(\pi_{ih})$, these reservation productivities can be defined as decreasing functions of the single endogenous variable W_u.

B.3 Aggregate labor Demand

This appendix computes the relation between the number of jobs in the economy and the present value of unemployment W_u. This corresponds to function $L(W_u,\pi_\ell,\pi_h)$ in the main text. More precisely, as indicated above in Appendix B.2, we consider a more general case than that presented in the main text since we assume that the stringency of regulation of temporary contracts can be different in establishment man-

aged by large and small firms. Therefore, we denote by π_{ih} and $\pi_{i\ell}$ the minimum share of permanent jobs created by old and young establishments respectively created by type-i firms and we define the function $L(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh}))$. To define this function, we first define the number of jobs at all ages of each establishment type-$(z, \pi_{ij}), i = s, b; j = h, \ell$. Then, we compute the number of each establishment type-(z, π_{ij}) and their age distribution. Finally, adding the employment of each establishment type we can define total employment $L(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh}))$.

Number of jobs in type-$(z, \pi_{i\ell})$ establishments We start by computing the number of jobs in young establishments created by type-$i = s, b$ firms. To do this, we compute, for each of these establishments, the number of jobs in each period from its period of creation. The job creation rate is $m(\theta(z, \pi_{i\ell}))v_i(z, \pi_{i\ell})$. Since the spell of temporary job equals one period, the number of temporay jobs in a type-$(z, \pi_{i\ell})$ establishment is

$$L_{it}(z, \pi_{i\ell}) = (1 - \pi_{i\ell})m(\theta(z, \pi_{i\ell}))v_i(z, \pi_{i\ell}) \tag{B17}$$

Together with equations (9) and (11), this equation implies that $L_{it}(z, \pi_{i\ell})$ can be defined as function of the single endogenous variable W_u. In our context, equations (9) and (11) can be written as follows:

$$\theta(z, \pi_{ij})m(\theta(z, \pi_{ij})) = \frac{(1 - \beta)W_u - b}{\beta\eta S(z, \pi_{ij})} \tag{B18}$$

$$C_i'(v_i(z, \pi_{ij})) = (1 - \mu)\frac{1 - \eta}{\eta}m(\theta(z, \pi_{ij}))\beta S(z, \pi_{ij}) \tag{B19}$$

The first equation together with the definition (B10) of the surplus defines a positive relation between the labor market tightness $\theta(z, \pi_{ij})$ and W_u (because the exit rate from unemployment $\theta m(\theta)$ increases with θ). Then, since $m'(\theta) < 0$ and $C_i^{''}(v_i(z, \pi_{ij})) > 0$, the second equation defines a negative relation between $v_i(z, \pi_{ij})$ and W_u. Using these two results in equation (B17) which defines $L_{it}(z, \pi_{i\ell})$, we find that $L_{it}(z, \pi_{i\ell})$ decreases with W_u.

The job destruction rate of permanent jobs is equal to $\lambda G(R(z))$. Temporary jobs are transformed into permanent jobs with probability $1 - \lambda G(T(z))$, where $T(z) = \{T | S_p(T, z) = 0\}$ is the threshold value of productivity below which temporary jobs are destroyed. Thus, the law of motion of the number of permanent jobs in a type-$(z, \pi_{i\ell})$ establishment is

$$L_{ip}^{+}(z, \pi_{i\ell}) = L_{ip}(z, \pi_{i\ell})\left[1 - \lambda G(R(z))\right] + m(\theta(z, \pi_{i\ell}))v_i(z, \pi_{i\ell})\left[\pi_{i\ell} + (1 - \pi_{i\ell})\left[1 - \lambda G(T(z))\right]\right]$$

Let us denote by $L_i^{\tau}(z, \pi_{i\ell})$ the number of jobs in type-$(z, \pi_{i\ell})$ establishments τ periods after their period of creation. We know that $L_i^0(z, \pi_{i\ell}) = 0$ and that the number of temporary jobs is constant from $\tau = 1$, since vacant jobs posted at $\tau = 0$ are filled at $\tau = 1$ and temporary jobs last one period only. Thus the law of motion of $L_{ip}^{+}(z, \pi_{i\ell})$ is of the form $x_{\tau+1} = ax_{\tau} + b$, with $x_0 = 0$, which implies that $x_{\tau} = b\sum_{n=1}^{\tau} a^{n-1}$, we get

$$L_{ip}^{\tau}(z, \pi_{i\ell}) = m(\theta(z, \pi_{i\ell}))v_i(z, \pi_{i\ell})\left[\pi_{i\ell} + (1 - \pi_{i\ell})\left[1 - \lambda G(T(z))\right]\right]\sum_{n=1}^{\tau}\left[1 - \lambda G(R(z))\right]^{n-1} \tag{B20}$$

The same proof as that used for equation (B17) shows that $L_{ip}^{\tau}(z, \pi_{i\ell})$ can be expressed as a decreasing function of the single endogenous variable W_u.

Adding the number of temporary and permanent jobs in each period, we find that the total number of jobs in type-$(z, \pi_{i\ell})$ establishments τ periods after their period of creation is

$$L_i^{\tau}(z, \pi_{i\ell}) = m(\theta(z, \pi_{i\ell}))v_i(z, \pi_{i\ell})\left(1 - \pi_{i\ell} + \left[\pi_{i\ell} + (1 - \pi_{i\ell})\left[1 - \lambda G(T(z))\right]\right]\sum_{n=1}^{\tau}\left[1 - \lambda G(R(z))\right]^{n-1}\right)$$

The same proof as that used to shows that

Number of jobs in type-(z, π_{ih}) establishments Now, we have to compute the number of jobs in type-(z, π_{ih}) establishments, i.e. type-$(z, \pi_{i\ell})$ establishments converted into type-(z, π_{ih}) because they became old. One must distinguish the establishments which continue hiring when they are converted into type-(z, π_{ih}) establishments (because their type is $z \geq \bar{z}(\pi_{ih})$) and those which stop hiring (such that $z < \bar{z}(\pi_{ih})$).

