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Employment Protection Reforms: From Firm-Level Effects to Aggregate Outcomes*

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Abstract

Employment protection legislation often varies with firm or establishment size and age, and many evaluations of EPL reforms exploit these thresholds. This paper develops a search-and-matching model with multi-establishment firms to disentangle direct effects from general-equilibrium spillovers. We combine the model with quasi-experimental evidence from a 2009 Portuguese reform that restricted fixed-term contracts in young establishments of large firms. Spillovers barely distort the reduced-form estimate, yet they overturn the aggregate conclusion: extrapolating the reduced-form estimate implies a 1.51% employment decline, compared with a 0.11% increase in general equilibrium. Counterfactuals show that conditioning EPL on size versus age can yield opposite welfare effects, even when employment effects are similar, and that fixed-term contract and firing restrictions must be evaluated jointly.

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1 Introduction

Employment protection legislation (EPL) governs how employers hire and dismiss workers. It shapes labor market fluidity, workers' job security, and remains the subject of active policy debate. On the firing margin, it specifies when open-ended contracts can be terminated, along with severance pay and procedural obligations. On the hiring margin, it determines when firms can use more flexible fixed-term contracts instead of open-ended ones. In most OECD countries, these rules vary with firm or establishment characteristics, with smaller and younger units typically granted more flexibility.[1]

A large empirical literature exploits this contingency of EPL rules on establishment or firm characteristics for policy evaluation.[2] Reduced-form methods, such as difference-in-differences and regression discontinuity designs, compare units targeted by a reform based on their size or age with those not targeted. Although these methods yield informative estimates of *relative* differences between targeted and non-targeted units, extrapolating to aggregate implications requires strong and often untested assumptions.

This paper develops a general equilibrium model with multi-establishment firms and frictional labor markets to study the aggregate effects of EPL-contingent reforms. The framework decomposes reduced-form estimates into the direct effects of policy on targeted units and general equilibrium adjustments. It also allows us to compare EPL regulations contingent on age with those contingent on size, at the firm or establishment level, and to assess how hiring and firing restrictions interact. We take the framework to a 2009 Portuguese reform that restricted the use of fixed-term contracts based on establishment age and firm size. Combining our empirical and structural methods delivers three main conclusions. First, firm-level reduced-form estimates can be uninformative about aggregate employment effects, even when the reform targets a small share of the economy and spillovers at the firm level are negligible. Extrapolating the reduced-form estimate predicts a 1.51% decline in aggregate employment, whereas the general equilibrium model implies a 0.11% increase. Second, the conditionality of EPL matters: conditioning a reform on size or on age can have opposite welfare effects, even when employment effects are similar. Third, pre-existing rules create distortions that a marginal tightening of EPL may offset, so hiring and firing restrictions must be modeled jointly.

Our directed-search framework is well suited to studying the diversity of EPL regulations across OECD countries, where EPL is often contingent on firm or establishment characteristics. Firms comprise multiple establishments whose productivity reflects entrepreneurial ability, thereby reproducing the empirical relationships between firm size,

[1] See OECD (2026) and Appendix F.

[2] See, for instance, Boeri & Jimeno (2005), Kugler & Pica (2008), Schivardi & Torrini (2008), Martins (2009), Olsson (2009), von Below & Skogman Thoursie (2010), Centeno & Novo (2012), Bornhäll et al. (2016), Hijzen et al. (2017), Bjuggren (2018), Amirapu & Gechter (2020), Ardito et al. (2022), Butschek & Jan Sauermann (2022).

establishment size, and the within-firm dispersion of establishment size. Establishments make endogenous job-creation and job-destruction decisions. EPL enters through restrictions on the use of fixed-term contracts (FTCs) and through the cost of terminating open-ended contracts (OECs), either of which may be contingent on firm or establishment size or age.

A reform that targets only a subset of units operates through a *job-value channel*, which changes match surpluses, and a *tightness channel*, which changes queue lengths as job seekers redirect their search across markets. Tightening EPL for targeted units reduces their hiring through both channels. In equilibrium, the value of unemployment falls, which raises job values and lengthens queues in non-targeted units, where hiring increases. Comparisons between targeted and non-targeted units therefore combine the direct losses of the former with the spillover gains of the latter, and may substantially overstate employment losses. The aggregate effect depends on the distribution of these responses across heterogeneous establishments.

To quantify these forces, we build on the calibration and estimation to evaluate the 2009 Portuguese reform. This policy restricted the use of fixed-term contracts for young establishments belonging to firms with at least 750 employees. The reform is particularly well suited to our analysis because its eligibility criteria combine establishment age and firm size. Using matched employer-employee data, we first estimate the change at the 750-employee threshold in a regression discontinuity design, with firm size measured before the reform. The reform sharply reduced FTC hiring in young establishments of targeted firms, relative to non-targeted firms. OEC hiring did not increase, leading to a reduction in their total hiring. We then complement this evidence with a difference-in-differences analysis to test for indirect effects on non-targeted firms. We compare the evolution of establishments of non-targeted firms across industry-by-region markets that are more or less exposed to targeted firms. Consistent with the model's spillover mechanism, non-targeted establishments increased hiring more in markets with greater exposure to targeted firms.

We estimate the structural model on pre-reform data and we identify the policy parameter by matching the reduced-form estimate for FTC hiring. We simulate the reform, allowing for establishment entry and cross-market adjustments. We first use the estimated model to decompose the regression discontinuity estimates into direct and general equilibrium effects. The model implies that spillovers generate only a small firm-level bias in the reduced-form estimate: for total hires, the response of non-targeted firms causes the local estimate to overstate the treatment effect by just 0.6%.[3] Yet these small effects on individual non-targeted firms become quantitatively important in the aggregate because those firms account for 85% of pre-reform employment: total employment increases by 0.11%. Contrary to a common intuition, a small treated group does not

[3]This estimate quantifies departures from the Stable Unit Treatment Value Assumption (SUTVA).

necessarily make general equilibrium effects negligible. When the non-treated group is large, even modest responses among its members can substantially alter aggregate outcomes. Reduced-form estimates may therefore be nearly unbiased for a local treatment effect and still be uninformative about the sign or magnitude of the aggregate effect.

The model further decomposes the aggregate response into the job-value and tightness channels and traces their incidence across establishments. Changes in labor market tightness, which rises in targeted establishments and declines in non-targeted ones, account for about 60% of the adjustment. Changes in job values account for most of the remainder, whereas establishment and firm entry play little role. The distribution of these responses is crucial. Because the reform targets large firms, employment losses are concentrated in relatively productive establishments with high-surplus jobs. Aggregating across establishments, this reallocation lowers the value of unemployment, strengthens outside-option adjustment, and expands hiring elsewhere, turning the net employment effect positive.

The employment gain does not imply a welfare gain.[4] The reform reduces total output net of costs by 0.10% because workers reallocate toward less productive establishments: output per job falls, and firing costs rise because these establishments have higher separation rates.

We use the structural model to conduct two sets of counterfactuals. First, we vary the firm-size cutoff for the 2009 FTC restriction to assess how the results depend on the employment share of targeted units. Employment effects remain positive at all cutoffs considered, corresponding to targeted shares ranging from 5% to 100%. At the cutoff of 250 employees subsequently adopted by Portugal in 2019, for example, the employment effect is +0.59%. As the cutoff falls, more firms are treated, magnifying the direct employment loss. At the same time, fewer firms remain untreated, narrowing the scope for positive hiring responses through job-value and tightness effects. However, the remaining untreated firms operate only the lowest-productivity establishments, which strengthens the outside-option adjustment: the value of search falls further, inducing greater reallocation toward these firms. Because these forces largely offset one another, changes in the cutoff have little effect on aggregate employment.

Second, we vary the dimension of EPL conditionality by simulating reforms based on firm size, establishment size, or establishment age, for both hiring and firing restrictions. Stricter EPL raises total employment whether it targets large firms, large establishments, or old establishments, but its welfare effects differ. Targeting large firms or large establishments reallocates jobs toward less productive units and lowers output. By contrast, constraining old establishments raises welfare because employment disproportionately reallocates toward more productive units. These exercises also show that the effects of EPL

[4] In our framework with risk-neutral workers, welfare is measured as total output net of vacancy-posting costs and the red-tape costs associated with EPL.

reforms depend on pre-existing hiring and firing restrictions: tightening one component may improve welfare when it offsets a distortion created by another. Because policymakers are often constrained to marginal changes in EPL (Saint-Paul 2000), our results imply that a tightening that does not target large firms or establishments can, in some settings, raise both employment and welfare.

Our article contributes to three main strands of research.

First, we contribute to the literature on the effects of employment protection, which has discussed the implications of the coexistence of open-ended and fixed-term contracts (Blanchard & Landier 2002, Cahuc & Postel-Vinay 2002, Boeri & Garibaldi 2007, Boeri 2011, Bentolila et al. 2012, Cahuc et al. 2016) and the role of the latter in workers' careers (Booth et al. 2002, García-Pérez et al. 2018). We focus on marginal EPL reforms, which keep the two-tier structure and change the restrictions on FTCs or OECs, as most countries have done in recent decades (OECD 2026). Existing work on these reforms is either reduced-form or fully structural. Reduced-form papers study changes in the conditions on the use of FTCs (García-Pérez et al. 2018, Martins 2021, Daruich et al. 2023), and many exploit contingent-EPL reforms as a source of identification (see Footnote 2). On the empirical side, Daruich et al. (2023) study a facilitation of FTCs in Italy, and find that firms replace OECs with FTCs. We study a restriction instead, and there is no reason for the effects to be symmetric. On the structural side, Cahuc et al. (2020) and Pijoan-Mas & Roldan-Blanco (2022) model changes in EPL, the latter in a directed search model used to simulate economy-wide policies. Our contribution is to connect the two approaches. We build a macro framework that maps reduced-form estimates into aggregate effects, taking into account the contingent nature of EPL, and we apply it to the Portuguese reform.

Second, we contribute to the growing literature combining micro empirical evidence with general equilibrium models to analyze labor market reforms, including the minimum wage (Engbom & Moser 2022, Hurst et al. 2022, Berger et al. 2025), unemployment insurance (Chodorow-Reich et al. 2019, Kekre 2023, Hartung et al. 2026), hiring subsidies (Cahuc et al. 2019), and working time regulations (Carry 2026). To our knowledge, we are the first to connect reduced-form and structural approaches in the context of EPL. This connection is particularly relevant for EPL because reforms typically differentiate across firms, and empirical papers rely on comparisons between targeted and non-targeted firms. Conceptually, our analysis of spillovers to non-targeted units is close to the program evaluation literature emphasizing structural models as useful complements to experimental data (Wolpin & Todd 2006, Attanasio et al. 2012, Ferrall 2012, Crépon et al. 2013, Galiani et al. 2015, Lise et al. 2015, Gautier et al. 2018). We provide clear evidence that a small unit-level bias from a violation of the Stable Unit Treatment Value Assumption (SUTVA) can lead to large aggregate implications.

Third, we add to the literature on firm-size-contingent regulations, especially papers emphasizing the reallocation of economic activity (Gourio & Roys 2014, Garcia-Santana & Pijoan-Mas 2014, Garicano et al. 2016, Bachas et al. 2019, Kaplow 2019, Ando 2021). We develop a model which accommodates regulations based on the size of firms or of their establishments. Although our focus is on EPL, our multi-establishment framework can be used to evaluate other types of contingent labor market policies.

The remainder of the paper is organized as follows. Section 2 documents the contingent nature of EPL stringency by firm and establishment characteristics in OECD countries. Section 3 presents our theoretical framework, outlining the key mechanisms driving both the direct and spillover effects of EPL reforms. Section 4 describes the Portuguese reform, the data, and our reduced-form strategy and results. Section 5 estimates the macro model, decomposes the reduced-form estimates, and quantifies the aggregate effects of the reform. It also presents counterfactuals assessing hiring versus firing restrictions and the role of targeting by size and age. Section 6 concludes.

2 Institutional heterogeneity in EPL

Statutes typically vary the stringency of protection based on firm or establishment characteristics, most commonly size, age, and sector, reflecting differences in productivity, financial constraints, and administrative capacity. This section reviews examples of such regulations, and Appendix F documents them for all OECD countries. This heterogeneity motivates our structural model.

Firm Size. One of the most common distinctions in EPL is based on firm size. Many countries impose stricter employment protection rules on larger firms while granting more flexibility to smaller enterprises. For example, in France, employment regulations become progressively stricter as firms cross specific size thresholds. Firms with 50 or more employees must implement formal layoff procedures and social plans in case of downsizing. In Italy, firms with fewer than 15 employees are exempt from some of the more rigid employment protection measures that apply to larger businesses, particularly in the area of unfair dismissal rules. Similarly, in Germany, labor laws impose stricter dismissal protections on firms with more than 10 employees. The Kündigungsschutzgesetz (Employment Protection Act) ensures that dismissals in these firms must be justified on economic or behavioral grounds, whereas smaller firms face fewer legal constraints when terminating employees.

Establishment Size. In addition to firm size, the size of individual establishments within firms also plays a role in determining EPL rules. Some regulations focus on establishments rather than entire firms, recognizing that local workplace dynamics differ depending on the scale of operations.

In Spain, labor laws distinguish between firms and establishments when applying collective bargaining agreements. While nationwide labor agreements set general employment standards, additional rules apply at the establishment level based on the number of employees in a given location. For instance, works councils must be established in workplaces with at least 50 employees, regardless of the overall firm size, influencing worker representation and employment protection. In Japan, some EPL provisions apply specifically at the establishment level, with larger workplaces required to offer more extensive employment security measures and severance protections.

Establishment Age. The age of establishments can also influence employment regulations, as policymakers recognize that newly opened workplaces may require greater flexibility in hiring and workforce management.

In Portugal, new establishments (defined as those less than two years old) are granted more flexibility in hiring through FTCs. This temporary exemption allows young businesses to scale up operations while minimizing the risk associated with permanent employment contracts. After two years, these establishments must comply with standard employment protection rules, including stricter conditions for FTC renewals and conversions. In Denmark, newly established branches or subsidiaries of firms can be granted temporary exemptions from EPL provisions contained in collective agreements. In Sweden, specific incentives exist for new establishments in sectors such as retail and services, where firms opening new outlets may benefit from lower employment-related obligations during their initial operational period.

As a result, establishments and firms facing different regulations coexist in equilibrium. A given establishment or firm may also be subject to different regulations at different points in its life, as additional rules take effect when it grows larger or becomes older. This motivates an equilibrium model of unemployment that accommodates heterogeneous policy parameters based on these characteristics. Our model allows for the two main components of EPL: restrictions at the hiring margin (limitations on the use of fixed-term contracts) and restrictions at the firing margin (limitations on the termination of permanent contracts).

3 The model

This section presents a search and matching model that incorporates (i) multiple-establishment firms, (ii) multiple-job establishments, and (iii) employment protection. Those model ingredients are necessary to capture the effects of EPL reforms based on the characteristics described in Section 2. We begin by outlining the framework before describing the behavior of firms and their establishments. We then analyze both the partial equilibrium and the general equilibrium. Model derivations and details are presented in Appendix A.

3.1 Framework

The framework is a directed search and matching model with endogenous job destruction. Time is discrete. The labor force consists of $\mathcal{N}$ identical, risk-neutral individuals with infinite lifespans who discount the future with a factor $\beta \in (0, 1)$. The structure of the model is depicted in Figure 1.

Firms. There exists a large number of entrepreneurs, denoted by $\mathcal{E}$, who can create establishments. The set of establishments created by an entrepreneur constitutes a firm. Each period, every entrepreneur receives ϕ opportunities (representing, for example, having an idea, access to financing, etc.) to create establishments. ϕ is exogenous and identical for all entrepreneurs. An opportunity allows the entrepreneur to draw a productivity for a potential new establishment, z, which then remains constant throughout the establishment life. Each entrepreneur is characterized by her ability, a, to draw a value of z from a distribution characterized by the cumulative distribution function $\Psi_a(z) : \mathbb{R} \to [0, 1]$, when she gets an opportunity to create an establishment. It is assumed that $\Psi_a(z)$ is continuously differentiable with respect to a and z and that $\partial \Psi_a(z)/\partial a < 0$, interpreting higher values of a as representing more efficient entrepreneurs who are able to create more productive establishments. The ability a is distributed according to the cumulative distribution function $\Gamma(a) : \mathbb{R} \to [0, 1]$.

Establishments. Establishments can employ multiple workers. A worker-establishment match produces $z \times \varepsilon$ per period, where ε is match-specific, independent of z and changes over time. For simplicity, it is assumed that $\varepsilon = \varepsilon_u$ for starting jobs. Then ε changes in each period. A productivity change is drawn from a distribution with support $(-\infty, \varepsilon_u]$, whose cumulative distribution is denoted by $G(.)$. Establishments are destroyed with probability μ per period.

Labor market regulation. In all countries, employment protection legislation imposes restrictions at the hiring and firing margins. To capture this, we introduce two EPL parameters. First, legislation permits FTCs only for certain jobs (e.g., temporary nature, a worker being absent). In practice, however, whether a given vacancy satisfies these legal conditions is not always clear ex ante. Legal rules often require interpretation, and firms may face uncertainty about how labor courts or administrative authorities would classify the job if the contract were challenged. We model this uncertainty as a Bernoulli realization: with probability π the activity does not qualify and the job must be created as a permanent contract, while with probability $1 - \pi$ an FTC is permitted. The parameter π thus reflects the strictness of EPL at the hiring margin. Second, there is a cost F associated with the destruction of permanent jobs. This cost represents a red tape or regulatory burden due to the dismissal procedure, e.g., just cause requirements. FTCs have to be either destroyed at zero cost or transformed into open-ended contracts after one period. Both parameters F and π may depend on the size and/or age of establishments or firms, a feature we use for the quantitative exercises.

Job creation and destruction. In every period, each establishment endogenously creates v job vacancies at an instantaneous cost $C(v)$. $C(.)$ is a homogeneous function of degree $\alpha > 1$. Vacant jobs are filled through a standard matching function. In consequence, if there are u unemployed persons and v vacant jobs in a labor market, 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. The vacancy-filling rate $m(\theta)$ is twice continuously differentiable and strictly decreasing, with $\lim_{\theta \to \infty} m(\theta) = 0$. The decisions to convert or terminate FTCs and to destroy permanent jobs are endogenous.

3.2 Behavior of workers, establishments and entrepreneurs

In each labor market, the type-z employers post labor contracts that are permanent with probability π and temporary with the complementary probability. These contracts yield a promised inter-temporal expected utility $W(z)$ to workers hired in the establishment. They are not renegotiable and apply throughout the employer-employee relationship. The search activity of job seekers can be directed toward their preferred market. The mobility of workers between labor markets is perfect. On-the-job search is impossible.

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 labor markets, so it will simply be denoted by W_u. Let b denote the instantaneous gains of an unemployed person. The expected utility of a person in search of work, W_u, satisfies the no-arbitrage condition:

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

where β stands for the discount factor. The no-arbitrage condition defines a decreasing relation between the labor market tightness $\theta(z)$ and the promised utility in employment $W(z)$. Differentiation of equation (1) with respect to $\theta(z)$ and $W(z)$ keeping W_u constant yields:

$$\frac{\partial\theta(z)}{\partial W(z)} = \frac{-\theta(z)}{(1-\eta)\left[W(z) - W_u\right]}, \tag{2}$$

where $\eta \equiv -\frac{\theta m'(\theta)}{m(\theta)}$ is the elasticity of the job filling rate, with $0 < \eta < 1$. This equation shows that the tightness is lower in labor markets where the employment value promised by establishments is higher.

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

1. Matches occur thanks to vacancies posted in $t-1$.
2. The match-specific productivity parameter ε is observed. It is equal to ε_u for all new matches and it changes from period $t-1$ to period t for incumbents.
3. Jobs whose productivity is too small are endogenously destroyed. FTCs are either destroyed or converted into permanent jobs.
4. Remaining and new workers produce and get paid.
5. Vacancies and contracts are posted.
6. Establishments are destroyed with probability μ.