Let us start by establishments which continue hiring when they are converted. Let us denote by τ_ℓ the age at which the type-$(z, \pi_{i\ell})$ establishment has been transformed into a type-(z, π_{ih}) establishment.

The job creation rate is $m(\theta(z, \pi_{ih}))v_i$. Since temporary jobs last one period, the number of temporary jobs in a type-(z, π_{ih}) establishment is

$$L_{it}(z, \pi_{ih}) = (1 - \pi_{ih})m(\theta(z, \pi_{ih}))v_i(z, \pi_{ih}). \tag{B21}$$

The same proof as that used for equation (B17) shows that $L_{it}(z, \pi_{ih})$ can be expressed as a decreasing function of the single endogenous variable W_u.

To compute the number of permanent jobs, we need to know the number of creations and destructions of permanent jobs and the rate of transformation of temporary jobs into permanent jobs. The job destruction rate of permanent jobs is equal to $\lambda G(R(z))$. Temporary jobs are transformed into permanent jobs with probability $1 - \lambda G(T(z))$, where $T(z) = \{T | S_p(T, z) = 0\}$ is the threshold value of productivity below which temporary jobs are destroyed. At date τ_ℓ, the number of permanent jobs is

$$L_{ip}^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih}) = L_{ip}^{\tau_\ell - 1}(z, \pi_{i\ell}) \left[1 - \lambda G(R(z))\right] + \pi_{ih} m(\theta(z, \pi_{ih}))v_i(z, \pi_{ih}) + L_{it}(z, \pi_{i\ell}) \left[1 - \lambda G(T(z))\right] \tag{B22}$$

Thus, the law of motion of the number of permanent jobs in type-(z, π_{ih}) establishments is for $\tau > \tau_\ell$ is

$$L_{ip}^{\tau}(z, \pi_{i\ell}, \pi_{ih}) = L_{ip}^{\tau - 1}(z, \pi_{i\ell}, \pi_{ih}) \left[1 - \lambda G(R(z))\right] + \pi_{ih} m(\theta(z, \pi_{ih}))v_i(z, \pi_{ih}) + L_{it}(z, \pi_{ih}) \left[1 - \lambda G(T(z))\right] \tag{B23}$$

This equation shows that the number of permanent jobs in type-(z, π_{ih}) establishments of age τ created by large firms, denoted by $L_{ip}^{\tau}(z, \pi_{i\ell}, \pi_{ih})$, is given by an equation of the form $x_\tau = a x_{\tau - 1} + b$, with $x_0 = L_{ip}^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih})$, which implies that

$$\begin{aligned} L_{ip}^{\tau}(z, \pi_{i\ell}, \pi_{ih}) \quad = \quad & \left[1 - \lambda G(R(z))\right]^{\tau - \tau_\ell} L_{ip}^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih}) \\ & + m(\theta(z, \pi_{ih}))v_i(z, \pi_{ih}) \left[\pi_{ih} + (1 - \pi_{ih}) \left[1 - \lambda G(T(z))\right]\right] \sum_{i=\tau_\ell}^{\tau - 1} \left[1 - \lambda G(R(z))\right]^{i - \tau_\ell} \end{aligned} \tag{B24}$$

The same proof as that used for equation (B17) shows that $L_{ip}^{\tau}(z, \pi_{i\ell}, \pi_{ih})$ can be expressed as a decreasing function of the single endogenous variable W_u.

Adding temporary and permanent jobs, we find that the total number of jobs in establishments that have been transformed into type-(z, π_{ih}) establishments at age τ_ℓ is defined,

$$L_i^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih}) = L_{it}(z, \pi_{ih}) + L_{ip}^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih})$$

where $L_{it}(z, \pi_{ih})$ and $L_{ip}^{\tau_\ell}(z, \pi_{i\ell}, \pi_{ih})$ are defined by equations (B21) and (B22) respectively at date τ_ℓ and by equations (B21) and (B24) at dates $\tau > \tau_\ell$.

Let us now compute the number of jobs in type-$(z, \pi_{i\ell})$ establishments that stop hiring when they are converted into type-(z, π_{ih}) establishments. In these establishments, there are no temporary jobs. Permanent jobs decrease at rate $\lambda G(R(z))$. Accordingly, the total number of jobs in a type-$(z, \pi_{i\ell})$ establishment that have not been transformed into a type-(z, π_{ih}) establishment at age τ_ℓ is

$$L_{i0}^{\tau}(z, \pi_{i\ell}, \pi_{ih}) = \left[1 - \lambda G(R(z))\right]^{\tau - \tau_\ell} \left\{ L_{ip}^{\tau_\ell - 1}(z, \pi_{i\ell}) \left[1 - \lambda G(R(z))\right] + \left[1 - \lambda G(T(z))\right] L_{it}(z, \pi_{i\ell}) \right\}. \tag{B25}$$

The age distribution of establishments Once the total number of jobs in each establishment type has been computed, one needs to compute the age distribution of all types of establishments. This distribution is computed in steady state. As shown in Appendix B.2, entrepreneurs create an establishment if $z \geq \bar{z}(\pi_{i\ell})$.