Entrepreneurs. An entrepreneur of type a creates establishments if they are profitable, and the collection of establishments created by an entrepreneur constitutes a firm. This implies that only sufficiently efficient entrepreneurs can create establishments and, consequently, firms. This also means that higher-a entrepreneurs create more establishments.

3.3 Partial equilibrium

We start by analyzing the partial equilibrium, assuming that the expected utility of unemployed workers, W_u, and the number of establishments both remain constant. Adjustments of these variables in general equilibrium are described afterwards.

Let $V(z)$ stand for the value of the marginal vacant job in type-z 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 establishments are:

$$S_k(z) = W_k(z) - W_u + J_k(z), \quad k = \{p, t\}, \tag{3}$$

where p stands for permanent and t for temporary. The expected profit, value to the worker and surplus of matches between a worker and a job offer from type-z establishments are:

$$D(z) = \pi D_p(z) + (1-\pi)D_t(z), \quad D = \{J, W, S\}, \tag{4}$$

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 surplus of temporary jobs, which can be destroyed at no cost at the end of the first period of employment, is bigger than that of permanent jobs, meaning that firms always prefer to start jobs with a temporary contract.[5] This implies that the regulatory constraint is binding, or to put it differently that a hire is a permanent contract with probability π.

The value of a marginal vacant job to a type-z establishment is equal to its marginal cost plus its expected gains:

$$V(z) = \max_{W} -C'(v(z)) + \beta(1-\mu)\left[m(\theta(z))J(z) + [1 - m(\theta(z))]\, V^{+}(z)\right] \tag{5}$$

where $V^{+}(z)$ 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 (1). Maximization with respect to W using the fact that $J = S - (W - W_u)$, yields the traditional Hosios-Diamond-Pissarides (HDP) condition:

$$W(z) - W_u = \eta S(z). \tag{6}$$

Using the definition (1) of W_u, this condition defines a decreasing relation between the labor market tightness and the surplus of type-(z, π) establishments:

$$\theta(z)m(\theta(z)) = \frac{(1-\beta)W_u - b}{\beta\eta S(z)} \tag{7}$$

The surplus of starting jobs, which shows up at the denominator of equation (7), 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 establishments, $V(z)$,

[5] The surpluses of jobs and their properties are computed in Appendix A.1.

is equal to zero for all (z), which implies, using equation (5):

$$\underbrace{C'(v)}_{\text{Marginal cost}} = \underbrace{\beta(1-\mu)m(\theta(z))J(z)}_{\text{Expected marginal gain conditional on establishment survival}} \tag{8}$$

This condition, together with the HDP condition (6), the definition of the surpluses (equations (3) and (4)) and equation (7), implies that the number of vacant jobs in a type-z establishment is defined by:

$$v(z) = \left\{ v | C'(v) = (1-\mu)\frac{1-\eta}{\eta}\frac{(1-\beta)W_u - b}{\theta(z)} \right\} \tag{9}$$

At this stage, we can define the partial (i.e., for a given value of W_u) equilibrium values of $\theta(z)$ and $v(z)$, from equations (7) and (9). It is easily checked that when productivity is higher, firms post more job vacancies which are more easily filled (i.e., $v(z)$ increases and $\theta(z)$ 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 $v(z)$ decreases and $\theta(z)$ 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 fewer job vacancies and higher labor market tightness.

3.4 Labor market equilibrium

We determine the equilibrium of the model accounting for the adjustment of the expected utility of unemployed workers and for establishment and firm creation. The size of the labor force is equal to $\mathcal{N}$, which is an exogenous variable. In each period, each entrepreneur gets ϕ production opportunities and an opportunity allows the entrepreneur to draw an establishment productivity z in the cumulative distribution function $\Psi_a(z)$. A firm creates an establishment only if the productivity z of the production opportunity is above the threshold:[6]

$$\bar{z} = \{z | S(z) = 0\}. \tag{10}$$

As the value of type-z establishments increases with their productivity z, and entrepreneurs with higher ability a create more productive establishments, there exists a threshold value of a, denoted by $a_{\min}$, below which type-a entrepreneurs do not create establishments:[7]

$$a_{\min} = \{a | \Psi_a(\bar{z}) = 1\}. \tag{11}$$

[6]It is shown in Appendix A.3.1 that the value of type-z establishment, denoted by $\Pi(z)$, satisfies $\Pi(z) \geq 0 \Leftrightarrow S(z) \geq 0$.

[7]See Appendix A.3.4 which provides the sufficient assumptions for the existence of this threshold.

Given that there are $\mathcal{E}$ entrepreneurs, this implies that there are $\phi \times \mathcal{E}$ establishment creation opportunities per period. Consequently, the number of establishments n_e created in each period by the $\mathcal{E}$ entrepreneurs, whose abilities are distributed according to the cumulative distribution function Γ_a, is given by:

$$n_e = \underbrace{\phi \times \mathcal{E}}_{\text{\# of production opportunities}} \times \underbrace{\int_{a_{\min}}^{\infty} [1 - \Psi_a(\bar{z})] \, \mathrm{d}\, \Gamma(a).}_{\text{Prob. to create an establishment}} \tag{12}$$

Finally, equilibrium employment is determined by the labor market clearing condition, which satisfies the resource constraint:

$$\underbrace{\mathcal{N} - \mathcal{U}(W_u, \bar{z}, a_{\min})}_{\text{Quasi-labor supply}} = \underbrace{L(W_u, \bar{z}, a_{\min})}_{\text{Quasi-labor demand}}, \tag{13}$$

where $\mathcal{N}$ denotes the fixed number of workers in the economy. The quasi-labor supply (QLS) corresponds to the population minus the aggregate number of unemployed workers, $\mathcal{U}(.)$, as computed in Appendix A.5. The calculation of $\mathcal{U}(.)$ combines the job creation condition (equation (9)) with the definition of labor market tightness, $\theta = v/u$. QLS is increasing in the unemployment value: a higher W_u reduces the jobs surplus and hence the number of jobs acceptable for unemployed workers, thereby decreasing $\mathcal{U}(.)$ and increasing $\mathcal{N} - \mathcal{U}(.)$.

The quasi-labor demand (QLD), $L(.)$, derived in Appendix A.4 represents aggregate employment. It is based on the steady-state condition equating flows into and out of employment. QLD is decreasing in W_u: a higher W_u lowers the surplus from matches, reducing job creation and increasing job destruction.

Since QLS is increasing in W_u and QLD is decreasing, equation (13) determines the equilibrium employment level and the unique unemployment value W_u, assuming it exists. Together, equations (13), (10), and (11) jointly pin down the equilibrium values of W_u, $\bar{z}$, and $a_{\min}$, thereby completing the characterization of the model's equilibrium.

Definition 1 (Labor market equilibrium)**.** *The equilibrium is a tuple* $\{\theta(z), W(z), v(z), W_u, \bar{z}, a_{\min}, n_e\}$*, with job values and surpluses* $\{J_k(z), W_k(z), S_k(z)\}_{k=p,t}$ *given by (3) and (4), such that: (i)* W_u *satisfies the no-arbitrage condition (1) in every active market; (ii)* $W(z)$ *satisfies the HDP condition (6); (iii)* $v(z)$ *satisfies the vacancy creation condition (9); (iv)* $\bar{z}$ *satisfies the entry condition (10); (v)* $a_{\min}$ *and* n_e *satisfy (11) and (12); (vi)* W_u *satisfies the labor-market clearing condition (13).*

Efficiency. As shown in Appendix A.10, absent EPL ($\pi = F = 0$) the decentralized equilibrium coincides with the solution of a planner maximizing output net of costs.[8]

[8]This is a standard property of directed search models (Wright et al. 2021).

Three considerations justify our choice of a framework whose market equilibrium is socially efficient absent EPL. First, we do not compare a fully unregulated economy to one with EPL. All OECD countries regulate hiring, firing, or both, and actual reforms shift one constraint while leaving the rest of the regulatory environment in place. These marginal reforms, also known as "partial employment reforms", are the experiments we study, and their effects are not pinned down by the efficiency of the unregulated benchmark. Even when no regulation would be efficient, the response of employment and welfare to tightening one margin, holding others fixed, remains an open question. Second, EPL is unlikely to reflect efficiency objectives in the first place. The literature traces it to insider interests and cultural preferences for job security (Lindbeck & Snower 1988, Saint-Paul 2000, Alesina et al. 2015), and policymakers' stated goals emphasize stability and low unemployment rates, rather than aggregate output or welfare. Third, directed search allows us to represent reallocation between targeted and non-targeted units through submarket-specific job values and market tightness, thereby simplifying the analysis relative to a random-search framework in our heterogeneous setting.

3.5 Effects of EPL reforms on equilibrium

Our model captures the impact of changes in EPL, through either firing costs or restrictions on FTCs, on labor market equilibrium. It allows EPL to vary with establishment or firm characteristics such as age and size. To incorporate this conditionality, we redefine establishment types to incorporate policy parameters, (z, π, F). Consider a reform that changes the EPL parameters for a subset of establishment types, hereafter targeted, leaving the other, non-targeted, types unchanged. We compare the steady-state equilibria with and without the reform and denote by $\Delta \ln x$ the log change of any equilibrium object x between the two.

The reform affects the equilibrium through two main channels. The *job-value channel* operates through the value of matches relative to unemployment: the surplus of starting jobs, $S(z, \pi, F)$, at the hiring margin, and the surplus of continuing matches. The *tightness channel* operates through queue lengths: the adjustment of $\theta(z, \pi, F)$, which determines how fast vacancies are filled. Rewriting the no-arbitrage condition (1) and taking log differences,

$$\underbrace{\Delta \ln \left[\theta(z, \pi, F)\, m(\theta(z, \pi, F))\right]}_{\text{tightness channel}} + \underbrace{\Delta \ln S(z, \pi, F)}_{\text{job-value channel}} = \underbrace{\Delta \ln \left[(1-\beta) W_u - b\right]}_{\text{common to all markets}}. \tag{14}$$

Identity (14) holds market by market. The sum of the job-finding rate response and of the worker's value gain response is pinned down by the change in the flow value of unemployment, which is common to all markets, while its composition is free to differ across markets.

On the firm side, hires per establishment are $h(z,\pi,F) = m(\theta(z,\pi,F))v(z,\pi,F)$. Using equation (9) and the homogeneity of the vacancy cost function of degree $\alpha > 1$, hires decompose as[9]

$$\Delta \ln h(z,\pi,F) = \underbrace{\frac{\alpha}{\alpha-1}\Delta \ln m(\theta(z,\pi,F))}_{\text{tightness channel}} + \underbrace{\frac{1}{\alpha-1}\Delta \ln S(z,\pi,F)}_{\text{job-value channel}}. \tag{15}$$

The coefficient $\alpha/(\alpha-1) > 1$ on the tightness channel reflects a double dividend of faster vacancy filling: a higher $m(\theta)$ raises hires per vacancy directly and, because each vacancy is more likely to be filled, induces additional posting.

Appendix A.7 similarly decomposes separations, $\bar{s}(z,\pi,F)$, into the two channels. These results combine into a decomposition of establishment-level employment. In steady state, hires equal separations, conditional on establishment survival. For an establishment active in both equilibria, employment $N(z,\pi,F)$ satisfies

$$\Delta \ln N(z,\pi,F) = \Delta \ln h(z,\pi,F) - \Delta \ln \bar{s}(z,\pi,F), \tag{16}$$

where $\Delta \ln h$ and $\Delta \ln \bar{s}$ both split into the tightness and job-value channels. When adding changes across establishments, there is an additional extensive margin due to firm and establishment entry margins affected by the EPL change.

The general equilibrium adjustment to a reform targeting a subset of establishments then unfolds in three steps. Consider a reform that tightens EPL for targeted types, through a higher π, as in the Portuguese application below, or a higher F. First, the surplus of starting jobs in targeted establishments falls. Hence, the job-value channel reduces their hiring directly and, by identity (14), tightness must rise, as job seekers redirect their search toward other markets. This shifts the QLD curve downward (see Figure 6(b) for the corresponding shift in our estimated model). Second, the QLD shift lowers the unemployment value W_u, as workers revise expectations about job availability and about the surplus of available jobs. Third, the decline in W_u affects the job-value channel positively in non-targeted markets: hiring and retention increase. By equation (14), tightness decreases in those markets, which increases the vacancy filling rate and hence vacancy posting. The decline in W_u also makes additional establishment types profitable and allows less able entrepreneurs to enter, lowering $\bar{z}$ and $a_{\min}$. Those effects on non-targeted units shift the QLS curve upward.

The total employment effect aggregates the two channels across establishments and extensive margin responses. We use the example of the 2009 Portuguese reform, which conditioned EPL on establishment age and firm size, to illustrate these mechanisms and

[9]Equations (14) and (15) are exact when the elasticity η is constant, as under the Cobb-Douglas matching function used in the quantitative model. Equation (15) exploits the constant-elasticity vacancy cost $C(v) = c_0 v^{\alpha}$.

quantify their relative importance.

4 Empirical application: The Portuguese EPL reform

4.1 Institutional context and FTC reform

Context. In Portugal, as in many countries, the use of FTCs is legally restricted, unlike permanent contracts which can be freely offered by firms. According to the Labor Code, FTCs are allowed only to meet a temporary need such as replacing an absent worker, seasonal work, temporary demand spikes, or for employment policy reasons (e.g. hiring long-term unemployed or first-time job seekers). FTCs are also permitted when a firm is newly established or when it launches a new establishment, with new establishments defined as those less than two years old, even if the need for such workers is permanent.

FTCs typically cannot exceed 36 months. Before reaching this limit, the contract must either be converted to permanent or terminated. If the limit is exceeded without proper justification, the contract is automatically deemed permanent. Such conversions entitle the worker to significantly stronger legal protection against dismissal. This is largely due to the judicial risks and costs for employers, including potential reinstatement and retroactive wage payments, if a dismissal is successfully challenged in court.

Reform. Due to the high share of FTCs in Portugal and concerns over labor market segmentation, the government introduced restrictions on their use. Law 7/2009, enacted on February 13, 2009, limited the ability of firms to justify FTCs based on the opening of new establishments to those with fewer than 750 employees.

Before the reform, any firm, regardless of size, could invoke this justification (e.g., a bank opening a new branch or a restaurant chain launching a new outlet). After the reform, firms with fewer than 750 employees could still do so, while those with 750 or more employees ("large firms") could only use FTCs in more limited cases, such as genuine temporary needs or hiring long-term unemployed or first-time job seekers.[10]

4.2 Expected effects based on the model

The 2009 reform maps naturally into the model as a tightening of EPL for a specific set of establishments. Let π_ℓ denote the probability that a hire must be made on a permanent

[10]The 2009 labor reform also introduced several other legal changes, but none that affected the same firm size threshold we consider here, nor any other threshold. Moreover, although the reform implemented in February 2009 was not entirely unexpected, it was unlikely to have influenced decisions in 2008 due to considerable uncertainty about its implementation—particularly regarding the exact size threshold. Below, we verify that there is no evidence of firms manipulating their size to avoid the reform.

contract under the less stringent regulation applying to young establishments before the reform. Before 2009, all young establishments face π_ℓ, regardless of firm size. After the reform, young establishments of firms with at least 750 employees instead face π_{reform}, while young establishments of smaller firms retain the more flexible regime π_ℓ. Thus, the reform raises π only for young establishments of large firms.

This change also implies different entry conditions across the two regulatory regimes. Let $\bar{z}(\pi_\ell)$ and $\bar{z}(\pi_{reform})$ denote the reservation productivity levels above which establishments are created under the flexible and stricter regimes, respectively.[11] Because more stringent regulation lowers establishment profitability, it raises the relevant productivity threshold for targeted establishments and can therefore reduce establishment creation.

The model predicts opposing responses among targeted and non-targeted firms. For large firms, the tightening of EPL reduces the surplus from jobs in young establishments. Through the job-value and tightness channels described in Section 3.5, this reduces hiring and discourages the creation of new establishments. These are the direct effects of the reform.

In equilibrium, however, the contraction of labor demand by large firms generates spillovers to firms that remain under the more flexible regime. The resulting decline in the value of unemployment raises job values and improves recruiting conditions in their markets, increasing hiring by small firms. It also lowers $\bar{z}(\pi_\ell)$ and $a_{\min}$, the entrepreneurial-ability threshold below which entrepreneurs do not create firms, encouraging establishment creation and the entry of additional entrepreneurs. The reform therefore generates negative direct effects on targeted firms together with positive equilibrium responses among non-targeted firms.

This distinction is central for interpreting the empirical evidence. Comparisons between targeted and non-targeted firms reflect both the direct response of the former and the equilibrium response of the latter. We therefore begin by estimating the reform's *relative* effects on targeted versus non-targeted firms and then examine empirically whether hiring also responds among non-targeted firms, to test the model predictions.

4.3 Data

Our empirical analysis is based on the 'Quadros de Pessoal' dataset. 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 with at least one employee. The data cover 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,

[11] $\bar{z}(\pi_\ell) = \{z \mid S(z, \pi_\ell) = 0\}$ and $\bar{z}(\pi_{reform}) = \{z \mid S(z, \pi_{reform}) = 0\}$. See Appendix A.3.1.

month, and year of birth, schooling, occupation, salary, hours of work, etc. Critically for the purposes of our paper, 'Quadros de Pessoal', which the Portuguese administration uses to calculate firm size, also includes information on the month and year when each employment contract started and the type of employment contract of each worker (namely OEC or FTC) as of October of each year.[12]

Given the timing of the reform, we consider January 2009 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).[13]

For each firm, we identify its new establishments (those present in October 2010 but not in October 2008), as well as the workers employed in these new establishments.[14] We also calculate the number of hires in those new establishments by type of contract, permanent or fixed-term. 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 in October 2010.[15]

In the main part of our study, we analyze a total of 2,854 firms employing between 100 and 2,000 workers as of January 2009, before the reform. We split our sample into two groups: 145 firms that employed 750 or more employees in January 2009 (our treatment group) and the remaining 2,709 firms that employed 749 or fewer employees at that time (our control group). The characteristics of the firms in our sample are summarized in Table B.1.1. Although the number of firms above the 750 threshold is not large, yielding less precise estimates, these firms employ a substantial share of the labor force (15% of private sector employment).

[12]See Damas de Matos & Parent (2016), Silva et al. (2018), Portugal & Varejao (2022) and Pereira et al. (2025) for previous studies using the FTC variable in QP.

[13]The number of employees in January 2009 is estimated using the available data for individuals employed in October of each year. We know the starting month and year of employment spells. Accordingly, we counted the individuals employed in October 2008, and added those employed in October 2009 whose contracts started between November 2008 and January 2009. We then subtracted the number of workers who left the company between November 2008 and January 2009. To approximate this number, we first calculate an annual separation rate for each company based on the data available for each year in October from 2002 to January 2008. This rate is then adjusted to a four-month figure, assuming that it remains constant throughout the three four-month periods of the year.

[14]Since there is information on the year but not on the exact date of creation of establishments, new establishments are defined as those firm/establishment 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.

[15]As the data is based on employment as of October of each year, we cannot consider very short employment spells that started after October of one year and ended before October of the following year. In some cases, some of the workers in a given new establishment in 2010 joined the firm before the establishment was created, as firms reallocate experienced workers into new establishments. Those workers are excluded from our counts of hires in new establishments as they are not subject to the provisions of the law reform.

4.4 Reduced-form estimates

4.4.1 Benchmark regression discontinuity design

Our main empirical analysis is based on a regression discontinuity approach (Hahn et al. (2001), Lee & Lemieux (2010), Cattaneo et al. (2019, 2024)). This approach has the advantage of identifying the impact of the reform by comparing firms of similar sizes, which are unlikely to be affected differently by the 2009 recession, conditional on the covariates. The running variable is the number of employees in firm i in January 2009, denoted by X_i. Each firm has two potential outcomes: $Y_i(1)$ when the new rules are implemented by the reform, and $Y_i(0)$ otherwise. We assume a sharp design where firms with 750 (the cutoff, c) or more employees are treated by the reform, while firms with fewer employees are not. In this framework, the sharp RD treatment effect of the reform on firms with 750 or more employees is

$$\tau \;=\; \mathbb{E}[\,Y_i(1) - Y_i(0) \mid X_i = c\,] \;=\; \lim_{x \downarrow c} \mathbb{E}[Y_i \mid X_i = x] \;-\; \lim_{x \uparrow c} \mathbb{E}[Y_i \mid X_i = x]\,. \tag{17}$$

Our main dependent variable, Y_i, is the number of hires made by firm i in the new establishments it created between 2009 and 2010, measured both for FTCs and in total. Each hire is weighted by the number of months the worker was employed through October 2010, so that hires under FTCs and open-ended contracts are placed on a comparable footing. It reflects not just how many workers were brought in but how long they stayed.