Now, we have to compute the age distribution of type-(z, π_{ih}) establishments and type-$(z, \pi_{i\ell})$ establishments created by $i = s, b$ firms. Remind that establishments are destroyed with probability μ from their period of creation $\tau = 0$ (meaning that the entrepreneur draw a production opportunity z and create job vacancies at $\tau = 0$, but a productivity shock which occurs with probability μ at the end of period 0 implies that the firm never reaches periods $\tau \geq 1$), whereas (young) type-$(z, \pi_{i\ell})$ establishments can be transformed into (old) type-(z, π_{ih}) establishment at probability ρ from period $\tau = 1$. Since $O_i\Gamma_i'(z)$ establishments are created in every period by type-i firms, $i = s, b$, the number of type-$(z, \pi_{i\ell})$ establishments of age τ belonging to type-i firms in each period is equal to

$$(1-\mu)^{\tau}(1-\rho)^{\tau-1}O_i\Gamma_i'(z) \tag{B26}$$

The conversion rate of type-$(z, \pi_{i\ell})$ establishments is equal to ρ, which implies that

$$\rho(1-\mu)^{\tau_\ell}(1-\rho)^{\tau_\ell-2}O_i\Gamma_i'(z)$$

type-$(z, \pi_{i\ell})$ establishments of age τ_ℓ belonging to type-i firms are converted into type-(z, π_{ih}) establishments at each date. The probability of death per period of each of these establishments is equal to μ. Therefore, there are

$$\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}O_i\Gamma_i'(z) \tag{B27}$$

type-(z, π_{ih}) establishments of age τ belonging to type-i firms which have been converted at age $\tau_\ell \leq \tau$ at each date.

Total number of jobs in the economy Now, from above, we can compute the total number of jobs in the economy. From equation (B26) we deduce that the total number of jobs in type-$\pi_{i\ell}$ establishments is

$$\sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} L_i^{\tau}(z, \pi_{i\ell})\mathrm{d}\Gamma_i(z). \tag{B28}$$

Equation (B27) implies that the total number of jobs in type-π_h establishments is

$$\sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty}\sum_{\tau=\tau_\ell}^{\infty}\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}\left[\int_{\bar{z}(\pi_{ih})}^{\infty} L_i^{\tau}(z, \pi_{i\ell}, \tau_{ih})\mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{i0}^{\tau}(z, \pi_{i\ell}, \tau_{ih})\mathrm{d}\Gamma_i(z)\right]. \tag{B29}$$

The total number of jobs is equal to the sum of jobs defined by equations (B28) and (B29):

$$\begin{aligned} L \;=\; & \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} L_i^{\tau}(z, \pi_{i\ell})\mathrm{d}\Gamma_i(z) \qquad \text{(B30)} \\ & + \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty}\sum_{\tau=\tau_\ell}^{\infty}\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}\left[\int_{\bar{z}(\pi_{ih})}^{\infty} L_i^{\tau}(z, \pi_{i\ell}, \pi_{ih})\mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{i0}^{\tau}(z, \pi_{i\ell}, \pi_{ih})\mathrm{d}\Gamma_i(z)\right] \end{aligned}$$

From this equation and the definitions of L_i^{τ}, it is clear that aggregate demand in the economy is a function of $W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi_{sh}), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh})$. We showed that L_i^{τ} can be defined as a decreasing function of the single endogenous variable W_u. Similarly, $\bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh})$ can be defined as increasing functions of the single endogenous variable W_u, as stated in Section 5.2. Therefore, these results together with equation (B30) imply that aggregate labor demand can be defined as an a decreasing function of the endogenous variable W_u, denoted by $L(W_u, \pi_{s\ell}, \pi_{sh}, \pi_{b\ell}, \pi_{bh})$.

B.4 Aggregate labor supply

This appendix computes the relation between total unemployment and the present value of unemployment W_u. This corresponds to function $u(W_u, \pi_\ell, \pi_h)$ in the main text. More precisely, as indicated above in Appendix B.2, we consider a more general case than that presented in the main text since we assume that the stringency of regulation of temporary contracts can be different in establishment managed by large and small firms. Therefore, we denote by π_{ih} and $\pi_{i\ell}$ the minimum share of permanent jobs created by old and young establishments respectively created by type-i firms and we define the function $u(W_u, \pi_{s\ell}, \pi_{sh}, \pi_{b\ell}, \pi_{bh})$.

To define this function, we use the age distributions of type-(z, π_{ij}) establishments computed in Appendix B.3, which imply that the sum of all unemployed workers can be written as follows

$$u = \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty} (1-\mu)^{\tau}(1-\rho)^{\tau-1} \int_{\bar{z}(\pi_{i\ell})}^{\infty} u(z, \pi_{i\ell}) \mathrm{d}\Gamma_i(z) + \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2} \left[\int_{\bar{z}(\pi_{ih})}^{\infty} u(z, \pi_{ih}) \mathrm{d}\Gamma_i(z) \right] \quad \text{(B31)}$$

where

$$u(z, \pi_{ij}) = \frac{v_i(z, \pi_{ij})}{\theta(z, \pi_{ij})}$$

Therefore, aggregate unemployment, u, can be written as function of the unknown variables $W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_b$ i.e. $u(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh}))$. $\bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh})$ can be defined as increasing functions of the single endogenous variable W_u, as stated in Section 5.2. Moreover, we know from equations (B18) and (B19) that $v_i(z, \pi_{ij})$ and $\theta(z, \pi_{ij})$ can be defined as functions of the single endogenous variable W_u, and that $v_i(z, \pi_{ij})$ decreases with W_u while $\theta(z, \pi_{ij})$ increases. Therefore, $u(z, \pi_{ij})$ can be defined as a decreasing function of the single endogenous variable W_u. Finally, using these results to compute the derivative of u with respect to W_u in equation (B31) shows that u decreases with W_u. Accordingly, aggregate labor supply, equal to $\mathcal{N} - u(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh}))$ increases with W_u.

B.5 Labor market equilibrium

The equilibrium value of the expected utility of unemployed workers, W_u, is obtained from the resource constraint which equalizes labor supply $\mathcal{N} - u$ – where u is defined by equation (B31) – with labor demand L, defined equation (B30):

$$\mathcal{N} - u(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh})) = L(W_u, \bar{z}(\pi_{s\ell}), \bar{z}(\pi s_h), \bar{z}(\pi_{b\ell}), \bar{z}(\pi_{bh})) \quad \text{(B32)}$$

B.6 Production

The aggregate production of the economy denoted by$\mathcal{A}$, is equal to the sum of the production of all establishments, $\mathcal{Y}$, and domestic production, $\mathcal{D}$, minus hiring costs $\mathcal{H}$ and firing costs $\mathcal{F}$:

$$\mathcal{A} = \mathcal{Y} + \mathcal{D} - \mathcal{H} - \mathcal{F}$$

Domestic production is merely equal to the number of unemployed workers u times the instantaneous utility of unemployed workers, denoted by b. In what follows, we compute the other components of aggregate production.