We estimate τ using local polynomial methods at the cutoff c, following the method described in Cattaneo et al. (2019), Cattaneo et al. (2024) and summarized in Cattaneo & Titiunik (2022). The benchmark estimates rely on recommended options of the package *rdrobust* detailed in Calonico et al. (2017): (i) a triangular kernel, which assigns weights that are highest at the cutoff and decrease linearly for values of the score away from the cutoff; (ii) polynomial order of 1, yielding the standard local linear RD point estimator; (iii) common MSE-optimal bandwidth selector; and (iv) heteroskedasticity-robust NN variance estimator with a minimum of 3 neighbors. Concretely, we estimate the following weighted least squares specification on the subsample of firms with $|X_i - c| \leq \hat{h}$:

$$Y_i \;=\; \alpha_0 \;+\; \alpha_1 T_i \;+\; \alpha_2(X_i - c) \;+\; \alpha_3\, T_i \cdot (X_i - c) \;+\; Z_i'\gamma \;+\; \epsilon_i, \tag{18}$$

where each observation is weighted by $K\Big((X_i - c)/\hat{h}\Big)$, with $K(\cdot)$ the triangular kernel and $\hat{h}$ the MSE-optimal bandwidth. The treatment indicator T_i equals one if firm size in January 2009 is 750 or above and zero otherwise. The interaction term $\alpha_3 T_i \cdot (X_i - c)$ allows the slope of the outcome in the running variable to differ on either side of the cutoff, so that (18) is numerically equivalent to fitting two separate local linear regressions above and below c, as implemented in *rdrobust*. The vector Z_i contains industry fixed effects, entered additively with a coefficient restricted to be common across the two sides of the cutoff, following the covariate-adjusted RD estimator of Calonico, Cattaneo, Farrell & Titiunik (2019); this adjustment is valid provided the covariates are themselves continuous at the cutoff, which we verify below. The coefficient $\hat{\alpha}_1$ is a consistent estimator of τ.

4.4.2 Main RD results

Insofar as the reform imposes constraints on the hiring of FTCs in new establishments, we begin by documenting its impact on this variable. The scatter plot in the right-top panel of Figure 2 shows that the number of FTC hires between March 2009 and October 2010 in new establishments (created after October 2008) declines at the 750-employee cutoff. Firms with a size close to and above the 750 threshold, which must comply with the new rule limiting the use of FTCs, hire significantly fewer workers under FTCs than firms with a size close to but below this cutoff. The linear fit of the scatter points indicates that the magnitude of this decline, encompassing both the extensive margin (i.e., the creation of establishments) and the intensive margin (i.e., the number of hires per establishment), is substantial, amounting to about 8 employees.

This result is confirmed by regression results displayed in Figure 3, which provide a point estimate implying about a 74% drop in the number of new FTC hires.[16] These findings emphasize the success of the reform in achieving its goal of restricting the use of FTCs.

We also find a negative impact on all hires, encompassing both fixed-term and permanent contracts. While the reform aimed to encourage large firms to replace fixed-term contracts with permanent positions, our results suggest that this substitution effect did not materialize. In practice, large firms reduced their reliance on fixed-term contracts but did not increase permanent positions (see Figures 2 and 3). Overall, the decline in fixed-term hires fully translated into a reduction in total hiring at new establishments, which dropped by approximately 51%, as shown in Figure 3.

The reform also impacted the number of new establishments created by large firms. Figure 3 suggests a drop in the number of establishments, although the small number of observations limits statistical power, meaning the estimates are not statistically significant.

Robustness. Our results hold across alternative samples and specifications. Panel (a) of Figure 3 shows similar effects when we exclude firms with size between 730 and 770, which accounts for potential uncertainty in treatment application near the cutoff. The

[16] This percentage is calculated from the ratio $\hat{\alpha}_1/(M - \hat{\alpha}_1)$, where $\hat{\alpha}_1$ is the RD estimate obtained when the dependent variable is the number of FTCs created in new establishments between March 2009 and October 2010, and M is the average number of FTCs created in new establishments belonging to large firms near the cutoff in the same period, with sizes between 750 and 800.

results are also similar under a fixed bandwidth (firms with size between 600 and 1200) rather than the optimal one.

To confirm that our results are not an artifact of the design, we implement two sets of falsification tests. First, we run placebo tests on pre-reform outcomes in 2008 at the 750 cutoff. Panels (a) and (c) of Figure 2 and Panel (b) of Figure 3 show no negative effect on FTCs or total hires in 2008. Appendix Figure B.4.2 further shows no discontinuity in other firm outcomes, such as sales, prior to the reform. Second, we replicate our main strategy at alternative size cutoffs, namely 200 and 400 rather than 750. These cutoffs carry no differential regulation, so we should observe no discontinuity. Panel (b) of Figure 3 confirms this, supporting that our results do not reflect a discontinuity unrelated to the reform.

4.4.3 Additional adjustment margins

We now examine whether firms adjust along margins beyond reducing hiring at their newly created establishments, which are the ones the reform targets.

Effects on old establishments. We investigate whether the reduction in job creation in new establishments was offset by job creation in pre-existing establishments, defined as those that were already in operation by October 2008, just before the law reform was introduced. However, it appears that this mechanism did not take effect, as we detect no impact of the reform on hiring in older establishments, whether in terms of the number of FTC hires, total hires, or the share of fixed-term positions (Appendix Figure B.3.1).

Effects on the creation of small firms by large firms. Another possibility is that large firms circumvented the reform by creating new, smaller firms that would have been exempted from the new restriction targeting new establishments. Although theoretically possible, this phenomenon is unlikely in practice: 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, workers' recruitment, and their relationship with suppliers and banking, for instance. There would also be costs in setting up the new firm and from the uncertainty regarding the possibility that these firms would be regarded as new establishments in the context of the law reform. We nonetheless explored this question in Appendix B.3.2 and find no evidence of such effects: income in subsidiaries did not increase significantly.

4.5 Evidence on spillovers

We find that the FTC restriction imposed on large firms sharply reduces FTC hires, with no offsetting increase in open-ended employment. Given the reduced labor demand by large firms, our theoretical model indicates that firms not targeted by the reform could face lower recruitment frictions and then hire more workers. This section focuses on investigating this possibility in the data. We begin by defining a measure of small firms' exposure to the potential spillovers from large firms before conducting an event study to evaluate these spillovers.

Definition of exposure to potential spillovers. We next examine the effects of the reform on hiring in the establishments of small firms, which are not targeted, considering firms with fewer than 750 employees in January 2009. We ask whether small firms more exposed to the directly impacted large firms, through shared local markets, benefit more from the latter's reduction in FTC hires. We define local markets by geographical and sectoral location, using the 'concelho' level for geography and the one-digit level for industry.[17] This yields 2,875 region-industry markets containing at least one establishment of a firm with fewer than 750 employees.

For each small-firm establishment, we compute the leave-one-out share of employment in establishments of firms with at least 750 employees within the local market, in each year from 2002 to 2008, and average these pre-reform measures. Appendix Figure C.0.1(a) shows wide dispersion in this exposure measure, with a first quartile of 22%, a median of 26%, and a third quartile of 33%. We interpret it as a proxy for a small firm's structural exposure to targeted firms and leverage this variation to test for spillovers.

Evolution of hiring in non-targeted establishments. To document the consequences of exposure to large firms, we compare the hires of small-firm establishments with exposure levels below the 10th percentile to those with exposure levels above the 50th and 75th percentiles. Appendix Figure C.0.1(b) displays the evolution of raw averages over time. While hiring declines generally from 2009, likely because of the Great Recession, this decline is smaller for small-firm establishments operating in labor markets more exposed to targeted firms. The number of hires in establishments located in markets within the first decile of the large-firm employment share drops by approximately 26% between 2008 and 2010. In contrast, the decline is limited to 20% for establishments in markets above the median and to 18% for those in the top quartile. This difference in hiring by exposure to large firms appears only from 2009 onward and is absent in the pre-reform years.

To further control for aggregate effects common to all establishments and for establishment-specific differences in levels, we rely on an event study design:

$$Y_{i,t} = \sum_{k=-4}^{k=2,k\neq 0} (\beta_k \times Z_i) \times \mathbf{1}_{t=2008+k} + \mu_i + \eta_t + \epsilon_{it}. \tag{19}$$

[17] Portugal is divided into 'distritos' and islands (districts), of which there are 30, further subdivided into 'concelhos' (municipalities), totaling 308 across the country. There are 10 one-digit industries, described in Table B.1.1.

Here, $Y_{i,t}$ is the number of hires (those between March of year $t-1$ and October of year t) in small-firm establishment i in year t. Z_i indicates whether the establishment faces high exposure to large firms, and μ_i and η_t are establishment and year fixed effects. The outcome is normalized by the mean of the group. The year 2008 ($k = 0$) is the year preceding the reform, and the coefficients β_k capture the difference in the evolution of hires between small-firm establishments with high and low exposure to large firms.[18]

Figure 4 confirms parallel trends across small-firm establishments in markets with different exposure to large firms before the reform. It also shows that restrictions on fixed-term contract use in establishments created by large firms affected hiring not only within those firms but also in small firms not directly subject to the restrictions. This positive effect is more pronounced for establishments in the top quartile of exposure. It is both statistically significant at the 95% level and economically meaningful: the number of hires in establishments in the upper quartile is approximately 7 percentage points higher than in those in the first decile of the large-firm market-share distribution.

Falsification tests. Beyond the pre-reform placebo test, we run falsification tests using exposure to alternative groups of firms. One concern is that establishments exposed to firms of different sizes in their local labor market responded differently to the recession for reasons unrelated to the reform. We therefore analyze hiring evolutions across establishments with varying exposure to large firms, now defining large firms as those above 200 or 400 employees and excluding those above 750. Figure C.0.2 shows no effect of exposure to these falsified groups after 2009. Finally, to rule out that we are capturing heterogeneous effects of the recession across local labor markets, we re-estimate our specification controlling for time-varying district fixed effects.[19] Figure C.0.3 shows similar results. Together, these tests support the interpretation that we are capturing spillovers from the reform onto non-targeted establishments.

While this exercise is useful for testing the presence of spillovers to non-targeted establishments, it cannot credibly quantify their overall magnitude. It abstracts from cross-market reallocation and instead relies on comparisons across markets, exploiting the fact that spillovers are more likely to occur within the same industry and location. Spillover effects imply that comparing targeted large firms with non-targeted small firms may not recover the true impact of the reform. Our model allows us to both decompose

[18]Because exposure is continuous, a TWFE specification with the dose itself would weight dose-specific ATTs with negative weights below the average dose (Callaway et al. 2026). We therefore compare two well-separated exposure groups, so the weighting pathology disappears and parallel trends is only required between the two groups rather than across all dose levels. Note that, since low-exposure establishments are themselves exposed, β_k identifies a *difference* in average treatment effects across exposure groups, not the effect of the reform on either group.

[19]We use the doubly robust estimator recommended by Sant'Anna & Zhao (2020), as the TWFE estimator is biased if the reform's effects are heterogeneous across districts.

the relative change between targeted and non-targeted units and assess the aggregate impact.

5 EPL reforms in the model: Quantification

This section describes the quantitative model and the estimation of parameters prior to the 2009 reform. We then identify the policy parameter (the value of π for targeted units) corresponding to the reform, implement it, and solve for the new general equilibrium. Using the estimated model, we conduct three sets of exercises. First, we decompose the regression discontinuity estimates from the data into direct and general equilibrium effects at the firm level. Second, we quantify the aggregate impact of the reform on employment and welfare. Third, we perform counterfactual simulations comparing reforms that impose stricter EPL based on firm size, establishment size, and establishment age.

5.1 Quantitative model

We now describe the functional and distributional assumptions, as well as the pre-reform EPL configuration, used to map the pre-2009 situation in Portugal.

Entrepreneur ability and establishment productivity. Establishment productivity is drawn from a distribution Ψ_a that depends on the entrepreneur's ability. We assume a uniform distribution: $z \sim \mathcal{U}[z_{\min}, a \times \delta]$, where $z_{\min}$ is a fixed lower bound common to all firms, and the upper bound is given by $a \times \delta$, with δ to be estimated. This assumption ensures tractability and reproduces the observed positive relationship between firm size and establishment size (when $\delta > 0$), as well as a positive correlation between firm size and the dispersion of establishment sizes (see Appendix Figure D.1.3(d)).

Other distributions. Entrepreneurial ability, a, follows a Weibull distribution with scale and shape parameters γ_1 and γ_2. The empirical distribution is truncated, as some potential entrepreneurs do not create establishments. Match productivity, ϵ, is drawn from a uniform distribution: $\epsilon \sim \mathcal{U}[1-\bar{\epsilon}, 1+\bar{\epsilon}]$ where $\bar{\epsilon} > 0$ governs the dispersion of match-specific productivity around its mean.

Functional forms. The vacancy cost function is homogeneous of degree $\alpha > 1$: $C(v) = c_0 v^{\alpha}$, with $c_0 > 0$. The matching function is Cobb-Douglas and homogeneous of degree one: $m(\theta) = m_0 \theta^{-\eta}$, where $\eta \in (0, 1)$ and $m_0 > 0$.

EPL structure pre-reform. Before the 2009 reform targeting large firms, the stringency of EPL for FTCs depended solely on the age of the establishment. New establishments benefited from greater flexibility, implying two values of π: one for young establishments (π_ℓ) and one for older ones (π_h). While 'new' generally refers to establishments under two years old, the definition is somewhat uncertain in the law. To capture this, we assume that in each period, establishments experience an aging shock with probability ρ, after which stricter regulation applies. In practice, we set $\rho = 0.5$, implying that establishments remain 'young' for an average of two years.

5.2 Estimation of model parameters before policy change

We estimate and calibrate the model parameters using data from the 2004–2008 period (prior to the reform), proceeding in four main steps. Table 1 summarizes all parameter values and their definitions.

Step 1: Fixed parameters. We begin by setting a subset of parameters through normalization or by directly matching data counterparts. One model period corresponds to one year. The discount factor is set to $\beta = 0.952$, consistent with a 5% annual interest rate. The elasticity of the matching function is fixed at $\eta = 0.5$, and we explore the sensitivity of our results to this choice. The scale parameter of the vacancy cost function, c_0, is normalized since it cannot be separately identified from the scale parameter of the matching function, m_0 (which we estimate). The scale parameter of the Weibull distribution, γ_1, cannot be separately identified from δ, $\bar{\epsilon}$, and γ_2. Therefore, we normalize this parameter and estimate the others. The establishment annual exit rate, μ, is set using its empirical value over 2004–2008. We calibrate π_ℓ and π_h to match the observed shares of OECs among new hires in young and old establishments, respectively. ϕ represents the maximum number of establishments that can be created by a firm per period. We calibrate this parameter using the 95$^{\text{th}}$ percentile of the distribution of new establishments per firm, equal to 2.

Step 2: Joint estimation targeting the jobs separation rate distribution. We jointly estimate three parameters at this stage: the firing cost (F), the shape of the ability distribution (γ_2), and the dispersion parameter of the match productivity distribution ($\bar{\epsilon}$). These parameters are jointly estimated to minimize the distance between the distribution of permanent job separation rates across establishments in the model and in the data. We use the generalized method of moments (GMM) for estimation. At the establishment level, firing costs F influence the separation rate of OEC: a higher F reduces the separation rate. Similarly, the distribution of match productivity and hence $\bar{\epsilon}$ will determine the fraction of jobs that are ended each period by an establishment. The aggregate distribution of separation rates additionally depends on the distribution of z: the establishment productivity distribution will determine the distribution of endogenous separation cutoffs.

The aggregate distribution of separation rates thus depends on the distribution of z, which in turn is governed by the ability distribution and the mapping from ability to productivity. To separate these effects, we nest a calibration of the parameter δ, which links entrepreneurial ability to establishment productivity. For each candidate vector of parameters $(F, \gamma_2, \bar{\epsilon})$, we solve for the value of δ such that the model matches the observed average number of establishments per firm (see Appendix A.3.4 for details). For each vector, we also determine the lower bound of z, common to all firms, such that the job separation rate is equal to 1 for that productivity level. Hence, the number of establishments per firm pins down δ, and the distribution of separation rates at the aggregate level pins down γ_2 (jointly with F and $\bar{\epsilon}$). Appendix Figure D.1.1 shows the model fit of the distribution of job destruction rates, which is the target of this estimation step.

Step 3: Calibration of the number of potential entrepreneurs. We deduce $\mathcal{E}$ by mapping the number of operating firms in the economy and in the model:

$$\text{Number of firms} = \mathcal{E}[1 - \Gamma(a_{\min})], \tag{20}$$

where the parameters that characterize $\Gamma(.)$ have been estimated in the previous step and therefore $\Gamma(a_{\min})$ can be deduced.

Step 4: Joint calibration targeting labor market equilibrium. In the final step, we jointly calibrate the elasticity of the vacancy cost function (α), the scale parameter of the matching function (m_0), and the instantaneous unemployment gain (b). We solve for parameters satisfying three equations matching three moments in the data: (i) the total number of employed workers, (ii) the total number of unemployed workers (or, equivalently, the unemployment rate), and (iii) the share of employment in firms with more than 750 employees. The third target ensures that the market share of firms affected by the policy matches the empirical pre-reform share. By construction, the model reaches a steady-state equilibrium at the end of this step, with the sum of employed and unemployed workers equal to the total population.

Model fit. Appendix Figure D.1.3 compares moments in the model and the data that we do not directly target in estimation. Panels (a) and (b) show that the model closely reproduces both the firm size and establishment size distributions, even though the only moment we target is the share of jobs in firms larger than 750 workers. Panel (c) shows that the model under-predicts the share of mono-establishment firms, which is 92% in the data but 73% in the model. Finally, Panel (d) shows that it reproduces the key empirical relationship between firm and establishment size: larger firms operate larger establishments and exhibit greater dispersion in their establishment size, although the latter is somewhat more pronounced in the model than in the data.

5.3 The Portuguese reform in the model: decomposition of regression discontinuity

The 2009 Portuguese reform restricted the use of FTCs in young establishments of large firms. In our model, this policy change is represented by an increase in the value of π, denoted π_{reform}, for the targeted establishments. We proceed in two steps. First, we identify the value of π_{reform} using our baseline reduced-form estimate for FTCs. Then, we implement the reform in the model and decompose all reduced-form estimates into direct effects and general equilibrium spillovers. Both steps require constructing an analogue to the RDD within our structural model.

Estimation of reform parameter. We choose π_{reform} to reproduce the observed RD estimate for the number of FTC hires in the model. As shown in Section 4.4.2, the reform reduced FTC hires by 73.8% in young establishments of large firms, relative to those of smaller firms. To mirror the empirical RDD in the model, we proceed as follows. First, treatment status is assigned based on firm size measured before the reform: January 2009 in the data, and the pre-reform equilibrium in the model. Second, firms just below and just above the 750-employee cutoff are compared in the post-reform equilibrium: 2010 in the data and the new steady state in the model. Third, the firm-level estimate is evaluated exactly at the 750-employee threshold. In practice, we iterate over values of π_{reform}, solve for the new general equilibrium, and compute the resulting RD estimate at each iteration. Hence, the model can capture both the outcome change for the targeted firms and the change induced by spillovers in the non-targeted firms, exactly as the reduced-form strategy does. The model-based RD estimate is monotone in π_{reform}, as verified in Figure D.2.1, which ensures a unique solution.

Our empirical estimates capture the effect of the reform as of 2010, whereas the structural approach compares two steady states. Because the policy targets hires, and FTC jobs are typically short-lived, we expect most of the adjustment to occur quickly. Section 5.4 presents estimates under alternative assumptions and our main conclusions are unchanged.

Decomposition of regression discontinuity estimates. We now decompose changes in firm-level outcomes at the 750-employee cutoff into direct and general equilibrium adjustments, and illustrate these decompositions using counterparts to the binscatter plots presented in Section 4.4.2. The main results are shown in Figure 5 (see Appendix Figure E.1.1 for additional outcomes).

On the x-axis, we report firm size, measured in the pre-reform equilibrium (i.e., equivalent to pre-2009 in the data). On the y-axis, we report the number of FTC hires (panel (a)) and the total number of hires (panel (b)) across all young establishments of a firm, measured in different equilibria.

The model-based RD estimate (defined in Appendix Equation (D.86)), corresponds to the jump in the solid orange line at the 750 threshold, expressed as a percentage change relative to the value just to the left of the cutoff. The orange line plots values in the post-reform equilibrium. For FTCs, this estimate matches the empirical result from Section 4.4.2 by construction, as we use it to calibrate π_{reform}. For total hires, the model predicts a reduction of 71.9%. Although this prediction differs from the empirical point estimates, it lies within their confidence intervals.[20] The model replicates the absence of substitution from FTCs to OECs at the cutoff and the negative RD estimate for total hires.

Both panels of Figure 5 reveal that, on the left-hand side of the cutoff, the orange line lies above the dashed purple line, which corresponds to the number of hires in the pre-reform equilibrium. This implies that when the reform is in place, there are more FTC hires and more hires in young establishments of non-targeted firms. This arises from the change in job value and in tightness, which result from the direct negative impact on treated firms. Non-treated firms respond by creating new establishments and expanding existing ones. For the same reason, the negative effect of the reform on treated firms is slightly attenuated when general equilibrium adjustments are allowed (orange line), compared to the partial equilibrium case (dotted light green line), which represents the number of jobs holding W_u fixed at its pre-reform value.

Figure 5 also shows that general-equilibrium effects are small locally around the cutoff. For non-treated firms, the gap between the orange and dashed purple lines is limited, and for treated firms the general-equilibrium response remains close to its partial-equilibrium counterpart. As a result, the model-implied treatment effect at the cutoff is close to the RD estimate. Absent general-equilibrium effects, the treatment effect at the cutoff is -74.4% for FTC hires and -72.4% for total hires. Thus, equilibrium spillovers generate little bias in the reduced-form estimate of the firm-level treatment effect. This does not imply, however, that they are unimportant in the aggregate: because non-treated firms are far more numerous than treated firms, even small responses among them can cumulate into substantial aggregate effects. We quantify these effects next.

[20] The corresponding empirical estimates are -50.8% in our baseline RD specification, -73.2% with the donut specification, and -48.9% with fixed bandwidth.

5.4 The Portuguese reform in the model: aggregate effects

The reduced-form estimates used to calibrate the policy parameter concern hiring flows in newly created establishments. The model translates these flows into steady-state employment stocks by accounting for subsequent job conversions and separations, as well as establishment entry and exit. We now use it to quantify the reform's effect on total employment across the entire economy, rather than only on hires around the 750-employee cutoff. Results are presented in Figure 6. The model also lets us assess the effect on total output net of costs, which is equivalent to welfare since agents are risk neutral.

Total employment changes. Panel (a) shows employment changes among all targeted and non-targeted firms, expressed as a share of total employment without the reform. The direct reduction from FTCs in targeted firms amounts to 2.72% of total employment. The number of open-ended contracts also decreases for two reasons. First, these establishments post fewer vacancies due to the change in job value, leading to fewer permanent hires. Second, with fewer FTCs, there are also fewer conversions. This change in flows at every period accumulates to a change in the number of OECs in the stock by -6.95% in targeted firms.

In contrast, non-targeted firms expand their hiring, especially in their young, less regulated establishments. This leads to an employment increase under both contract types in those firms. The gains among non-targeted firms reach 9.77% of total employment and hence more than offset the losses among targeted firms, yielding a net increase in total employment of 0.11%.

Decomposition of the change in labor market equilibrium. Panel (b) displays the labor market equilibrium with and without the reform and illustrates the key result: although the reform reduces employment among treated firms, aggregate employment increases. The total effect combines the two channels described in Section 3.5, the job-value channel and the tightness channel, each operating at the establishment level, with the distribution of these responses across establishment types. Appendix Figure E.3.1 reports estimates of both channels by establishment productivity, separately for establishments of treated and non-treated firms. At treated establishments, the reform directly lowers the expected surplus of new jobs: job values fall, which discourages vacancy posting, and tightness rises as unemployed workers redirect their search toward other markets, so vacancies are filled more slowly. Table 2 quantifies the relative importance of the two channels after aggregating across establishment groups: for young establishments of large firms, the increase in tightness accounts for 56% of the negative employment effect, changes in job values explain the remainder, and establishment entry plays a negligible role. At non-treated establishments, the two channels operate in reverse, as an equilibrium response to the reform: job values rise, and the inflow of job seekers redirected from treated markets lowers tightness, so vacancies are filled faster. Both the negative responses of treated establishments and the positive responses of non-treated ones are larger at low productivity, where jobs are more often marginal even before the reform.

These establishment-level responses translate into the equilibrium shifts displayed in Panel (b) of Figure 6: the direct effects of the reform on treated firms shift QLD downward, inducing a decline in the value of unemployment, W_u. As this decline raises the job value, QLS shifts upward. The magnitude of each shift depends not only on the within-establishment responses but also on where they fall in the productivity distribution. Treated firms are concentrated among high-z establishments, where fewer jobs are close to the profitability margin, so the downward shift in QLD generates only modest job losses. The contraction in these markets nonetheless lowers W_u. Because W_u aggregates the value of search across establishment types, its decline combines the within-establishment changes with their distribution across types: unemployed workers face lower job-finding rates, and the deterioration is concentrated among high-surplus jobs, as targeted establishments tend to be more productive. The lower W_u raises match surplus and makes a larger set of jobs profitable. Because this response is strongest for low-productivity jobs, and non-treated firms account for most low-z establishments, the upward shift in QLS generates job creation that more than offsets the losses at treated firms.

Comparison between reduced-form and structural approaches. Our RD strategy implies that the reform reduced hires in young establishments of targeted firms by 50.78% (Section 4.4). For new establishments, hires equal employment by construction.[21] Assuming no effect on old establishments (consistent with our findings in Section 4.4.3), we combine this estimate with young establishments' pre-reform employment share of 2.98% to obtain a back-of-the-envelope estimate of the aggregate employment effect: a 1.51% decline in total employment. Applying the same calculation to the model-based RD estimate yields a decline of 2.14%, because, as explained above, the model overstates the magnitude of the RD effect on total hires relative to its empirical counterpart, although the model-based estimate lies within the latter's 95% confidence interval. Both estimates are reported at the top of panel (c) of Figure 6.

The three estimates below them instead use the structural model to account for general equilibrium effects, in particular labor reallocation toward non-treated establishments. The third bar (+0.11%) is our baseline estimate of the aggregate employment effect, also presented in panel (a). The last two bars probe alternative assumptions. "Model, short run" holds employment in old establishments at its pre-reform value and lets only young establishments adjust. The motivation is that employment changes in old establishments

[21] See Section 4.3.

accumulate through changes in hires over many periods and thus may materialize only in the longer run. Under this version, the estimate is -0.01%. "Model, allowing for bunching" lets all establishments adjust, as in the baseline, and additionally allows firms to bunch endogenously below the 750 cutoff. In the baseline, treatment status is determined by pre-reform firm size. This mirrors the reduced-form design and facilitates a direct comparison with the empirical estimates. In practice, however, some firms may limit their growth and remain just below the cutoff to avoid the stricter regulation.[22] In this specification, the employment losses among potentially treated firms (that is, firms that would exceed the cutoff in the absence of bunching) are exactly offset by employment gains among firms that remain untreated. The aggregate employment effect is therefore zero.

Across all versions, the general equilibrium effects captured by the structural model overturn the conclusion one would draw from the back-of-the-envelope computation: a naive extrapolation of the reduced-form estimate implies a sizable employment loss, whereas the model implies an effect close to zero or slightly positive.

Sensitivity. Appendix Figure E.4.1 tests the sensitivity of our employment effects to the elasticity of the matching function (η) and the elasticity of the vacancy cost function (α). We vary each parameter holding the other fixed and recompute the pre- and post-reform equilibria. We vary η because it is fixed at 0.5 rather than estimated. Even for large deviations, total employment effects remain small and positive, ranging from +0.07% to +0.12%. Although α is estimated, we also consider departures from its value because it is the main driver of the employment distribution across firm sizes and therefore matters for the effects of a size-dependent regulation. Here again, our conclusions are unchanged, with employment effects between +0.04% and +0.12%.

Welfare. Panel (d) of Figure 6 reports the change in total output net of costs, which equals the welfare change under our quasi-linear utility. Welfare decreases by 0.10% post-reform, and this change decomposes into four components. Market production falls by 0.03%: although more workers are employed, jobs reallocate toward less productive establishments. Non-market production falls because unemployment is lower. Hiring costs decline because recruitment shifts from larger to smaller establishments and these costs are convex. Finally, total firing costs rise because jobs reallocate toward establishments with higher turnover. Thus, although the reform slightly raised employment, it did so entirely through cross-firm reallocation, and this reallocation reduced welfare.

[22]We identify the ability support corresponding to firms that would be larger than 750 absent the constraint, but smaller than 750 with the reform to estimate the bunching mass. To close the model, we make additional assumptions to assign queue lengths across markets, described in Appendix E.2.

5.5 The design of EPL: targeting and policy interactions

The counterfactual exercises in this section deliver three main results. First, the positive aggregate employment effect of the Portuguese reform is robust to large variations in the share of firms subject to the regulation. Second, the targeting of EPL reforms matters: policies differentiating EPL based on different criteria can have opposite welfare effects. Third, the effects of a reform are shaped by its interaction with pre-existing hiring and firing restrictions, which emphasizes the importance of modeling those two aspects of EPL jointly.

Varying the firm-size cutoff. In Section 5.4, we show that the positive employment response of non-targeted firms more than offsets the contraction of targeted firms, which account for 15% of total employment in the baseline. To assess whether this result depends on the limited bite of the reform, we vary the firm-size cutoff and thereby change the treated employment share from 5% to 100%.

Figure 7 shows that the aggregate employment effect remains positive throughout this range: at every cutoff, employment gains among non-targeted firms slightly exceed losses among targeted firms. At the 250-employee cutoff introduced by the Portuguese government in 2019, the model predicts a 0.59% increase in total employment. This stability reflects two opposing forces. On the one hand, lowering the cutoff mechanically shrinks the set of firms that face only indirect effects and therefore expand. On the other hand, a lower cutoff leaves only the lowest-z establishments untreated, so employment reallocates toward the lowest-surplus jobs. Therefore, as the cutoff falls, there is a larger decline in W_u, inducing a stronger response of non-treated establishments.

Alternative forms of targeting. We next compare hiring and firing restrictions differentiated according to the three criteria documented in Section 2: firm size, establishment size, and establishment age. We first compute a benchmark equilibrium with uniform EPL and then increase either the restriction on fixed-term hiring, π, or the firing cost, F, for the targeted units. To make the policies comparable, targeted units account for 40% of employment in every experiment. Figure 8 reports the aggregate employment and welfare effects, and Appendix Figure E.5.1 provides the decomposition between targeted and non-targeted units.

Stricter hiring restrictions raise total employment under all three targeting rules, but their welfare effects differ. Targeting large firms or large establishments reallocates employment away from relatively productive, high-surplus jobs and reduces welfare despite increasing employment. By contrast, targeting old establishments raises both employment and welfare: the policy induces search and vacancy creation to shift toward relatively productive young establishments. Similar forces operate when firing costs are increased. Increasing EPL in old establishments raises both employment and welfare, whereas the welfare effects of targeting large firms or establishments are non-monotonic.

These findings illustrate an important second-best mechanism. Hiring and firing restrictions interact, so tightening one component of EPL can partly offset a pre-existing distortion created by another. In particular, when firing costs already depress employment and output, a targeted restriction on fixed-term hiring can improve welfare by redirecting vacancy creation toward productive establishments. Conversely, a modest increase in firing costs can be welfare-improving when pre-existing restrictions on fixed-term contracts keep unemployment inefficiently high. The relevant policy question is therefore not whether stricter EPL raises or lowers employment in isolation, but which units it targets and how it interacts with the rest of the regulatory system.

6 Conclusion

This paper contributes to the analysis of employment protection legislation by connecting policy effects identified from comparisons between targeted and non-targeted units to their aggregate implications. We apply our framework to a restriction on the use of fixed-term contracts targeting young establishments of large firms in Portugal. We find that accounting for these equilibrium forces reverses the estimated employment effect from -1.51% obtained from a back-of-the-envelope computation using the reduced form, to $+0.11\%$. The framework also shows how aggregate employment and welfare depend on whether EPL is contingent on firm size, establishment size, or establishment age, and on its interaction with pre-existing hiring and firing restrictions.

These conclusions are subject to several limitations. First, the quantitative results are disciplined by a particular reform in one country, and their magnitude need not carry over to economies with different firm-size distributions, labor market institutions, or patterns of worker mobility. Nonetheless, the Portuguese reform provides a clear example in which a reduced-form estimate that is informative about the firm-level treatment effect can be uninformative about the aggregate effect. Second, the model gives a central role to directed search and assumes perfect mobility across labor markets and no on-the-job search. These assumptions make the reallocation of search across targeted and non-targeted markets transparent, but they abstract from geographic, sectoral, and occupational barriers that may dampen or redirect spillovers. Finally, the welfare analysis abstracts from richer worker heterogeneity and from distributional considerations that may be central to the political economy of employment protection.

These limitations suggest several directions for future research. One is to estimate how mobility costs, on-the-job search, and segmentation across occupations or locations shape the adjustment of equilibrium effects. A second is to incorporate heterogeneous workers in order to study how aggregate gains and losses are distributed across skill, gender, age, tenure, and initial contract status. Finally, applying the framework to reforms in other institutional settings would help establish which features of the Portuguese results are general and which depend on the structure of its labor market. Together, these extensions would move the evaluation of EPL beyond the effects observed around a policy threshold toward a broader account of how targeted labor market regulations reshape employment, productivity, and welfare in equilibrium.

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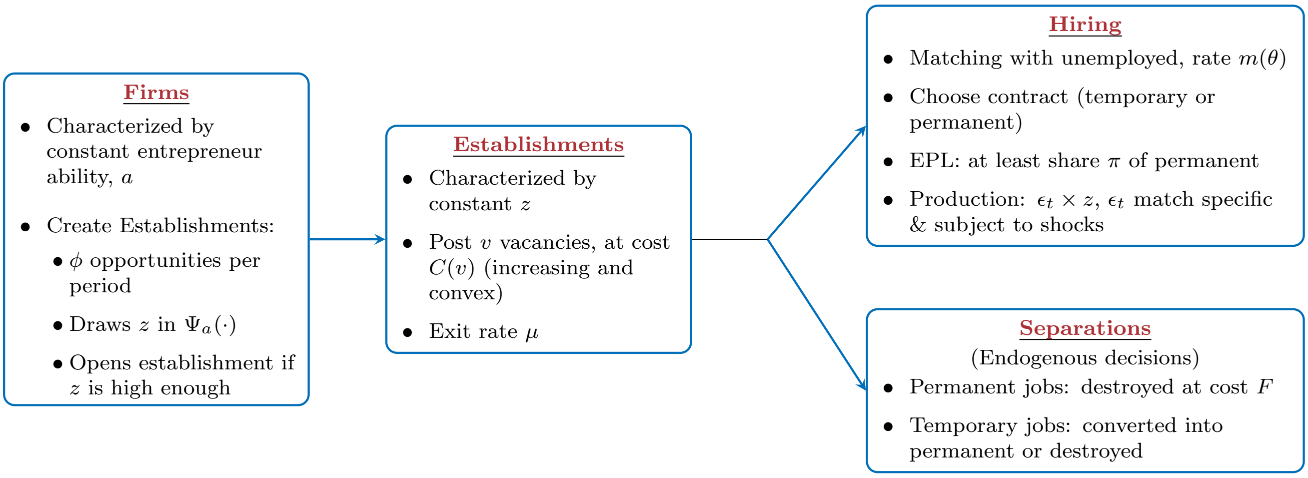
Figures

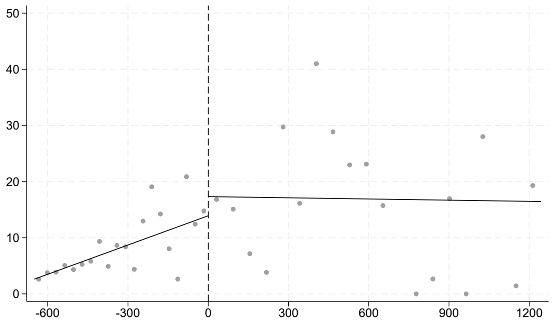
Figure 1: **Main ingredients of the structural model**



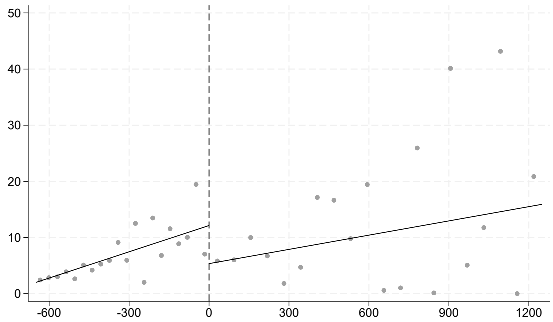
Notes: This figure describes the structure of the model. A firm is defined as the collection of establishments created by a single entrepreneur of ability a. In each period, the entrepreneur receives ϕ opportunities, representing ideas, access to financing, or other conditions favorable to starting a business, and draws an associated productivity z from $\Psi_a(\cdot)$ for each opportunity. More able entrepreneurs draw from more favorable distributions. An establishment is opened when z is sufficiently high. An active establishment posts $v(z)$ vacancies at convex cost $C(v)$ and exits exogenously at rate μ. Matches with unemployed workers form at rate $m(\theta)$. For each match, the firm chooses between a fixed-term and an open-ended contract, subject to the employment-protection constraint that at least a share π of hires be made under open-ended contracts. Job productivity is the product of z and a match-specific shock ε_t that evolves stochastically over time. Open-ended jobs are destroyed at firing cost F when ε_t falls below an endogenous threshold. Fixed-term jobs are either converted into open-ended jobs or terminated upon expiration.