B.6.1 Production of establishments

Production of type-$(z, \pi_{i\ell})$ establishments Let us denote by $Y_i^{\tau}(z, \pi_{i\ell})$, $i = b, s$ the expected production of type-$(z, \pi_{i\ell})$ establishments of age τ. When $\tau = 1$, since all jobs start at the highest productivity

$\varepsilon_{\max}$, the productivity of all jobs in type-$(z, \pi_{i\ell})$ establishments is equal to $z\varepsilon_{\max}$, which implies that

$$Y_i^1(z, \pi_{i\ell}) = v_i(z, \pi_{i\ell}) m(\theta(z, \pi_{i\ell})) z\varepsilon_{\max} \tag{B33}$$

All jobs draw a new productivity level ε in each period. Therefore, when $\tau > 1$, the expected production of type-$(z, \pi_{i\ell})$ establishments of age τ is equal to

$$\begin{aligned} Y_i^\tau(z, \pi_{i\ell}) = & \underbrace{v_i(z, \pi_{i\ell}) m(\theta(z, \pi_{i\ell}))}_{\text{New jobs}} z\varepsilon_{\max} + \underbrace{(1 - \pi_{i\ell}) v_i(z, \pi_{i\ell}) m(\theta(z, \pi_{i\ell})) [1 - G(T(z))]}_{\text{Permanent jobs which were temporary in previous period}} \frac{T(z) + \varepsilon_{\max}}{2} \\ & + \underbrace{\left(L_{ip}^\tau(z, \pi_{i\ell}) - v_i(z, \pi_{i\ell}) m(\theta(z, \pi_{i\ell})) \left((1 - \pi_{i\ell}) [1 - G(T(z)] + \pi_{i\ell}\right)\right)}_{\text{Permanent jobs with at least 2 periods seniority minus new temp jobs}} \frac{R(z) + \varepsilon_{\max}}{2} z \end{aligned} \tag{B34}$$

where $L_{ip}^\tau(z, \pi_{i\ell})$ stands for the expected number of permanent jobs in type-$(z, \pi_{i\ell})$ establishments of age τ, defined equation (B20).

Production of type-(z, π_{ih}) establishments Let us denote by $Y_i^\tau(z, \pi_{i\ell}, \pi_{ih})$, $i = b, s$ the expected production of type-(z, π_{ih}) establishments of age $\tau > 1$ that were previously complying with the less stringent regulation $\pi_{i\ell}$. For the establishments which continue hiring after being constrained to comply with the stringent regulation π_{ih}, i.e. whose $z > \bar{z}(\pi_{ih})$, we get:

$$\begin{aligned} Y_i^\tau(z, \pi_{ih}, \pi_{i\ell}) = & \underbrace{v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih}))}_{\text{New jobs}} z\varepsilon_{\max} + \underbrace{(1 - \pi_{ih}) v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih})) [1 - G(T(z))]}_{\text{Permanent jobs which were temporary in previous period}} \frac{T(z) + \varepsilon_{\max}}{2} \\ & + \underbrace{\left(L_{ip}^\tau(z, \pi_{i\ell}, \pi_{ih}) - v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih})) \left((1 - \pi_{ih}) [1 - G(T(z)] + \pi_{ih}\right)\right)}_{\text{Permanent jobs with at least 2 periods seniority minus new temp jobs}} \frac{R(z) + \varepsilon_{\max}}{2} z \end{aligned} \tag{B35}$$

where $L_{ip}^\tau(z, \pi_{i\ell}, \pi_{ih})$ stands for the expected number of permanent jobs in type-$(z, \pi_{i\ell})$ establishments of age τ defined equation (**??**). Note that it is assumed that young establishments know in period $\tau - 1$ that they will become old and thus constrained to comply with the stringent regulation π_{ih} in period τ.

The production of establisments which stop hiring when they are constrained to comply with the stringent regulation π_{ih}, i.e. whose $z \in [\bar{z}(\pi_{i\ell}), \bar{z}(\pi_{ih})]$, is

$$Y_{i0}^\tau(z, \pi_{i\ell}, \pi_{ih}) = \underbrace{L_{0p}^\tau(z, \pi_{i\ell}, \pi_{ih})}_{\text{Permanent jobs with at least 2 periods seniority}} \frac{R(z) + \varepsilon_{\max}}{2} z$$

where $L_{0p}^\tau(z, \pi_{i\ell}, \pi_{ih})$ is defined equation (B25)

Aggregate production of all establishments The aggregate production of all establishments can be computed from the sum of production of all establishments using the definition of aggregate employment provided by equation (B30). We get

$$\begin{aligned} \mathcal{Y} = & \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty} (1 - \mu)^\tau (1 - \rho)^{\tau - 1} \int_{\bar{z}(\pi_{i\ell})}^{\infty} Y_i^\tau(z, \pi_{i\ell}) \mathrm{d}\Gamma_i(z) \\ & + \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho (1 - \mu)^\tau (1 - \rho)^{\tau_\ell - 2} \left[\int_{\bar{z}(\pi_{ih})}^{\infty} Y_i^\tau(z, \pi_{i\ell}, \pi_{ih}) \mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} Y_{i0}^\tau(z, \pi_{i\ell}, \pi_{ih}) \mathrm{d}\Gamma_i(z) \right] \end{aligned} \tag{B36}$$

B.6.2 Hiring costs

Aggregate hiring costs are computed by summing the hiring costs of all establishments. Using as above the definition of aggregate employment provided by equation (B30) we get:

$$\begin{aligned}\mathcal{H} &= \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} C_i(v_i(z,\pi_{i\ell}))\mathrm{d}\Gamma_i(z) \\ &+ \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty}\sum_{\tau=\tau_\ell}^{\infty}\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}\int_{\bar{z}(\pi_{ih})}^{\infty} C_i(v_i(z,\pi_{ih}))\mathrm{d}\Gamma_i(z)\end{aligned} \tag{B37}$$

where $C_i(v_i(z,\pi_{ij}))$ stands for the hiring cost of type-(z,π_{ij}) establishments.