Figure 2: **Hires in young establishments pre-reform and post-reform**

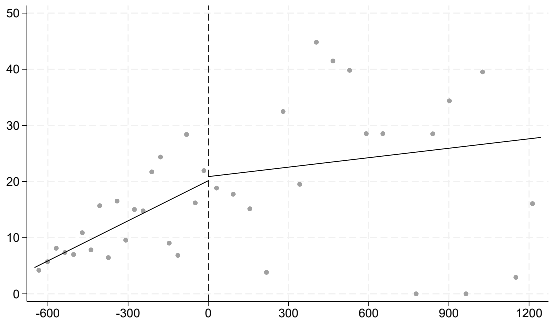
(a) Fixed-term contracts, 2008 (pre-reform)



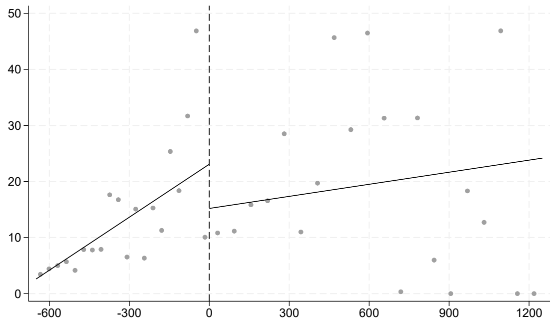
(b) Fixed-term contracts, 2010 (post-reform)



(c) Total, 2008 (pre-reform)



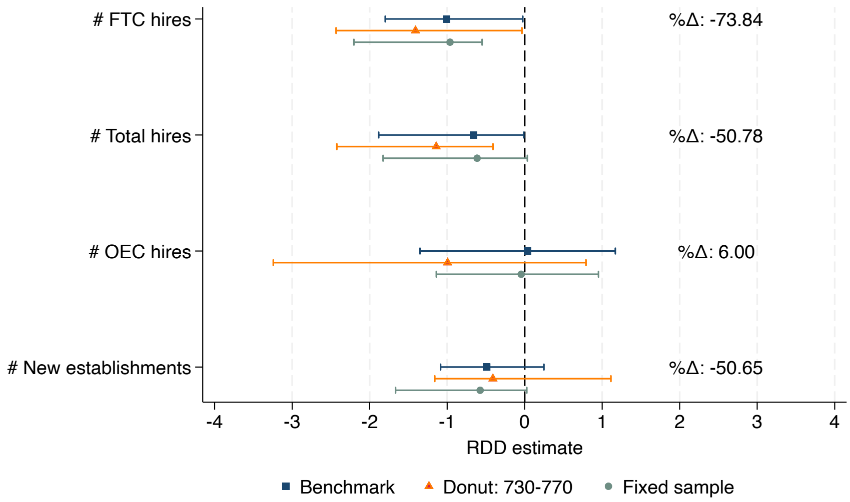
(d) Total, 2010 (post-reform)



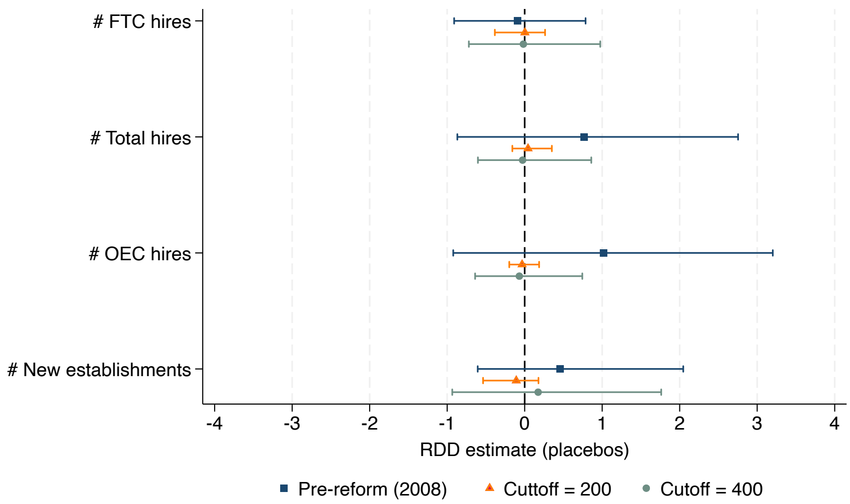
Notes: This figure reports the number of hires under fixed-term contracts (panels (a) and (b)) and the total number of hires (panels (c) and (d)) in newly created establishments. The 2008 pre-reform outcomes are the numbers of hires occurring between March 2007 and October 2008, whereas the 2010 post-reform outcomes are the numbers of hires occurring between March 2009 and October 2010. Each hire is weighted by the number of months of the associated employment spell. Panels (a) and (c) report the pre-reform outcomes, and panels (b) and (d) report the post-reform outcomes. The horizontal axis reports firm size normalized at 750, in January 2008 for panels (a) and (c) and in January 2009 for (b) and (d), both before the reform. All outcomes are residualized with respect to industry fixed effects. Firms that did not open a new establishment are included, with their number of hires set to zero. The lines show linear fits. Calculations are based on *Quadros de Pessoal* data.

Figure 3: **Regression discontinuity estimates of the effects of the reform and placebo tests**

(a) Main results: 2010

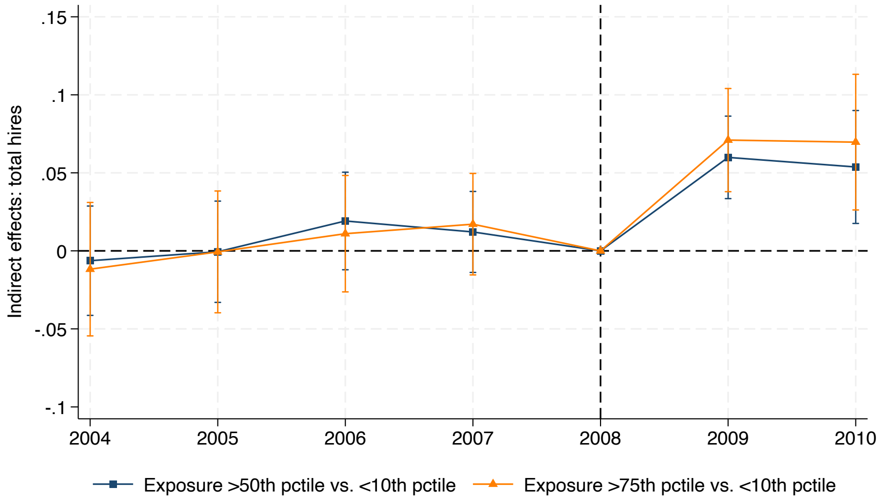


(b) Placebos: pre-reform and different cutoffs



Notes: This figure reports regression discontinuity estimates and 95% confidence intervals for α_1 in Equation (18). The vertical axis lists four firm-level outcomes: (i) the number of hires under fixed-term contracts, (ii) the total number of hires, (iii) the number of hires under open-ended contracts, and (iv) the number of new establishments. The hiring outcomes are computed across all newly created establishments belonging to a firm. In the main post-reform analysis, hires are the number of hires occurring between March 2009 and October 2010. Because the establishments are newly created, their hires coincide with their employment over the observation window. Outcomes are normalized by their standard deviations. Panel (a) reports the main results for three specifications. The blue squares show estimates from the benchmark specification described in Section 4.4.1. The orange triangles exclude firms with between 730 and 770 employees. The green circles use a fixed bandwidth of 600 to 1,200 employees instead of the optimal bandwidth. For each outcome, the corresponding percentage change relative to the baseline mean is reported. Panel (b) reports three sets of placebo estimates obtained using the benchmark approach: (i) pre-reform outcomes measured between March 2007 and October 2008, (ii) an alternative firm-size cutoff of 200 employees, and (iii) an alternative cutoff of 400 employees. Calculations are based on *Quadros de Pessoal* data.

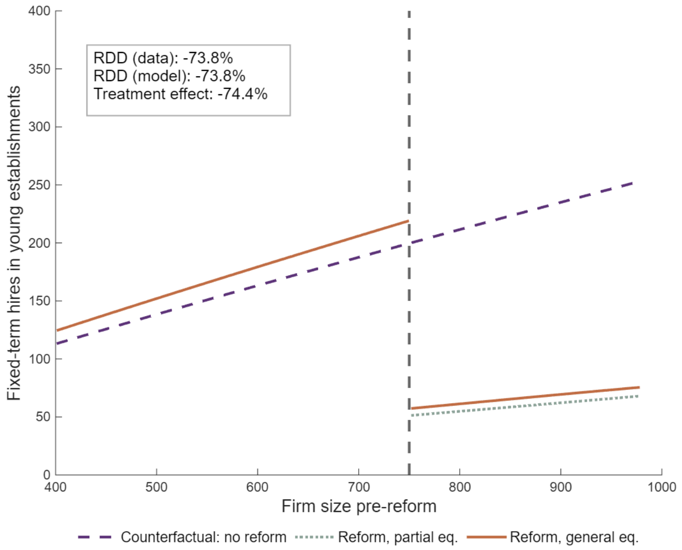
Figure 4: **Indirect effects: Hires by small-firm establishments according to their exposure to large firms**



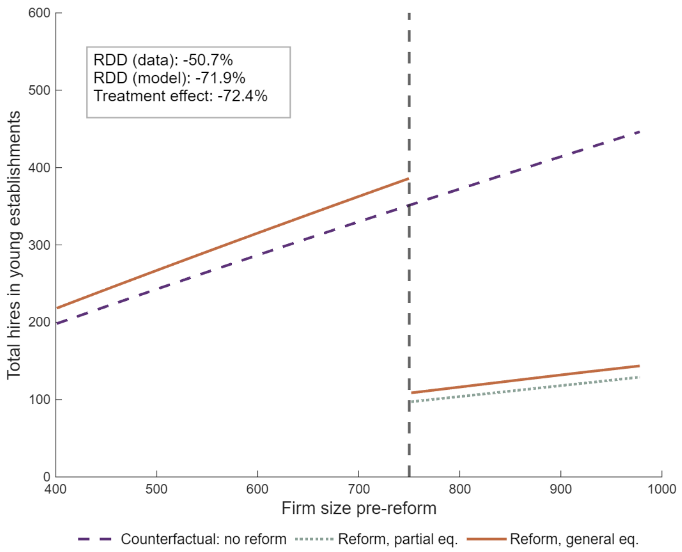
Notes: This figure reports estimates of β_k in Equation (19). The outcome is the total number of hires in establishments belonging to firms with fewer than 750 employees, which were not directly targeted by the reform. For year t, hires are measured between March of year $t-1$ and October of year t, and each hire is weighted by the number of months of the associated employment spell. In particular, the 2010 outcome covers hires occurring between March 2009 and October 2010. The outcome is divided by its 2008 mean within the corresponding exposure group. Exposure is measured by the leave-one-out share of local labor-market employment accounted for by establishments belonging to firms with at least 750 employees, computed annually and averaged over 2002–2008, before the reform. Local labor markets are defined by the interaction of concelho and one-digit industry. The squares compare establishments with exposure above the median to those with exposure in the bottom decile. The triangles compare establishments with exposure above the 75th percentile to those with exposure in the bottom decile. The vertical bars report 95% confidence intervals. Standard errors are clustered at the establishment level. Estimates and standard errors are reported in Table C.0.1 in Appendix C, and the corresponding raw time series are shown in Figure C.0.1 in the same appendix on *Quadros de Pessoal* data.

Figure 5: **Decomposition of RD estimates in the structural model**

(a) Fixed-term contracts

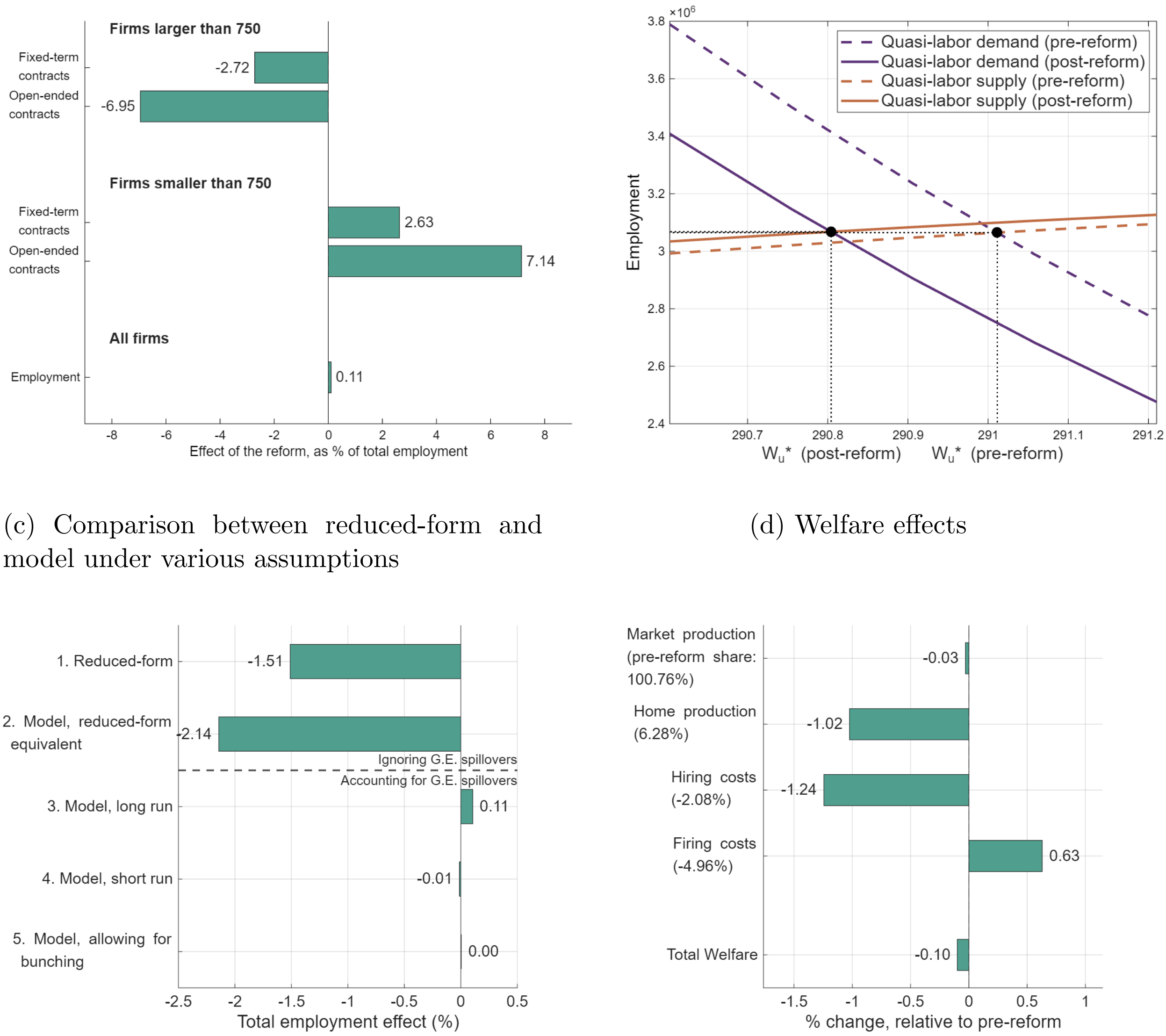


(b) Total hires



Notes: This figure reproduces the regression discontinuity exercise in the estimated structural model. It plots the number of hires under fixed-term contracts in panel (a) and the total number of hires in panel (b) in young establishments as functions of firm size. Firm size is computed in the pre-reform equilibrium—the model counterpart of the situation in Portugal before 2009—as in the main regression discontinuity specification. The dashed purple line shows outcomes before the introduction of the discontinuity in employment protection at 750 employees. The dotted green line shows outcomes for firms affected by the reform when π_{reform} applies but before any general-equilibrium adjustment, so that W_u remains at its pre-reform value. In this partial-equilibrium counterfactual, only firms with more than 750 employees are affected. The solid orange line shows outcomes in the post-reform general equilibrium, in which π_{reform} applies to large firms and W_u has adjusted. "RDD (data)" is the percentage change estimated in the empirical reduced-form analysis and reported in Figure 3. "RDD (model)" is its model counterpart, calculated as the difference between the values immediately to the right and left of the 750-employee cutoff on the solid orange line, divided by the value immediately to the left. "Treatment effect" is the difference at the cutoff between the partial-equilibrium outcome shown by the dotted green line and the no-reform counterfactual shown by the dashed purple line, divided by the no-reform counterfactual.

Figure 6: **Aggregate effects of the restriction in fixed-term contracts**



(a) Decomposition of employment effects

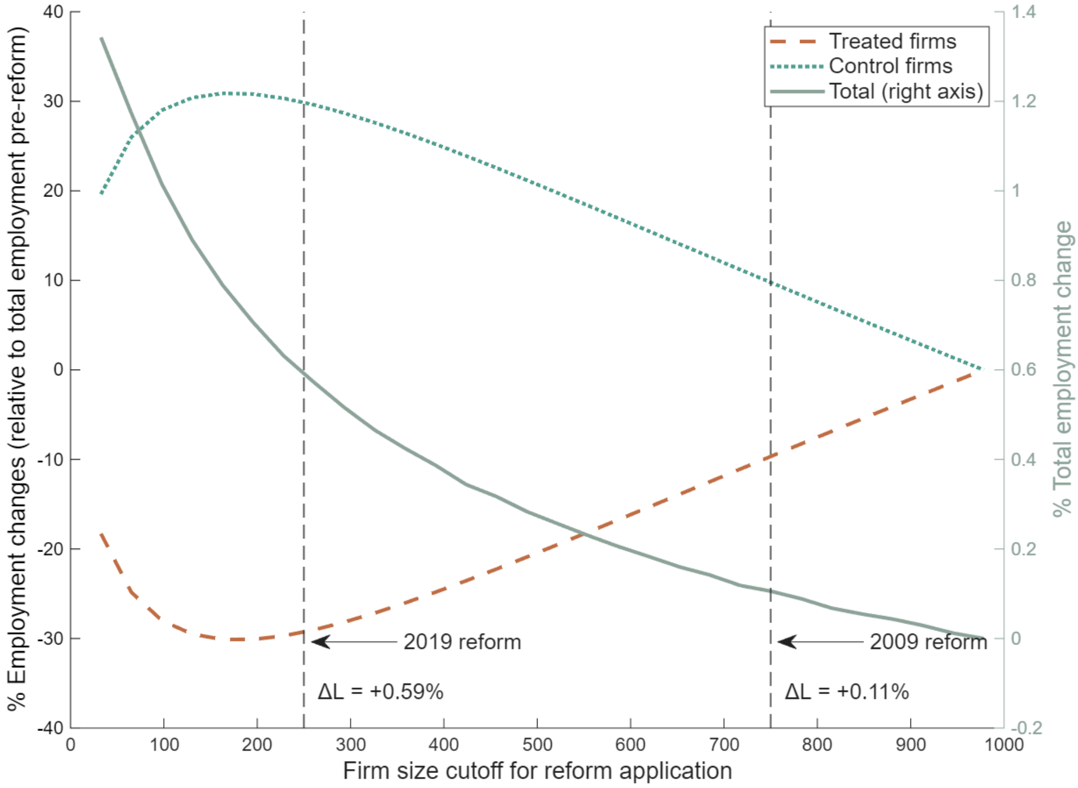
(b) Labor market equilibrium

(c) Comparison between reduced-form and model under various assumptions

(d) Welfare effects

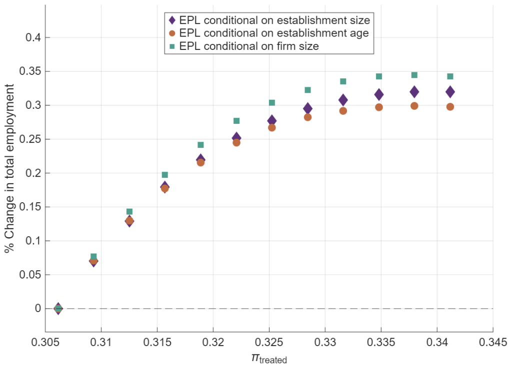
Notes: This figure illustrates the change in total equilibrium employment and welfare resulting from the 2009 restriction on fixed-term contracts in Portugal. Panel (a) decomposes the employment change, expressed as a percentage of pre-reform total employment, by contract type, separately for targeted and non-targeted firms. Panel (b) displays the quasi-labor supply ($\mathcal{N} - \mathcal{U}(W_u, \bar{z}, a_{\min})$) and quasi-labor demand ($\mathcal{L}(W_u, \bar{z}, a_{\min})$) curves before (dashed lines) and after (solid lines) the reform. Their intersection determines equilibrium employment and the value of unemployment. Panel (c) compares total employment effects derived from reduced-form estimates (combined with the market share of targeted establishments) and from the structural model under various assumptions. Estimate 1 is the product of the reduced-form RD estimate (-50.78%) and the market share of young establishments in large firms. Estimate 2 uses the model-implied analogue of the RD estimate, combined with the same market share. Estimates 3 to 5 incorporate general equilibrium adjustments. Estimate 3 includes all adjustments and is the one also displayed in panel (a). Estimate 4 ignores employment effects in old establishments, as these largely reflect changes in hires accumulated over many periods and thus may materialize only in the longer run. In estimates 1 to 4, the set of targeted firms is fixed based on pre-reform size, to follow the logic of the reduced form. Estimate 5 combines all adjustments and further allows for endogenous bunching of firms below the 750-employee threshold. Panel (d) decomposes the change in total welfare, defined as total market production and non-market production net of hiring and firing costs. Pre-reform shares of each component of welfare are reported on the left in parentheses.

Figure 7: **Counterfactuals: varying firm-size cutoff for the change in EPL**

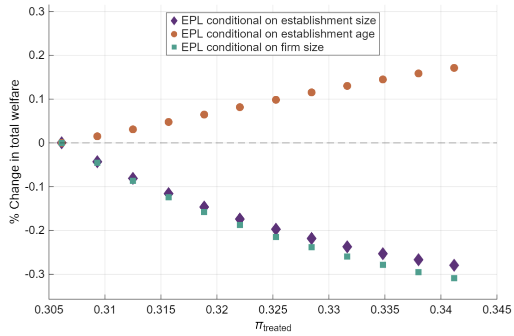


Notes: This figure depicts the effects of a restriction on the use of fixed-term contracts for large firms, under varying size cutoffs determining the set of targeted firms. The x-axis reports the firm size cutoff each counterfactual considers, above which firms are targeted by the restriction. The reform is the same as the 2009 policy in Portugal, and only the set of targeted firms changes across these counterfactuals. The dashed and dotted curves (left y-axis) report the employment change in targeted and non-targeted firms, respectively, as a fraction of total pre-reform employment. The solid curve (right y-axis) reports the change in aggregate employment. The dashed vertical line on the right indicates the 2009 reform we study. The dashed vertical line on the left indicates a later reform: in 2019, Portugal reduced the size threshold for the policy to 250, from 750 in 2009.

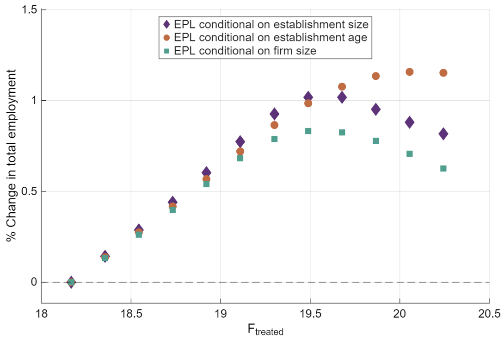
Figure 8: **Counterfactuals: EPL reforms conditional on different establishment or firm characteristics**



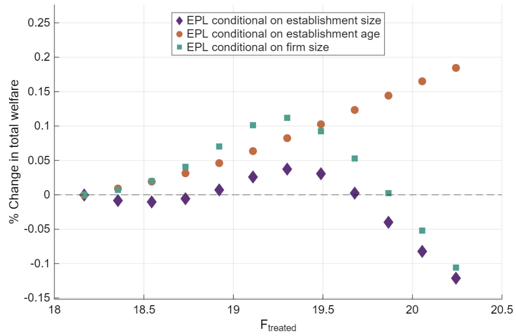
(a) Employment effects, hiring restrictions (π)



(b) Welfare effects, hiring restrictions (π)



(c) Employment effects, firing restrictions (F)



(d) Welfare effects, firing restrictions (F)

Notes: This figure depicts the percent change in total employment (panels (a) and (c)) and in total welfare (panels (b) and (d)) in the economy under several counterfactual values for π (top row) or F (bottom row), when different rules for employment protection are simulated. All changes are relative to a benchmark equilibrium in which EPL is uniform in the economy (i.e. there is a unique value of π and a unique value of F). A higher π reflects stronger restrictions on the use of fixed-term contracts and a higher F stronger firing restrictions for open-ended contracts. "EPL conditional on establishment size" applies the larger π or F to large establishments, "establishment age" applies it to older establishments, and "firm size" applies it to large firms. The cutoff for what is considered a large establishment or firm, or an old establishment, is calibrated so that a constant share of 40% of employment is targeted by the policy change across all counterfactuals. Welfare is defined as total market production and non-market production net of hiring costs and firing costs. Each marker is obtained by simulating the reform, computing the new general equilibrium and the associated employment and welfare levels, and comparing them to the benchmark equilibrium. Each marker combines the impact on targeted and non-targeted units.

Tables

Table 1: **Calibrated parameters for the structural model**

Parameter	Description	Value	Source
Step 1: fixed and externally calibrated parameters.			
β	Discount factor	0.9524	5% annual interest rate
η	Matching function elasticity	0.5	Fixed
ρ	Aging shock into high EPL	0.5	Portugal regulation
μ	Establishment destruction shock	0.1316	Estab. exit rate (QP)
π_ℓ	Share of permanent hires (young)	0.3061	OEC rate, young (QP)
π_h	Share of permanent hires (old)	0.5144	OEC rate, old (QP)
ϕ	Number of establishment creation opportunities per period	2	95th pctile, number of new estab. (QP)
c_0	Scale parameter of vacancy cost function	0.02	Normalized
γ_1	Ability dist. scale parameter	2	Normalized
Step 2: estimated			
F	Cost of permanent worker layoff	18.1657	Distribution of permanent job separation rates (QP)
$\bar{\varepsilon}$	Match productivity shock parameter	0.6172	
γ_2	Ability dist. shape parameter	17.5033	
Nested calibration			
δ	Relationship between entrepreneur's ability and establishment productivity	5.4444	Avg. # of estabs. per firm (QP)
Step 3: calibration			
$\mathcal{E}$	Number of potential entrepreneurs	6.2880+E05	Number of firms (QP)
Step 4: joint calibration			
b	Flow value of unemployment	9.4046	Total employment, unemployment, and employment share in firms >750 (QP)
α	Convexity parameter of vacancy cost function	1.2417	
m_0	Matching scale parameter	0.9125	

Notes: This table reports estimates of the model parameters before the introduction of the 2009 reform. Parameters are estimated using data from the period 2004 to 2008. The estimation consists of several steps implemented sequentially. First, we fix some parameter values using either moments in Quadros de Pessoal (QP) over 2004 to 2008 or normalizations. The population, $\mathcal{N}$, is the product of the number of workers (employed and unemployed) and the share of private sector employees. Second, we estimate several parameters by targeting the distribution of job separation rates for OECs. At this stage, a nested procedure calibrates the parameter representing the relationship between ability, a, and establishment productivity, z. Third, we infer the number of potential entrepreneurs by matching the number of operating firms in the model and in the data. In a last step, we jointly calibrate the three remaining parameters to match the number of jobs, the number of unemployed workers, and the employment share in firms larger than 750 employees.

Table 2: **Decomposition of employment effects into channels**

	Targeted firms		Non-targeted firms	
	Young estab.	Old estab.	Young estab.	Old estab.
% of the total effect explained by:				
Tightness channel	56.00	62.14	59.97	49.87
Job value channel: hiring	45.89	50.94	39.08	32.40
Job value channel: retention	-1.89	-13.17	0.95	17.44
Extensive margin	3.47E-07	1.25E-07	3.49E-19	1.08E-19

Notes: This table decomposes the change in employment induced by the 2009 Portuguese reform within each firm group (targeted and non-targeted) and by establishment age (young and old). For a given establishment that operates in both equilibria, we decompose the log difference in employment, $\Delta \ln(N(z))$, across the two equilibria. We follow Equations 15 and 16 and split the change into a tightness channel and a job value channel. The latter is further split into a hiring margin and a retention margin. We use Montgomery-style weights to aggregate establishment-level differences at the group level. Each row reports a given channel divided by the total employment effect in that group, to reflect contributions. "Extensive margin" captures the contribution of establishment entry and exit, that is, the employment effects driven by establishments that exist in one equilibrium but not the other.

Online Appendix

Employment Protection Reforms: From Firm-Level Effects to Aggregate Outcomes

Pierre Cahuc, Pauline Carry, Franck Malherbet, and Pedro S. Martins

A Model appendix

This appendix presents the theoretical model. We start by presenting the computation of the surplus of jobs before presenting i) the creation and destruction of jobs, ii) the creation and destruction of establishments, iii) the aggregate labor demand, iv) the aggregate labor supply and v) the labor market equilibrium.

In what follows, 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.

A.1 Job surplus

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.

A.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):

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

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 two previous equations we get:

$$S_p^c(\varepsilon, z) = \varepsilon z - (1-\beta)\left(W_u - F\right) + \beta\mu F + \beta(1-\mu)\int \max\left[S_p^c(\varepsilon, z), 0\right] dG(\varepsilon) \tag{A.21}$$

A.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:

$$S_p^c(\varepsilon_u, z) = S_p(z) + F \tag{A.22}$$

This relation together with the definition (A.21) of $S_p^c(\varepsilon, z)$ yields:

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

A.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:

$$R(z) = \left\{R | S_p^c(R, z) = 0\right\} \tag{A.23}$$

which implies, from equation (A.21):

$$R(z) = \frac{1}{z}\left[(1-\beta)(W_u - F) - \beta\mu F\right] - \beta(1-\mu)\int_{R(z)}^{\infty}(\varepsilon - R(z))\,\mathrm{d}G(\varepsilon) \tag{A.24}$$

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 (A.21) and the definition of the reservation productivity (A.23) we can also write the surplus of a continuing job as follows:

$$S_p^c(\varepsilon, z) = z\left[\varepsilon - R(z)\right] \tag{A.25}$$

Therefore, the relation (A.22) between the surplus of starting and continuing jobs yields:

$$S_p(\varepsilon, z) = z\left[\varepsilon - R(z)\right] - F \tag{A.26}$$

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.

A.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 (A.21) and (A.24), this implies that:

$$T(z) = R(z) + \frac{F}{z} \tag{A.27}$$

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:

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

Therefore, the surplus of a temporary job:

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

can be written as follows:

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

From this equation and from equation (A.21), we can show that the surplus of temporary jobs is bigger than the surplus of permanent starting jobs. We get:

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

Using the relation:

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

we can write the difference between the two surpluses, $S_t(z) - S_p(z)$, as follows:

$$S_t(z) - S_p(z) = \beta(1-\mu)\left[-\int_{R(z)}^{T(z)} S_p(\varepsilon, z)\,\mathrm{d}G(\varepsilon) + G(R)F\right] \tag{A.28}$$

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 (A.28) together with equation (A.22) implies that:

$$S_t(z) = S_p^c(\varepsilon_u, z) - \beta(1-\mu)\int_{R(z)}^{T(z)} S_p^c(\varepsilon, z)\,\mathrm{d}G(\varepsilon) - F\left[1 - \beta(1-\mu)G(T(z))\right] \tag{A.29}$$

The monotonicity of the surplus of temporary jobs follows directly from its expression above: the term $-(1-\beta)W_u$ decreases with W_u and, since $R(z)$ increases with W_u, the integrand $\max\left[S_p(\varepsilon, z), 0\right] = \max\left[z\left(\varepsilon - R(z)\right) - F, 0\right]$ decreases pointwise with W_u. Hence $S_t(z)$ 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:

$$S(z, \pi) = z\left(\varepsilon_u - R(z)\right) + (1-\pi)\beta(1-\mu)\int_{T(z)}^{R(z)} z\left(\varepsilon - R(z)\right)\mathrm{d}G(\varepsilon) - F\left[1 - (1-\pi)\beta(1-\mu)G(T(z))\right] \tag{A.30}$$

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 (A.24)) and $T(z)$ (from equation (A.27)).

Moreover, since we have shown that the job surplus of permanent and temporary jobs decrease with W_u, the job surplus of starting jobs also decreases with W_u.

A.2 Job creation and number of jobs in type-(z, π) establishments

The surplus of temporary jobs, which can be destroyed at no 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-(z, π) establishments.

The value of a marginal vacant job to type-(z, π) establishments, denoted by $V(z, \pi)$, is equal to its marginal cost plus its expected gains:

$$V(z, \pi) = \max_{W} -C'(v) + \beta(1-\mu)\left[m(\theta)J(z, \pi) + [1-m(\theta)]\, V^{+}(z, \pi)\right] \tag{A.31}$$

where $V^{+}(z, \pi)$ denotes the future value of marginal job vacancies, which is equal to zero in equilibrium and

$$J(z, \pi) = (1-\pi)J_t(z) + \pi J_p(z)$$

is the expected value of a filled job to type-(z, π) establishments.

The relation between θ and W is defined by equation (1). Maximization with respect to W using the fact that $J = S - (W - W_u)$, yields the traditional Hosios-Diamond-Pissarides (HDP) condition:

$$W(z, \pi) - W_u = \eta S(z, \pi). \tag{A.32}$$

Using the definition (1) of W_u, this condition defines a decreasing relation between the labor market tightness and the surplus of type-(z, π_ℓ) establishments:

$$\theta(z, \pi)m(\theta(z, \pi)) = \frac{(1-\beta)W_u - b}{\beta\eta S(z, \pi)} \tag{A.33}$$

The surplus of starting jobs computed above, which shows up at the denominator of equation (A.33), 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 (A.31):

$$\underbrace{C'(v)}_{\text{Marginal cost}} = \underbrace{\beta(1-\mu)m(\theta(z, \pi))J(z, \pi)}_{\text{Expected marginal gain conditional on establishment's survival}} \tag{A.34}$$

This condition, together with the HDP condition (A.32), the definition of the surpluses

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

and equation (A.33), implies that the number of vacant jobs in a type-(z, π) establishment is defined by:

$$v(z, \pi) = \left\{ v | C'(v) = (1-\mu)\frac{1-\eta}{\eta}\frac{(1-\beta)W_u - b}{\theta(z, \pi)} \right\} \tag{A.35}$$

A.2.1 Number of jobs in type-(z, π_ℓ) establishments.

We start by computing the number of jobs in young establishments. 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 $m(\theta(z, \pi_\ell))v(z, \pi_\ell)$. Since the spell of temporary job equals one period, the number of temporary jobs in a type-(z,π_ℓ) establishment is:

$$L_t(z,\pi_\ell) = (1-\pi_\ell)m(\theta(z,\pi_\ell))v(z,\pi_\ell) \tag{A.36}$$

Together with equations (A.33) and (A.35), this equation implies that $L_t(z,\pi_\ell)$ can be defined as function of the single endogenous variable W_u. In our context, equations (A.33) and (A.35) can be written as follows:

$$\theta(z,\pi_\ell)m(\theta(z,\pi_\ell)) = \frac{(1-\beta)W_u - b}{\beta\eta S(z,\pi_\ell)} \tag{A.37}$$

$$C'(v(z,\pi_\ell)) = (1-\mu)\frac{1-\eta}{\eta}m(\theta(z,\pi_\ell))\beta S(z,\pi_\ell) \tag{A.38}$$

The first equation together with the definition (A.30) of the surplus defines a positive relation between the labor market tightness $\theta(z,\pi_\ell)$ and W_u (because the exit rate from unemployment $\theta m(\theta)$ increases with θ). Then, since $m'(\theta) < 0$ and $C''(v(z,\pi_\ell)) > 0$, the second equation defines a negative relation between $v(z,\pi_\ell)$ and W_u. Using these two results in equation (A.36) which defines $L_t(z,\pi_\ell)$, we find that $L_t(z,\pi_\ell)$ decreases with W_u.

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

$$L_p^{\tau+1}(z,\pi_\ell) = L_p^{\tau}(z,\pi_\ell)\left[1-G(R(z))\right] + \pi_\ell\, m(\theta(z,\pi_\ell))\, v(z,\pi_\ell) + L_t^{\tau}(z,\pi_\ell)\left[1-G(T(z))\right],$$

with the following assumptions:

$$\begin{aligned}
&\text{For } \tau = 0: \quad L_p^0(z,\pi_\ell) = L_t^0(z,\pi_\ell) = 0 \\
&\text{For } \tau \geq 1: \quad L_t^{\tau}(z,\pi_\ell) = (1-\pi_\ell)\, m(\theta(z,\pi_\ell))\, v(z,\pi_\ell) \geq 0
\end{aligned}$$

Hence, for $\tau = 1$, we obtain:

$$\begin{aligned}
L_p^1(z,\pi_\ell) &= L_p^0(z,\pi_\ell)\left[1-G(R(z))\right] + \pi_\ell m(\theta(z,\pi_\ell))v(z,\pi_\ell) + L_t^0(z,\pi_\ell)\left[1-G(T(z))\right] \\
&= \pi_\ell m(\theta(z,\pi_\ell))v(z,\pi_\ell)
\end{aligned}$$

For $\tau \geq 2$:

$$\begin{aligned}
L_p^{\tau+1}(z,\pi_\ell) = {} & L_p^{\tau}(z,\pi_\ell)\left[1-G(R(z))\right] \\
& + \pi_\ell m(\theta(z,\pi_\ell))v(z,\pi_\ell) + (1-\pi_\ell)m(\theta(z,\pi_\ell))v(z,\pi_\ell)\left[1-G(T(z))\right]
\end{aligned}$$

Define $a = 1 - G(R(z))$ and $b = m(\theta(z,\pi_\ell))\, v(z,\pi_\ell)\left[1-(1-\pi_\ell)G(T(z))\right]$. This is a linear recurrence relation of the form $L_p^{\tau+1}(z,\pi_\ell) = aL_p^{\tau}(z,\pi_\ell) + b$, valid for $\tau \geq 1$. The general solution is:

$$L_p^{\tau}(z,\pi_\ell) = a^{\tau-1}L_p^1(z,\pi_\ell) + b\sum_{k=0}^{\tau-2}a^k = a^{\tau-1}L_p^1(z,\pi_\ell) + b\cdot\frac{1-a^{\tau-1}}{1-a}.$$

Substituting $1 - a = G(R(z))$, we obtain, for:

$$\begin{aligned}
&\tau = 0 \quad L_p^0(z, \pi_\ell) = 0, \\
&\tau = 1 \quad L_p^1(z, \pi_\ell) = \pi_\ell m(\theta(z, \pi_\ell))v(z, \pi_\ell), \\
&\tau \geq 2 \quad L_p^\tau(z, \pi_\ell) = m(\theta(z, \pi_\ell))v(z, \pi_\ell) \times \\
&\qquad \left[\pi_\ell \left(1 - G(R(z))\right)^{\tau-1} + \frac{[1 - (1 - \pi_\ell)G(T(z))]}{G(R(z))} \left(1 - \left(1 - G(R(z))\right)^{\tau-1}\right) \right].
\end{aligned} \tag{A.39}$$

The same proof as that used for equation (A.36) shows that $L_p^\tau(z, \pi_\ell)$ 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, π_ℓ) establishments $\tau \geq 1$ periods after their period of creation is:

$$\begin{aligned}
L^\tau(z, \pi_\ell) \quad = \quad & m(\theta(z, \pi_\ell))v(z, \pi_\ell) \times \\
& \left[(1 - \pi_\ell) + \pi_\ell \left(1 - G(R(z))\right)^{\tau-1} + \frac{[1 - (1 - \pi_\ell)G(T(z))]}{G(R(z))} \left(1 - \left(1 - G(R(z))\right)^{\tau-1}\right) \right].
\end{aligned} \tag{A.40}$$

A.2.2 Number of jobs in type-(z, π_h) establishments.

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

Type-(z, π_h) establishments which continue hiring when they are converted. 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, π_ℓ) establishment has been transformed into a type-(z, π_h) establishment.