B.6.3 Firing costs

Firing costs paid by each establishment depend on the number of destructions of permanent jobs since there are no firing costs for the destruction of temporary jobs. In each period, the probability destruction of permanent jobs in type-(z,π_{ij}) establishments is equal to $G(R(z))$ and firing costs for each job destruction amount to F. Therefore, using again equation (B30) which defines total employment, we can compute the total number of permanent jobs and then total firing costs:

$$\begin{aligned}\mathcal{F} &= \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} L_p^{\tau}(z,\pi_{i\ell})FG(R(z))\mathrm{d}\Gamma_i(z) \\ &+ \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty}\sum_{\tau=\tau_\ell}^{\infty}\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}\int_{\bar{z}(\pi_{ih})}^{\infty} L_p^{\tau}(z,\pi_{i\ell},\pi_{ih})FG(R(z))\mathrm{d}\Gamma_i(z) \\ &+ \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty}\sum_{\tau=\tau_\ell}^{\infty}\rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2}\int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{p0}^{\tau}(z,\pi_{i\ell},\pi_{ih})FG(R(z))\mathrm{d}\Gamma_i(z)\end{aligned} \tag{B38}$$

B.7 Job flows

This appendix defines the destruction rate of permanent jobs and the rate of conversion of temporary jobs into permanent jobs for young and old establishments created by small and large firms.

Permanent job destruction In each period, the probability destruction of permanent jobs in type-(z,π_{ij}), $i=b,s; j=h,\ell$, establishments is equal to $G(R(z))$. Therefore, we can compute the job destruction rate of type-(z,π_{ij}) establishment from the number of permanent jobs in each establishment and from their age distribution.

Average permanent job destruction rate in young establishments Using the definition of the number of permanent jobs in type-$(z,\pi_{i\ell})$ establishments of age τ, provided equation (B20), and the age distribution of establishments, provided Appendix B.3, we find that the permanent job destruction rate in young establishments created by type-i, $i=b,s$ firms is

$$pjd_{i\ell} = \frac{\sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} L_p^{\tau}(z,\pi_{i\ell})G(R(z))\mathrm{d}\Gamma_i(z)}{\sum_{i=s,b} O_i \sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\bar{z}(\pi_{i\ell})}^{\infty} L_p^{\tau}(z,\pi_{i\ell})\mathrm{d}\Gamma_i(z)}$$

Average permanent job destruction rate in old establishments Using the definition of the number of permanent jobs in type-(z,π_{ih}) establishments of age τ, provided equation (B24), and the age distribution of establishments, provided Appendix B.3, we find that the permanent job destruction rate in old

establishments created by type-i, $i = b, s$ firms is

$$pjd_{ih} = \frac{\sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2} \int_{\bar{z}(\pi_{ih})}^{\infty} L_p^{\tau}(z,\pi_{i\ell},\pi_{ih}) G(R(z)) \mathrm{d}\Gamma_i(z)}{\sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2} \left(\int_{\bar{z}(\pi_{ih})}^{\infty} L_p^{\tau}(z,\pi_{i\ell},\pi_{ih}) \mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{p0}^{\tau}(z,\pi_{i\ell},\pi_{ih}) \mathrm{d}\Gamma_i(z) \right)}$$
$$+ \frac{\sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2} \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{p0}^{\tau}(z,\pi_{i\ell},\pi_{ih}) G(R(z)) \mathrm{d}\Gamma_i(z)}{\sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho(1-\mu)^{\tau}(1-\rho)^{\tau_\ell-2} \left(\int_{\bar{z}(\pi_{ih})}^{\infty} L_p^{\tau}(z,\pi_{i\ell},\pi_{ih}) \mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L_{p0}^{\tau}(z,\pi_{i\ell},\pi_{ih}) \mathrm{d}\Gamma_i(z) \right)}$$

Conversion of temporary jobs into permanent jobs Temporary jobs last one period and are converted with probability $[1 - G(T(z))]$ and destroyed with the complementary probability in type-$(z, \pi_{ij}), i = b, s; j = h, \ell$, establishments. Therefore, the average conversion rate of temporary jobs in type-(z, π_{ij}) establishments is

$$tc_{ij} = \frac{\int_{\bar{z}(\pi_{ij})}^{\infty} (1-\pi_{ij}) m(\theta(z,\pi_{ij})) v_i(z,\pi_{ij}) \left[1 - G(T(z))\right] \mathrm{d}\Gamma_i(z)}{\int_{\bar{z}(\pi_{ij})}^{\infty} (1-\pi_{ij}) m(\theta(z,\pi_{ij})) v_i(z,\pi_{ij}) \mathrm{d}\Gamma_i(z)}$$

B.7.1 Welfare

The equilibrium welfare of unemployed workers, W_u, is determined by the labor market equilibrium condition (B32). This appendix computes the average welfare of permanent and temporary workers in type-(z, π), $i = b, s; j = h, \ell$, establishments. In equilibrium, the contracts posted by firms share the job surplus according to the surplus sharing rule (8):

$$W(z,\pi) - W_u = \eta S((z,\pi)$$

Since the surplus of each job is an affine function of its production, as shown by equations (B5), (B6) and (B9), the average welfare of permanent and temporary worker can be computed from the production of establishments and from their age distribution.