The job creation rate is $m(\theta(z, \pi_h))v$. Since temporary jobs last one period, the number of temporary jobs in a type-(z, π_h) establishment is:

$$L_t(z, \pi_h) = (1 - \pi_h)m(\theta(z, \pi_h))v(z, \pi_h). \tag{A.41}$$

The same proof as that used for equation (A.36) shows that $L_t(z, \pi_h)$ 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 $G(R(z))$. Temporary jobs are transformed into permanent jobs with probability $1 - G(T(z))$, 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:

$$L_p^{\tau_\ell}(z, \pi_\ell, \pi_h) = L_p^{\tau_\ell - 1}(z, \pi_\ell)\left[1 - G(R(z))\right] + \pi_h m(\theta(z, \pi_h))v(z, \pi_h) + L_t(z, \pi_\ell)\left[1 - G(T(z))\right] \tag{A.42}$$

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

$$L_p^\tau(z, \pi_\ell, \pi_h) = L_p^{\tau-1}(z, \pi_\ell, \pi_h)\left[1 - G(R(z))\right] + \pi_h m(\theta(z, \pi_h))v(z, \pi_h) + L_t(z, \pi_h)\left[1 - G(T(z))\right] \tag{A.43}$$

This equation shows that the number of permanent jobs in type-(z,π_h) establishments of age τ created by large firms, denoted by $L_p^\tau(z,\pi_\ell,\pi_h)$, is given by an equation of the form $x_\tau = ax_{\tau-1}+b$, with $x_0 = L_p^{\tau_\ell}(z,\pi_\ell,\pi_h)$,

$$\begin{aligned} L_p^\tau(z,\pi_\ell,\pi_h) &= [1-G(R(z))]^{\tau-\tau_\ell} L_p^{\tau_\ell}(z,\pi_\ell,\pi_h) \\ &\quad + m(\theta(z,\pi_h))v(z,\pi_h)\left[\pi_h + (1-\pi_h)\left[1-G(T(z))\right]\right]\sum_{i=\tau_\ell}^{\tau-1}[1-G(R(z))]^{i-\tau_\ell} \end{aligned}$$

or

$$\begin{aligned} L_p^\tau(z,\pi_\ell,\pi_h) &= [1-G(R(z))]^{\tau-\tau_\ell} L_p^{\tau_\ell}(z,\pi_\ell,\pi_h) \\ &\quad + \frac{m(\theta(z,\pi_h))\,v(z,\pi_h)\,[1-(1-\pi_h)G(T(z))]}{G(R(z))}\left[1-[1-G(R(z))]^{\tau-\tau_\ell}\right] \end{aligned} \tag{A.44}$$

The same proof as that used for equation (A.36) shows that $L_p^\tau(z,\pi_\ell,\pi_h)$ 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_h) establishments at age τ_ℓ is defined as:

$$L^\tau(z,\pi_\ell,\pi_h) = L_t(z,\pi_h) + L_p^\tau(z,\pi_\ell,\pi_h), \qquad \tau \geq \tau_\ell,$$

where $L_t(z,\pi_h)$ and $L_p^{\tau_\ell}(z,\pi_\ell,\pi_h)$ are defined by equations (A.41) and (A.42) respectively at date τ_ℓ and by equations (A.41) and (A.44) at dates $\tau > \tau_\ell$.

Type-(z,π_h) establishments which stop hiring when they are converted. Let us now compute the number of jobs in type-(z,π_ℓ) establishments that stop hiring when they are converted into type-(z,π_h) establishments. In these establishments, there are no temporary jobs. Permanent jobs decrease at rate $G(R(z))$. Accordingly, the total number of jobs in a type-(z,π_ℓ) establishment that have not been transformed into a type-(z,π_h) establishment at age τ_ℓ is:

$$L_0^\tau(z,\pi_\ell,\pi_h) = [1-G(R(z))]^{\tau-\tau_\ell}\left\{L_p^{\tau_\ell-1}(z,\pi_\ell)\,[1-G(R(z))] + [1-G(T(z))]\,L_t^{\tau_\ell-1}(z,\pi_\ell)\right\}. \tag{A.45}$$

where $L_p^{\tau_\ell-1}$ and $L_t^{\tau_\ell-1}$ are given by the standard type-(z,π_ℓ) equations.

A.3 Establishments creation

Each period, every entrepreneur receives Φ opportunities to create establishments. For a type-a entrepreneur, each opportunity allows them to draw a value of z, the productivity of the establishment, from a distribution characterized by the cumulative distribution function $\Psi_a(z)$. The entrepreneur will decide to create an establishment only if the drawn productivity yields an establishments whose present value is positive. Therefore, one needs to define the present value of establishments to determine the number of establishments created by type-a entrepreneur.

A.3.1 Value of type-(z, π_h) establishments

Type-(z, π_h) establishments are old establishments facing more stringent regulation that constrains them to create a larger share $\pi_h > \pi_\ell$ of permanent jobs.

From above, we know that the value of marginal jobs $J(z, \pi)$ does not depend on the number of jobs in the establishment. Therefore, the optimality condition for the number of vacancies (A.35) 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) establishment. Note also that the function $\theta(z, \pi)$, which is determined by equation (A.33), stemming from the Hosios condition and the non-arbitrage condition of unemployed workers, depends on the establishment type-(z, π) but does not depend on the properties of the vacancy cost function of the establishment.

Let us first compute the net values of type-(z, π_h) establishments, which are defined, at any date t, as the present value of profits induced by hires from date $t + 1$, net of the 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 $v(z, \pi_h)m(\theta(z, \pi_h))$ job creations in type-(z, π_h) establishment and each job creation yields an expected gain equal to $J(z, \pi_h)$. Therefore, the present value of all job creations, that will occur from date 1 to infinite is equal to:

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

The present cost of job vacancies (created from date 0) is equal to $\sum_{t=0}^{\infty} [\beta(1-\mu)]^t C[v(z, \pi_h)]$. Thus, we get the value of a type-(z, π_h) establishment:

$$\Pi(z, \pi_h) = \frac{v(z, \pi_h)m(\theta(z, \pi_h))\beta(1-\mu)J(z, \pi_h) - C[v(z, \pi_h)]}{1-\beta(1-\mu)}$$

The homogeneity of degree α of the vacancy cost function C implies that $C'(v) = \alpha C(v)/v$. Using this condition together with the previous equation, the optimality condition (A.34) and the Hosios condition, which implies that $J(z, \pi_h) = (1-\eta)S(z, \pi_h)$, we get

$$\Pi(z, \pi_h) = \frac{(\alpha-1)v(z, \pi_h)m(\theta(z, \pi_h))\beta(1-\mu)(1-\eta)S(z, \pi_h)}{\alpha[1-\beta(1-\mu)]}. \tag{A.46}$$

Using equation (A.33), we get:

$$\Pi(z, \pi_h) = \frac{(\alpha-1)(1-\mu)(1-\eta)}{\alpha[1-\beta(1-\mu)]\eta} u(z, \pi_h)[(1-\beta)W_u - b] \tag{A.47}$$

This equation implies that $\Pi(z, \pi_h)$ increases with z because when z is higher, the surplus of jobs is also higher and it is possible to attract more unemployed workers, $u(z, \pi)$, in the labor pool of the establishment. Equation (A.46) implies that $\Pi(z, \pi) > 0$ for all z such that $S(z, \pi) > 0$ because equation (A.33) implies that the labor market tightness is positive, and goes to infinity when $S(z, \pi)$ goes to zero. This means that if $S(z, \pi) \leq 0$, the establishment cannot promise a utility $W(z, \pi) > W_u$ which implies that it cannot recruit workers. This implies that type-(z, π_h) establishments are created (or continue to hire from the date at which they have to be transformed from type-π_ℓ to type-π_h) only if their productivity type z is above the threshold:

$$\bar{z}(\pi_h) = \{z|S(z,\pi_h) = 0\}\,. \tag{A.48}$$

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 (A.30) together with its properties described below equation (A.30). Since job surpluses decrease with W_u and increase with z, equation (A.48) implies that $\bar{z}(\pi_h)$ increases with W_u.

A.3.2 Value of type-(z,π_ℓ) establishments

Now, let us compute the net value of type-(z,π_ℓ) establishments. These are new establishments facing the less stringent regulation allowing them to create a smaller share $\pi_\ell < \pi_h$ than old establishments.

In type-(z,π_ℓ) establishments, at each date $t \geq 1$, there are $v(z,\pi_\ell)m(\theta(z,\pi_\ell))$ job creations and each job creation yields an expected gain equal to $J(z,\pi_\ell)$. It is assumed that establishments can be transformed into type-(z,π_h) 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,π_ℓ) establishments are transformed into type-(z,π_h) 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,π_ℓ) establishments is equal to:

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

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:

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

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

$$\frac{1}{1-\beta(1-\mu)(1-\rho)}\left(C\left[v(z,\pi_\ell)\right]+\frac{\rho\beta(1-\mu)}{\left[1-\beta(1-\mu)\right]}C\left[v(z,\pi_h)\right]\right)$$

Therefore, we get the present value of a type-(z,π_ℓ) establishment:

$$\begin{aligned}
\Pi(z,\pi_\ell) &= \frac{v(z,\pi_\ell)m(\theta(z,\pi_\ell))\beta(1-\mu)J(z,\pi_\ell)-C\left[v(z,\pi_\ell)\right]}{1-\beta(1-\mu)(1-\rho)} \\
&\quad +\beta\rho(1-\mu)\max\left[\frac{v(z,\pi_h)m(\theta(z,\pi_h))\beta(1-\mu)J(z,\pi_h)-C\left[v(z,\pi_h)\right]}{\left[1-\beta(1-\mu)\right]\left[1-\beta(1-\mu)(1-\rho)\right]},0\right]
\end{aligned} \tag{A.49}$$

The homogeneity of degree α of the vacancy cost function C implies that $C'(v) = \alpha C(v)/v$. Using this condition together with the previous equation, the optimality condition (A.34) and the Hosios condition, which implies that $J(z,\pi_\ell) = (1-\eta)S(z,\pi_\ell)$, we get

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

Substituting in (A.49) yields:

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

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

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

Since $S(z,\pi_\ell) > S(z,\pi_h)$ (because $\pi_\ell < \pi_h$), and $S(z,\pi_h)$ and $S(z,\pi_\ell)$ increase with z, this expression of $\Pi(z,\pi_\ell)$ implies that type-(z,π_ℓ) establishments, are created only if their productivity type z is above the threshold:

$$\bar{z}(\pi_\ell) = \left\{z|S(z,\pi_\ell) = 0\right\}. \tag{A.50}$$

with $\bar{z}(\pi_\ell) < \bar{z}(\pi_h)$. For the same reasons as for $\bar{z}(\pi_h)$, the reservation productivity $\bar{z}(\pi_\ell)$ increases with W_u.

A.3.3 Number of establishments created by type-a entrepreneurs

Now, we know that entrepreneurs will create an establishment only if they draw a value of z above the threshold $\bar{z}(\pi_\ell)$, defined in equation (A.50). The average number of establishments created in each period by a type-a entrepreneur who draws ϕ production opportunities per period is therefore:

$$\phi\left[1-\Psi_a(\bar{z}(\pi_\ell))\right]$$

In the steady state, the number of establishments created by a type-a entrepreneur is equal to the number of establishments destroyed. The number of establishments destroyed is equal to $\mu n(a)$, where μ is the exogenous destruction rate (μ is the average rate of establishment destruction observed directly in the data) and $n(a)$ is the number of establishments in the stock. By equating inflows and outflows, we have:

$$n(a) = \frac{\phi}{\mu}\left[1-\Psi_a(\bar{z}(\pi_\ell))\right] \tag{A.51}$$

Starting from period $t+1$, the establishment becomes old with probability ρ. Establishments created are therefore all young for at least one period and are subject to the legislative constraint π_ℓ. Once an establishment becomes old, it is subject to the stricter regulation π_h.

A.3.4 Number of establishments

More efficient entrepreneurs have a higher probability of creating more productive establishments. To ensure the existence of a threshold value of ability below which entrepreneurs are unable to create establishments, we assume that $\Psi_a(z) : \mathbb{R} \rightarrow [0, 1]$ is continuously derivable and decreasing with respect to a and that there exists $a \in \mathbb{R}$ such that $\Psi_a(0) = 1$. This is a sufficient condition, as only establishments with productivity z exceeding the threshold $\overline{z}(\pi_\ell) > 0$ are created. Under this assumption, the threshold value of ability, denoted by $a_{\min}$, below which type-a entrepreneurs are unable to create establishments is

$$a_{\min} = \{a|\Psi_a(\overline{z}(\pi_\ell)) = 1\} \tag{A.52}$$

Then, using equation (A.51), and denoting by $\Phi = \phi\mathcal{E}$ the number of production opportunities drawn by the $\mathcal{E}$ entrepreneurs, we deduce that the total number of establishments is equal to

$$\int_{a_{\min}}^{\infty} \frac{\Phi}{\mu} [1 - \Psi_a(\overline{z}(\pi_\ell))] \, \mathrm{d} \, \Gamma(a)$$

A.4 Aggregate labor demand

Now, we can compute 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. To define this function, we use the number of jobs at all ages of each establishment type-$(z, \pi_i), i = \{h, \ell\}$ computed above and we compute the number of each establishment type-(z, π_i) and their age distribution. Finally, adding the employment of each type of establishment, we can define the total employment $L(W_u, \pi_\ell, \pi_h)$.

A.4.1 The age distribution of establishments.

The age distribution of the establishments is computed in steady state. Let $\tau = 0, \ldots, \infty$ denote the age of an establishment.

- At $\tau = 0$, the establishment is, by definition, young. It posts job vacancies that will be filled at age $\tau = 1$. The establishment can be destroyed at the end of the period, and thus before $\tau = 1$. However, the establishment cannot experience an aging shock at this stage. Hires made at $\tau = 1$ are therefore subject to the legislation π_ℓ.
- At age $\tau = 1$, the establishment learns, with a probability ρ, that it will become old at $\tau = 2$. The establishment is destroyed with a probability μ at the end of period $\tau = 1$. Therefore, the probability that the establishment survives at $\tau = 1$ is equal to $(1 - \mu)$. The probability that the establishment remains young at $\tau = 1$ is equal to 1.
- The probability that the establishment is not destroyed at $\tau = 2$ is equal to $(1 - \mu)^2$; the probability that it remains young at $\tau = 2$ is equal to $1 - \rho$ ...

Establishments can be destroyed as early as their creation period, but they remain young for at least one period. The destruction shock and the aging shock are independent of z and

a. Thus, the age distribution does not depend on the type of establishment or firm considered. The number of type-(z, π_ℓ) establishments of age τ created by type-a entrepreneurs is given by:

$$\underbrace{\Phi\Psi'_a(z)\Gamma'(a)}_{\text{Quantity of type }(z,\pi_\ell)\text{ establishments created}} \times \underbrace{(1-\mu)^\tau}_{\text{Prob the establishment is not destroyed}} \times \underbrace{(1-\rho)^{\tau-1}}_{\text{Prob the establishment remains young}}$$

We now calculate the number of type-(z, π_h) establishments of age τ_ℓ that age at each date. This means finding the number of establishments with the productivity parameter z that remained young up to age τ_ℓ and were not destroyed during the τ_ℓ preceding periods. The probability that an establishment is not destroyed for τ_ℓ years is $(1-\mu)^{\tau_\ell}$. The probability that the establishment did not age during the $\tau_\ell - 1$ years is $(1-\rho)^{\tau_\ell-2}$ (because the establishment can be destroyed from the first period, but the first aging shock can only occur starting in the second period). Conditional on not being destroyed and not having aged, the probability that the establishment is old at age τ_ℓ is ρ. The number of type-(z, π_ℓ) establishments converted into type-(z, π_h) establishments at age τ_ℓ is therefore:

$$\underbrace{\rho}_{\text{Aging shock}} \times \underbrace{\Phi\Psi'_a(z)\Gamma'(a)}_{\text{Nb type }(z,\pi_\ell)\text{ establishments created each period}}$$
$$\times \underbrace{(1-\mu)^{\tau_\ell}}_{\text{Prob the establishment is not destroyed}} \times \underbrace{(1-\rho)^{\tau_\ell-2}}_{\text{Prob the establishment remains young up to }\tau_\ell-1}$$

The number of type-(z, π_h) establishments of age $\tau \geq \tau_\ell$ created by type-a firms and converted at age $\tau_\ell \leq \tau$ is thus:

$$\underbrace{\rho}_{\text{Aging shock}} \times \underbrace{\Phi\Psi'_a(z)\Gamma'(a)}_{\text{Nb type }(z,\pi_\ell)\text{ establishments created each period}}$$
$$\times \underbrace{(1-\mu)^{\tau}}_{\text{Prob the establishment is not destroyed}} \times \underbrace{(1-\rho)^{\tau_\ell-2}}_{\text{Prob the establishment remains young up to }\tau_\ell-1}$$

A.4.2 Total number of jobs in the economy

Now, from above, we can compute the total number of jobs in the economy.

Total number of jobs in type-π_ℓ establishments. The number of type-(z, π_ℓ) establishments of age τ belonging to a firm of type a is:

$$\Phi\Psi'_a(z)\Gamma'(a) \times (1-\mu)^\tau \times (1-\rho)^{\tau-1}.$$

The number of jobs in a type-(z, π_ℓ) establishment of age τ is $L^\tau(z, \pi_\ell)$ (as calculated earlier). Therefore, the total number of jobs in type-(z, π_ℓ) establishments of age τ, belonging to a firm of type a, is:

$$\underbrace{L^{\tau}(z,\pi_\ell)}_{\text{Number of jobs in each establishment of this type}} \times \underbrace{\Phi\Psi_a'(z)\Gamma'(a)(1-\mu)^{\tau}(1-\rho)^{\tau-1}}_{\text{Number of establishments of this type}}$$

The number of jobs in all establishments under the regulation π_ℓ, of age τ, and belonging to a firm of type a, corresponds to the jobs in these establishments irrespective of their productivity z (such that $z > \overline{z}(\pi_\ell)$):

$$\int_{\overline{z}(\pi_\ell)}^{\infty} L^{\tau}(z,\pi_\ell)\Phi\Gamma'(a)(1-\mu)^{\tau}(1-\rho)^{\tau-1}\,\mathrm{d}\Psi_a(z) = \Phi\Gamma'(a)(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{\overline{z}(\pi_\ell)}^{\infty} L^{\tau}(z,\pi_\ell)\,\mathrm{d}\Psi_a(z).$$

Taking into account all firms of type a, the total number of jobs in establishments of age τ under regulation π_ℓ is:

$$\Phi(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{a_{\min}}^{\infty}\int_{\overline{z}(\pi_\ell)}^{\infty} L^{\tau}(z,\pi_\ell)\,\mathrm{d}\Psi_a(z)\,\mathrm{d}\Gamma(a).$$

To obtain the total number of jobs in establishments under the regulation π_ℓ, we consider employment in establishments of type π_ℓ for all possible ages starting from $\tau = 1$:

$$\Phi\sum_{\tau=1}^{\infty}(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{a_{\min}}^{\infty}\int_{\overline{z}(\pi_\ell)}^{\infty} L^{\tau}(z,\pi_\ell)\,\mathrm{d}\Psi_a(z)\,\mathrm{d}\Gamma(a).$$

Total number of jobs in type-π_h establishments. To compute the total number of jobs in type-π_h establishments, one needs to distinguish the establishments which stop hiring when they become old, whose productivity z belongs to the segment $[\overline{z}(\pi_\ell), \overline{z}(\pi_h)]$, from those which continue hiring, which belong to the segment $[\overline{z}(\pi_h), +\infty)$.