Welfare of permanent workers

Permanent workers in young establishments Since all jobs start at the highest productivity $\varepsilon_{\max}$, the surplus of all jobs in type-$(z, \pi_{i\ell})$ establishments of age $\tau = 1$, is equal to $S_p(z, \varepsilon_{\max})$. This implies that the sum of welfare of permanent workers in a type-$(z, \pi_{i\ell})$ establishment of age $\tau = 1$

$$\bar{W}_{ip}^{1}(z,\pi_{i\ell}) = \pi_{i\ell} v_i(z,\pi_{i\ell}) m(\theta(z,\pi_{i\ell})) \left[\eta S_p(z,\varepsilon_{\max}) + W_u\right]$$

All jobs draw a new productivity level ε in each period. Therefore, when $\tau > 1$, using the definition of the expected production of type-$(z, \pi_{i\ell})$ establishments of age τ provided equation (B34), we can compute the sum of welfare of permanent workers in these establishments, denoted by $\bar{W}_{ip}^{\tau}(z, \pi_{i\ell})$:

$$\bar{W}_{ip}^{\tau}(z,\pi_{i\ell}) = \underbrace{\pi_{i\ell} v_i(z,\pi_{i\ell}) m(\theta(z,\pi_{i\ell}))}_{\text{New permanent jobs}} \left[\eta S_p(z,\varepsilon_{\max}) + W_u\right] \tag{B39}$$
$$+ \underbrace{(1-\pi_{i\ell}) v_i(z,\pi_{i\ell}) m(\theta(z,\pi_{i\ell})) \left[1 - G(T(z))\right]}_{\text{Permanent jobs which were temporary in previous period}} \left[\eta S_p^c\left(z, \frac{T(z)+\varepsilon_{\max}}{2}\right) + W_u\right]$$
$$+ \underbrace{\left(L_{ip}^{\tau}(z,\pi_{i\ell}) - v_i(z,\pi_{i\ell}) m(\theta(z,\pi_{i\ell}))(1-\pi_{i\ell}) \left[1 - G(T(z)\right] + \pi_{i\ell}\right)}_{\text{Permanent jobs with at least 2 periods seniority}} \left[\eta S_p^c\left(z, \frac{R(z)+\varepsilon_{\max}}{2}\right) + W_u\right]$$

where $L_{ip}^{\tau}(z, \pi_{i\ell})$ stands for the expected number of permanent jobs in type-$(z, \pi_{i\ell})$ establishments of age τ, defined equation (B20); $S_p(z, \varepsilon_{\max})$ stands for the surplus of starting permanent jobs defined equation (B6) and $S_p^c(z, \varepsilon)$ is the surplus of continuing jobs with productivity ε defined equation (B5)

Permanent workers in old establishments Using the definition of the expected production of type-(z, π_{ih}), $i = b, s$ establishments of age $\tau > 1$ that were previously complying with the less stringent regulation $\pi_{i\ell}$ and which continue hiring after being constrained to comply with the stringent regulation π_{ih}, i.e. whose $z > \bar{z}(\pi_{ih})$, provided equation (B35), we can compute the sum of welfare of permanent workers in these establishments:

$$\begin{aligned}\bar{W}^{\tau}_{ip}(z, \pi_{ih}, \pi_{i\ell}) = & \underbrace{\pi_{ih} v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih}))}_{\text{New permanent jobs}} [\eta S_p(z, \varepsilon_{\max}) + W_u] \\ & + \underbrace{(1 - \pi_{ih}) v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih})) [1 - G(T(z))]}_{\text{Permanent jobs which were temporary in previous period}} \left[\eta S^c_p\left(z, \frac{T(z) + \varepsilon_{\max}}{2}\right) + W_u\right] \\ & + \underbrace{\left(L^{\tau}_{ip}(z, \pi_{i\ell}, \pi_{ih}) - v_i(z, \pi_{ih}) m(\theta(z, \pi_{ih})) \left((1 - \pi_{ih}) [1 - G(T(z)] + \pi_{ih}\right)\right)}_{\text{Permanent jobs with at least 2 periods seniority minus new temp jobs}} \left[\eta S^c_p\left(z, \frac{R(z) + \varepsilon_{\max}}{2}\right) + W_u\right]\end{aligned} \tag{B40}$$

where $L^{\tau}_{ip}(z, \pi_{i\ell}, \pi_{ih})$ stands for the expected number of permanent jobs in type-$(z, \pi_{i\ell})$ establishments of age τ defined equation (**??**).

The sum of welfare of permanent workers in establishments which stop hiring when they are constrained to comply with the stringent regulation π_{ih}, i.e. whose $z \in [\bar{z}(\pi_{i\ell}), \bar{z}(\pi_{ih})]$, is

$$\bar{W}^{\tau}_{i0}(z, \pi_{i\ell}, \pi_{ih}) = L^{\tau}_{0p}(z, \pi_{i\ell}, \pi_{ih}) \left[\eta S^c_p\left(z, \frac{R(z) + \varepsilon_{\max}}{2}\right) + W_u\right]$$

where $L^{\tau}_{0p}(z, \pi_{i\ell}, \pi_{ih})$ is defined equation (B25).

Welfare of permanent workers The sum of welfare of permanent workers can be computed by summing the welfare of all permanent workers in all types of establishments using the previous definitions and the age distribution of establishments provided Appendix B.3. We get

$$\begin{aligned}\bar{W}_p = & \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty} (1-\mu)^{\tau} (1-\rho)^{\tau-1} \int_{\bar{z}(\pi_{i\ell})}^{\infty} \bar{W}^{\tau}_{ip}(z, \pi_{i\ell}) \mathrm{d}\Gamma_i(z) \\ & + \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho (1-\mu)^{\tau} (1-\rho)^{\tau_\ell - 2} \left[\int_{\bar{z}(\pi_{ih})}^{\infty} \bar{W}^{\tau}_{ip}(z, \pi_{ih}, \pi_{i\ell}) \mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} \bar{W}^{\tau}_{i0}(z, \pi_{i\ell}, \pi_{ih}) \mathrm{d}\Gamma_i(z)\right]\end{aligned} \tag{B41}$$

The average welfare of permanent workers is equal to $\bar{W}_p$ divided by the number of permanent workers, equal to

$$\begin{aligned}L_p = & \sum_{i=s,b} O_i \sum_{\tau=1}^{\infty} (1-\mu)^{\tau} (1-\rho)^{\tau-1} \int_{\bar{z}(\pi_{i\ell})}^{\infty} L^{\tau}_{ip}(z, \pi_{i\ell}) \mathrm{d}\Gamma_i(z) \\ & + \sum_{i=s,b} O_i \sum_{\tau_\ell=2}^{\infty} \sum_{\tau=\tau_\ell}^{\infty} \rho (1-\mu)^{\tau} (1-\rho)^{\tau_\ell - 2} \left[\int_{\bar{z}(\pi_{ih})}^{\infty} L^{\tau}_{ip}(z, \pi_{i\ell}, \pi_{ih}) \mathrm{d}\Gamma_i(z) + \int_{\bar{z}(\pi_{i\ell})}^{\bar{z}(\pi_{ih})} L^{\tau}_{i0}(z, \pi_{i\ell}, \pi_{ih}) \mathrm{d}\Gamma_i(z)\right]\end{aligned} \tag{B42}$$

Welfare of temporary workers Temporary jobs last one period in all establishments. Therefore, the average expected utility of temporary workers in type-$(z, \pi_{ij}), i = b, s; j = h, \ell$, establishments is

$$WT_{ij} = \frac{\int_{\bar{z}(\pi_{ij})}^{\infty} (1 - \pi_{ij}) m(\theta(z, \pi_{ij})) v_i(z, \pi_{ij}) [\eta S_t(z) + W_u] \mathrm{d}\Gamma_i(z)}{\int_{\bar{z}(\pi_{ij})}^{\infty} (1 - \pi_{ij}) m(\theta(z, \pi_{ij})) v_i(z, \pi_{ij}) \mathrm{d}\Gamma_i(z)}$$

where $S_t(z)$ stands for the surplus of temporary jobs defined equation (B9).

C Estimation procedure

This appendix presents the estimation procedure of the search and matching model. Let us denote by $\gamma_{i1}, \gamma_{i2}, \gamma_{i3}$, $i = s, b$ the location, scale and shape parameters of the generalized extreme value distribution of establishment specific productivity z created by small and large firms respectively. Parameters are estimated with an iterative process. Every iteration proceeds as follows:

For the given vector of parameters $y = (F, W_u, \bar{\epsilon}, c_s, c_b, \alpha, \pi_{s\ell}, \pi_{sh}, \pi_{b\ell}, \pi_{bh}, \gamma_{s1}, \gamma_{s2}, \gamma_{s3}, \gamma_{b1}, \gamma_{b2}, \gamma_{b3})$

1. We compute the 4 endogenous variables $\bar{z}(\pi_{ij})$) by equalizing the surplus of starting jobs (using equations (B4) and (B6)) to zero according to the definitions of $\bar{z}(\pi_{ij})$ provided in Appendix B.2.

2. We use $\bar{z}(\pi_{ij})$, $i = s, b$; $j = h, \ell$ to deduce together with equation (13) the number of opportunities of creation of establishments O_s and O_b.

3. We calibrate (m_0, b) conditional on vector y, using the definitions of aggregate employment (equation (B30)) and aggregate unemployment (equation (B31)) to match the empirical values of the number of jobs and of the number of unemployed workers.

4. Conditional on $\bar{z}(\pi_{ij})$, $i = s, b$; $j = h, \ell$, m_0, b, O_s, O_b, we compute the distributions of the number of temporary jobs in young and old establishments created by large and small firms. We use the percentiles of these distributions to identify parameters F, W_u, $\bar{\epsilon}$, c_s, c_b, α, π_{sh}, $\pi_{s\ell}$, π_{bh}, $\pi_{b\ell}$, γ_{s1}, γ_{s2}, γ_{s3}, γ_{b1}, γ_{b2}, γ_{b3} from the expression of the number of temporary jobs, which can be written, using equations (B17), (B18), (B19):

$$L_{it}(z, \pi_{ij}) = (1 - \pi_{ij}) m_0 \left[\frac{(1-\beta)W_u - b}{m_0 \beta \eta S(z, \pi_{ij})} \right]^{\left(\frac{1}{1-\alpha} - \eta\right)\frac{1}{1-\eta}} \left((1-\mu) \frac{1-\eta}{\eta c_i \alpha} \left[(1-\beta)W_u - b \right] \right)^{\frac{1}{\alpha - 1}} \tag{C43}$$

   where the expression of the surplus $S(z, \pi_{ij})$ is provided by equations (B4) and (B10).

5. We compute the squared distance between the distributions obtained in the model and those of the data

We iterate over the vector y and repeat these operations until we reach a minimum.

This iterative process is applied in several stages in order to obtain the estimated values of the parameters in vector Ω. First, we start by implementing a global method that identifies the relevant parametric zone: we evaluate the objective function defined in equation (16) on a large grid of parameter values. Once a zone is identified, we implement a local minimization using the identity the the weighting matrix W. We find a first optimum, $\hat{\Omega}_1$. Finally, we compute $W = g(\hat{\Omega}_1) g(\hat{\Omega}_1)'$ and minimize $\mathcal{G}(\Omega)$ again using this new matrix.

D Structural estimation of the Average Treatment effect on Treated firms

This appendix shows how we use equation (20) to adjust the share of temporary jobs in hires of large firms – i.e. parameter $\pi_{b\ell}$ – which matches the reduced form estimates. The reduced form estimate of the average treatment effect on the treated relies on the Poisson regression which assumes:

$$\mathbb{E}(y_i|x_i, A_i, I = 1) = \exp(\alpha_0 + \alpha_1 A_i + \alpha_2 x_i + \frac{\sigma^2}{2})$$

where x_i is the vector of control variables, A_i is the indicator variable for assignment to treatment, I is the indicator variable for the implementation of the treatment. σ is the standard error of the error term ε_i in equation (2). The estimate of coefficient α_1 yields the estimation of $\widetilde{ATT}$ defined by equation (19).

This implies that

$$\mathbb{E}(y_i|x_i, A_i = 1, I = 1) - \mathbb{E}(y_i|x_i, A_i = 0, I = 1) = (e^{\alpha_1} - 1)\,\mathbb{E}(y_i|x_i, A_i = 0, I = 1)$$

or, equivalently

$$\mathbb{E}(y_i|x_i, A_i = 1, I = 1) - \mathbb{E}(y_i|x_i, A_i = 0, I = 0) - [\mathbb{E}(y_i|x_i, A_i = 0, I = 1) - \mathbb{E}(y_i|x_i, A_i = 0, I = 0)] = (e^{\alpha_1} - 1)\,\mathbb{E}(y_i|x_i, A_i = 0, I = 1)$$

The first two terms of the right hand side $\mathbb{E}(y_i|x_i, A_i = 1, I = 1) - \mathbb{E}(y_i|x_i, A_i = 0, I = 0)$ determine the true effect of the treatment while the two other terms, $[\mathbb{E}(y_i|x_i, A_i = 0, I = 1) - \mathbb{E}(y_i|x_i, A_i = 0, I = 0)]$ determine the bias in the reduced form estimate as defined by equation (20).

The assumption that assignment to treatment is independent of potential outcomes implies that the empirical counterpart of $\mathbb{E}(y_i|x_i, A_i = 0, I = 0)$ is identical for treated and non-treated firms. This allows us to write the empirical counterpart of the previous formula as follows

$$\left[\frac{1}{N}\sum_{i|A_i=1} y_i(1,1) - \frac{1}{N}\sum_{i|A_i=1} y_i(0,0)\right] - \left[\frac{1}{N}\sum_{i|A_i=0} y_i(0,1) - \frac{1}{N}\sum_{i|A_i=0} y_i(0,0)\right] = (e^{\hat{\alpha}_1} - 1)\frac{1}{N}\sum_{i|A_i=0} y_i(0,1)$$

where $y_i(T_i, I)$ is the potential outcome of firm i, with $T_i \in \{0, 1\}$ equal to one if firm i is treated and $I \in \{0, 1\}$ equal to one if the treatment is implemented. N is the number of firms in each group, asssumed identical for the sake of simplicity. The assumption of comparability between treated and non-treated firms on the running variable of the Regression Discontinuity design implies that $\frac{1}{N}\sum_{i|A_i=1} y_i(0,0) = \frac{1}{N}\sum_{i|A_i=0} y_i(0,0)$. Therefore, the previous formula can be written

$$e^{\hat{\alpha}_1} - 1 = \frac{\sum_{i|A_i=1} y_i(1,1) - \sum_{i|A_i=0} y_i(0,1)}{\sum_{i|A_i=0} y_i(0,1)} \equiv A \tag{D44}$$

We adjust parameter $\pi_{b\ell}$ to satisfy this equality where $\hat{\alpha}_1$ is the reduced form estimate of $\widetilde{ATT}$ for the impact of the reform on the number of entries into temporary jobs created by young establishments of large firms, reported in Table 3. We select the coefficient of Column (2), equal to -1.461, as reported in Table 8. This implies a change in the number of entries into those jobs equal to $e^{-1.461} - 1 = -76.80\%$. This Figure induces the value reported in Table 8, bottom panel, Row "Large firm-Young", Column"$U \to L_t$" which displays the impact of the reform on the number of entries into temporary jobs created by young establishments of large

firms in the case where the impact of the reform is evaluated with reduced form estimates assuming SUTVA.

E Estimation of the bias in the reduced form estimates

This appendix explains how we compute the bias in the reduced form estimates from the structural model. Under SUTVA, we get $\sum_{i|A_i=0} y_i(0,1) = \sum_{i|A_i=0} y_i(0,0)$, which implies that $e^{\hat{\alpha}_1} - 1$ defined equation (D44) becomes

$$\frac{\sum_{i|A_i=1} y_i(1,1) - \sum_{i|A_i=0} y_i(0,1)}{\sum_{i|A_i=0} y_i(0,0)} \equiv B$$

and we get

$$\hat{\alpha}_1 = \log(B+1) \text{ if SUTVA is satisfied} \tag{E45}$$

From the definitions of A (equation D44) and B (equation E45), we can write

$$e^{\hat{\alpha}_1} - 1 = B + \underbrace{A - B}_{\widehat{Bias}} \tag{E46}$$

where

$$A - B = \frac{\sum_{i|A_i=1} y_i(1,1)}{\sum_{i|A_i=1} y_i(0,0)} \left(\frac{\sum_{i|A_i=0} y_i(0,0)}{\sum_{i|A_i=0} y_i(0,1)} - 1 \right) = (B+1) \left(\frac{\sum_{i|A_i=0} y_i(0,0)}{\sum_{i|A_i=0} y_i(0,1)} - 1 \right)$$

which implies that (E46) can be written as

$$e^{\hat{\alpha}_1} = (B+1) \left(\frac{\sum_{i|A_i=0} y_i(0,0)}{\sum_{i|A_i=0} y_i(0,1)} \right) \tag{E47}$$

or

$$\widehat{Bias} = \log \left(\frac{\sum_{i|A_i=0} y_i(0,0)}{\sum_{i|A_i=0} y_i(0,1)} \right) \tag{E48}$$

Hence, we get

$$\hat{\alpha}_1 = \log \left(\frac{\sum_{i|A_i=1} y_i(1,1)}{\sum_{i|A_i=1} y_i(0,0)} \right) + \underbrace{\log \left(\frac{\sum_{i|A_i=0} y_i(0,0)}{\sum_{i|A_i=0} y_i(0,1)} \right)}_{\widehat{Bias}} \tag{E49}$$