- On the segment $[\overline{z}(\pi_\ell), \overline{z}(\pi_h)]$. The number of type-$(z,\pi_h)$ establishments of age τ, belonging to firms of type a, that became old at age τ_ℓ is:

$$\Phi\Psi_a'(z)\Gamma'(a)\rho(1-\rho)^{\tau_\ell-2}(1-\mu)^{\tau}.$$

  If the productivity z lies between $\overline{z}(\pi_\ell)$ and $\overline{z}(\pi_h)$, these establishments no longer hire after their conversion into old establishments. In this case, the number of jobs in such establishments is $L_0^{\tau}(z,\pi_\ell,\pi_h)$, given by equation (A.45). Thus, for type-(z,π_h) establishments of age τ, belonging to firms of type a, that became old at date τ_ℓ, such that $z < \overline{z}(\pi_h)$, the number of jobs will be:

$$\Phi\Psi_a'(z)\Gamma'(a)\rho(1-\rho)^{\tau_\ell-2}(1-\mu)^{\tau} \times L_0^{\tau}(z,\pi_\ell,\pi_h) \text{ for } \tau > \tau_\ell.$$

- On the segment $[\overline{z}(\pi_h), +\infty[$. Conversely, if the productivity z is greater than $\overline{z}(\pi_h)$, an establishment will continue hiring after its conversion, and the number of jobs will be $L^{\tau}(z,\pi_\ell,\pi_h)$. The number of jobs in type-(z,π_h) establishments of age τ, belonging to firms of type a, that became old at date τ_ℓ, such that $z > \overline{z}(\pi_h)$, is:

$$\Phi \Psi_a'(z)\Gamma'(a)\rho(1-\rho)^{\tau_\ell - 2}(1-\mu)^{\tau} \times L^{\tau}(z, \pi_\ell, \pi_h) \text{ for } \tau > \tau_\ell.$$

- On the segment $[\overline{z}(\pi_\ell), +\infty[$ (i.e. all old establishments). To simplify the expressions, let us define $\Xi \equiv \rho(1-\rho)^{\tau_\ell-2}(1-\mu)^{\tau}$. If we now consider all productivities, conditional on the firm's productivity a, we get:

$$\int_{\overline{z}(\pi_\ell)}^{\overline{z}(\pi_h)} \Phi \Psi_a'(z)\Gamma'(a) \cdot \Xi \cdot L_0^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}z + \int_{\overline{z}(\pi_h)}^{\infty} \Phi \Psi_a'(z)\Gamma'(a) \cdot \Xi \cdot L^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}z.$$

  By combining terms, the total number of jobs in type-(z, π_h) establishments of age τ is:

$$\Phi \cdot \Xi \int_{a_{\min}}^{\infty} \left[\int_{\overline{z}(\pi_\ell)}^{\overline{z}(\pi_h)} L_0^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) + \int_{\overline{z}(\pi_h)}^{\infty} L^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) \right] \mathrm{d}\Gamma(a).$$

  Finally, the total number of jobs in type-π_h establishments, regardless of age, that became old at age τ_ℓ is:

$$\begin{aligned} &\sum_{\tau=\tau_\ell}^{\infty} \Phi \underbrace{\rho(1-\rho)^{\tau_\ell-2}(1-\mu)^{\tau}}_{\Xi} \int_{a_{\min}}^{\infty} \left[\int_{\overline{z}(\pi_\ell)}^{\overline{z}(\pi_h)} L_0^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) + \int_{\overline{z}(\pi_h)}^{\infty} L^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) \right] \mathrm{d}\Gamma(a) \\ &= \Phi\rho(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} (1-\mu)^{\tau} \int_{a_{\min}}^{\infty} \left[\int_{\overline{z}(\pi_\ell)}^{\overline{z}(\pi_h)} L_0^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) + \int_{\overline{z}(\pi_h)}^{\infty} L^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) \right] \mathrm{d}\Gamma(a). \end{aligned}$$

  This first summation accounts for all establishments, regardless of their age or the size of the firm they belong to, for a given τ_ℓ. For establishments converted at $\tau_\ell = 2$, we sum over all establishments for $\tau = 2, 3, \ldots, \infty$. For those with $\tau_\ell = 3$, we sum over all establishments for $\tau = 3, \ldots, \infty$, and so on. Then, we add up all these sums for all possible values of τ_ℓ from 2 to ∞.The total number of jobs in type-π_h establishments, regardless of the age at which they were converted, is therefore:

$$\Phi\rho \sum_{\tau_\ell=2}^{\infty} (1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} (1-\mu)^{\tau} \int_{a_{\min}}^{\infty} \left[\int_{\overline{z}(\pi_\ell)}^{\overline{z}(\pi_h)} L_0^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) + \int_{\overline{z}(\pi_h)}^{\infty} L^{\tau}(z, \pi_\ell, \pi_h)\, \mathrm{d}\Psi_a(z) \right] \mathrm{d}\Gamma(a).$$

  Remark that we start summing from 2 because it is assumed that the establishments cannot become old in the first period.

Total number of jobs in all establishments. To calculate the total number of jobs in all establishments, we need to determine the number of establishments created by a firm of type a. We distinguish between the number of young establishments and the number of old establishments. Let $L^{\tau}(z, \pi_\ell)$ denote the number of jobs in an establishment of age τ and type (z, π_ℓ). The number of establishments of this type belonging to type-a firms is:

$$\underbrace{\Phi\left[1-\Psi_a(\bar{z}(\pi_\ell))\right]}_{\text{Nb of establishments created by type } a} \times \underbrace{\Psi_a'(z)}_{\text{Prob that the establishment is of type } z}$$
$$\times \underbrace{(1-\mu)^\tau}_{\text{Prob the establishment is not destroyed}} \times \underbrace{(1-\rho)^{\tau-1}}_{\text{Prob the establishment remains young}}$$

Total employment in young establishments is therefore:

$$\sum_{\tau=1}^{\infty} \Phi(1-\mu)^\tau(1-\rho)^{\tau-1} \int_{a_{\min}}^{\infty} [1-\Psi_a(\bar{z}(\pi_\ell))] \left[\int_{\bar{z}(\pi_\ell)}^{\infty} \frac{L^\tau(z,\pi_\ell)}{1-\Psi_a(\bar{z}(\pi_\ell))} \,\mathrm{d}\Psi_a(z)\right] \mathrm{d}\Gamma(a).$$

Similarly, employment in old establishments that continue to hire is:

$$\rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} [1-\Psi_a(\bar{z}(\pi_h))] \left[\int_{\bar{z}(\pi_h)}^{\infty} \frac{L^\tau(z,\pi_\ell,\pi_h)}{1-\Psi_a(\bar{z}(\pi_h))} \,\mathrm{d}\Psi_a(z)\right] \mathrm{d}\Gamma(a).$$

$$\rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} [1-\Psi_a(\bar{z}(\pi_h))] \left[\int_{\bar{z}(\pi_h)}^{\infty} \frac{L^\tau(z,\pi_h,\pi_h)}{1-\Psi_a(\bar{z}(\pi_h))} \,\mathrm{d}\Psi_a(z)\right] \mathrm{d}\Gamma(a).$$

and employment in old establishments that no longer hire is:

$$\rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} [\Psi_a(\bar{z}(\pi_h))-\Psi_a(\bar{z}(\pi_\ell))] \left[\int_{\bar{z}(\pi_\ell)}^{\bar{z}(\pi_h)} \frac{L_0^\tau(z,\pi_\ell,\pi_h)}{\Psi_a(\bar{z}(\pi_h))-\Psi_a(\bar{z}(\pi_\ell))} \,\mathrm{d}\Psi_a(z)\right] \mathrm{d}\Gamma(a).$$

Summing these 3 equations, the total number of jobs in the economy is:

$$\begin{aligned} L(W_u,\pi_\ell,\pi_h) = &\sum_{\tau=1}^{\infty} \Phi(1-\mu)^\tau(1-\rho)^{\tau-1} \int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_\ell)}^{\infty} L^\tau(z,\pi_\ell)\,\mathrm{d}\Psi_a(z)\,\mathrm{d}\Gamma(a) \\ &+ \rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} \left[\begin{array}{l} \displaystyle\int_{\bar{z}(\pi_\ell)}^{\bar{z}(\pi_h)} L_0^\tau(z,\pi_\ell,\pi_h)\,\mathrm{d}\Psi_a(z) \\ \displaystyle+\int_{\bar{z}(\pi_h)}^{\infty} L^\tau(z,\pi_\ell,\pi_h)\,\mathrm{d}\Psi_a(z) \end{array}\right] \mathrm{d}\Gamma(a) \end{aligned} \tag{A.53}$$

Since the surplus of all jobs decreases with W_u, employment in each establishment also decreases with respect to W_u (as shown in Section A.2.1) and $\bar{z}(\pi_\ell)$ increases with W_u (as shown in Section A.3.2). Therefore, the total number of jobs defined by equation (A.53) is a decreasing function of W_u :

$$\frac{\partial L(W_u,\pi_\ell,\pi_h)}{\partial W_u} < 0 \tag{A.54}$$

A.5 Aggregate labor supply

The function $L(W_u, \pi_\ell, \pi_h)$ represents the aggregate labor demand of all establishments in the economy. Next, we compute the aggregate labor supply, which is the labor force minus the sum of workers looking for jobs. The sum of workers looking for jobs corresponds to the function $\mathcal{U}(W_u, \pi_\ell, \pi_h)$ in the main text. This function is obtained by summing the number of unemployed individuals seeking a job in each sub-market, i.e., all the functions $u(z,\pi) = v(z,\pi)/\theta(z,\pi)$. To define the function $\mathcal{U}(W_u, \pi_\ell, \pi_h)$, we proceed similarly to the computation of aggregate labor demand. Using equation (A.53), the sum of all unemployed workers can be expressed as follows:

$$\mathcal{U}(W_u, \pi_\ell, \pi_h) = \sum_{\tau=1}^{\infty} \Phi(1-\mu)^{\tau}(1-\rho)^{\tau-1} \int_{a_{\min}}^{\infty} \int_{\overline{z}(\pi_\ell)}^{\infty} u(z,\pi_\ell)\mathrm{d}\Psi_a(z)\mathrm{d}\Gamma(a)$$
$$+ \rho \sum_{\tau_\ell=2}^{\infty} (1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^{\tau} \int_{a_{\min}}^{\infty} \int_{\overline{z}(\pi_h)}^{\infty} u(z,\pi_h)\mathrm{d}\Psi_a(z)\mathrm{d}\Gamma(a) \quad \text{(A.55)}$$

We know from equations (A.37) and (A.38) that $v(z,\pi)$ and $\theta(z,\pi)$ can be defined as functions of the single endogenous variable W_u, and that $v(z,\pi)$ decreases with W_u while $\theta(z,\pi)$ increases. Therefore, $u(z,\pi)$ is a decreasing function of the single endogenous variable W_u. Since $\overline{z}(\pi_h)$increases with W_u equation (A.55) shows that $\mathcal{U}(W_u, \pi_\ell, \pi_h)$ is a decreasing function of W_u. Accordingly, aggregate labor supply, equal to $\mathcal{N} - \mathcal{U}(W_u, \pi_\ell, \pi_h)$ increases with W_u :

$$\frac{\mathrm{d}\left[\mathcal{N} - \mathcal{U}(W_u, \pi_\ell, \pi_h)\right]}{\mathrm{d}\ W_u} > 0 \quad \text{(A.56)}$$

A.6 Labor market equilibrium

The equilibrium value of the expected utility of unemployed workers, W_u, is obtained from the resource constraint which equalizes the aggregate labor supply $\mathcal{N} - \mathcal{U}$ – where $\mathcal{U}$ is defined by equation (A.55) – with the aggregate labor demand L, as defined by equation (A.53). Since the aggregate labor demand decreases with W_u and the aggregate labor supply increases with W_u, it follows that the equilibrium value of W_u is uniquely defined by the following equation, provided it exists:

$$\mathcal{N} - \mathcal{U}(W_u, \pi_\ell, \pi_h) = L(W_u, \pi_\ell, \pi_h) \quad \text{(A.57)}$$

A.7 Decomposition into two channels: Job-value and tightness

This appendix decomposes the separation side of Equation (16) into the two channels of Section 3.5. The reservation productivity $R(z)$ and the conversion threshold $T(z) = R(z) + F/z$ depend on (z, F, W_u) only: neither the hiring restriction π nor the tightness θ enters their determination. The destruction rate of permanent jobs, $G(R(z))$, and the termination rate of FTCs, $G(T(z))$, therefore have no tightness component and load entirely on the job-value channel. For a reform of π, this channel operates through the general equilibrium adjustment of W_u alone, identically in targeted and non-targeted markets conditional on z. Implicit differentiation of (A.24) yields

$$\frac{\partial R(z)}{\partial W_u} = \frac{(1-\beta)/z}{1-\beta(1-\mu)\left[1-G(R(z))\right]} > 0, \qquad \frac{\partial T(z)}{\partial W_u} = \frac{\partial R(z)}{\partial W_u}, \tag{A.58}$$

so a decline in W_u reduces destructions and terminations in every market. A reform of F shifts the thresholds of targeted markets directly, an effect that also belongs to the job-value channel.

The average separation rate entering equation (16) combines these rates with the composition of employment. Conditional on establishment survival, hires equal endogenous separations. In steady state, these outflows in market (z, π, F) are the terminations of FTCs in the entering cohort and the endogenous destructions of permanent jobs, so that

$$\bar{s}(z, \pi, F) \;=\; (1-\pi)\, G(T(z))\, \frac{h}{N} \;+\; G(R(z))\, \frac{N_p}{N}, \tag{A.59}$$

where h, N and N_p denote hires, employment and permanent employment in the market. A reform therefore moves $\bar{s}$ through the rates $G(R(z))$ and $G(T(z))$, which is the job-value channel at the separation margin, and through the composition of employment.

A.8 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, $\mathcal{F}$. We get:

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

Domestic production is merely equal to the number of unemployed workers $\mathcal{U}$ times the instantaneous utility of unemployed workers, denoted by b. In what follows, we compute the other components of aggregate production.

A.8.1 Production of establishments

Production of type-(z, π_ℓ) establishments. Let us denote by $Y^\tau(z, \pi_\ell)$ the expected production of type-(z, π_ℓ) establishments of age τ. When $\tau = 1$, since all jobs start at the highest productivity ε_u, the productivity of all jobs in type-(z, π_ℓ) establishments is equal to $z \times \varepsilon_u$, which implies that:

$$Y^1(z, \pi_\ell) = v(z, \pi_\ell) m(\theta(z, \pi_\ell)) z \varepsilon_u \tag{A.60}$$

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

$$\begin{aligned}Y^\tau(z,\pi_\ell) = &\underbrace{v(z,\pi_\ell)m(\theta(z,\pi_\ell))}_{\text{New jobs}} \cdot z\varepsilon_u \\ &+ \underbrace{(1-\pi_\ell)v(z,\pi_\ell)m(\theta(z,\pi_\ell))\left[1-G(T(z))\right]}_{\text{Permanent jobs which were temporary in previous period}} \cdot \int_{T(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(T(z))}\,\mathrm{d}G(\varepsilon) \\ &+ \underbrace{\left(L_p^\tau(z,\pi_\ell) - v(z,\pi_\ell)m(\theta(z,\pi_\ell))\left((1-\pi_\ell)\left[1-G(T(z))\right]+\pi_\ell\right)\right)}_{\text{Permanent jobs with at least 2 periods seniority minus new permanent jobs}} \cdot \int_{R(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(R(z))}\,\mathrm{d}G(\varepsilon)\end{aligned} \tag{A.61}$$

where $L_p^\tau(z,\pi_\ell)$ stands for the number of permanent jobs in type-(z,π_ℓ) establishments of age τ, defined in equation (A.39). $\int_{T(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(T(z))}\mathrm{d}G(\varepsilon)$ is the expected productivity of surviving temporary jobs, and $\int_{R(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(R(z))}\mathrm{d}G(\varepsilon)$ is the expected productivity of surviving permanent jobs.

Production of type-(z,π_h) establishments. Let us denote by $Y^\tau(z,\pi_\ell,\pi_h)$, the expected production of type-(z,π_h) establishments of age $\tau > 1$ that were previously complying with the less stringent regulation π_ℓ.

- For the establishments which continue hiring after being constrained to comply with the stringent regulation π_h, i.e. whose $z > \bar{z}(\pi_h)$, we get:

$$\begin{aligned}Y^\tau(z,\pi_\ell,\pi_h) = &\underbrace{v(z,\pi_h)m(\theta(z,\pi_h))}_{\text{New jobs}} \cdot z\varepsilon_u \\ &+ \underbrace{L_t^{\tau-1}(z,\pi_\ell,\pi_h)\left(1-G(T(z))\right)}_{\substack{\text{Permanent jobs which were}\\ \text{temporary in previous period}}} \cdot \int_{T(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(T(z))}\,\mathrm{d}G(\varepsilon) \\ &+ \underbrace{L_p^{\tau-1}(z,\pi_\ell,\pi_h)(1-G(R(z)))}_{\substack{\text{Permanent jobs which were}\\ \text{permanent in previous period}}} \cdot \int_{R(z)}^{\varepsilon_u} \frac{z\varepsilon}{1-G(R(z))}\,\mathrm{d}G(\varepsilon)\end{aligned} \tag{A.62}$$

  where $L_p^{\tau-1}(z,\pi_\ell,\pi_h)$ stands for the expected number of permanent jobs in the previous period, and $L_t^{\tau-1}(z,\pi_\ell,\pi_h)$ stands for the expected number of temporary jobs in the previous period, $(\tau-1)$. If $\tau > \tau_\ell$, these are, respectively, the expected number of permanent and temporary jobs in a type-(z,π_h) establishment (for instance, see equation (A.41)). If $\tau = \tau_\ell$, these are, respectively, the expected number of permanent and temporary jobs in a type (z,π_ℓ) establishment. 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_h in period τ.

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

$$Y_0^\tau(z, \pi_\ell, \pi_h) = \underbrace{(1 - G(R(z)))^{\tau-\tau_\ell} \cdot L_0^{\tau_\ell}}_{\substack{\text{Permanent jobs surviving} \\ \text{from } \tau_\ell \text{ onward}}} \cdot \int_{R(z)}^{\varepsilon_u} \frac{z\varepsilon}{1 - G(R(z))} \, \mathrm{d}G(\varepsilon)$$

whenever $\tau > \tau_\ell$. $L_0^{\tau_\ell}(z, \pi_\ell, \pi_h)$ is defined by equation (A.45), substituting in τ_ℓ.

When $\tau = \tau_\ell$, some temporary jobs have been converted from the previous period, and so the production formula for the establishments that stop hiring is:

$$\begin{aligned} Y_0^{\tau_\ell}(z, \pi_\ell, \pi_h) = \; & \underbrace{(1 - G(R(z))) \cdot L_p^{\tau_\ell - 1}}_{\substack{\text{Permanent jobs} \\ \text{from } \tau_\ell - 1}} \cdot \int_{R(z)}^{\varepsilon_u} \frac{z\varepsilon}{1 - G(R(z))} \, \mathrm{d}G(\varepsilon) \\ & + \underbrace{(1 - G(T(z))) \cdot L_t^{\tau_\ell - 1}}_{\substack{\text{Converted temp jobs} \\ \text{from } \tau_\ell - 1}} \cdot \int_{T(z)}^{\varepsilon_u} \frac{z\varepsilon}{1 - G(T(z))} \, \mathrm{d}G(\varepsilon) \end{aligned}$$

where $L_p^{\tau_\ell - 1}$ and $L_t^{\tau_\ell - 1}$ are defined by the standard type-(z, π_ℓ) establishment equations.

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 (A.53). We get:

$$\begin{aligned} \mathcal{Y} = & \sum_{\tau=1}^{\infty} \Phi(1-\mu)^\tau (1-\rho)^{\tau-1} \int_{a_{\min}}^{\infty} \int_{\bar{z}(\pi_\ell)}^{\infty} Y^\tau(z, \pi_\ell) \, \mathrm{d}\Psi_a(z) \, \mathrm{d}\Gamma(a) \\ & + \rho \sum_{\tau_\ell=2}^{\infty} (1-\rho)^{\tau_\ell - 2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} \left[\begin{array}{l} \displaystyle\int_{\bar{z}(\pi_\ell)}^{\bar{z}(\pi_h)} Y_0^\tau(z, \pi_\ell, \pi_h) \, \mathrm{d}\Psi_a(z) \\ \displaystyle + \int_{\bar{z}(\pi_h)}^{\infty} Y^\tau(z, \pi_\ell, \pi_h) \, \mathrm{d}\Psi_a(z) \end{array} \right] \mathrm{d}\Gamma(a) \end{aligned} \tag{A.63}$$

A.8.2 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 (A.53), we get:

$$\begin{aligned} \mathcal{H} \; = & \sum_{\tau=0}^{\infty} \Phi(1-\mu)^\tau (1-\rho)^\tau \int_{a_{\min}}^{\infty} \int_{\bar{z}(\pi_\ell)}^{\infty} C(v(z, \pi_\ell)) \, d\Psi_a(z) \, d\Gamma(a) \\ & + \rho \sum_{\tau_\ell=2}^{\infty} (1-\rho)^{\tau_\ell - 2} \sum_{\tau=\tau_\ell - 1}^{\infty} \Phi(1-\mu)^\tau \int_{a_{\min}}^{\infty} \int_{\bar{z}(\pi_h)}^{\infty} C(v(z, \pi_h)) \, d\Psi_a(z) \, d\Gamma(a) \end{aligned} \tag{A.64}$$

where $C(v(z, \pi_i))$ stands for the hiring cost of type-(z, π_i), $i = h, \ell$, establishments. For young establishments, this is $C(v_\ell) = c_0 v_\ell^\alpha$, and for old establishments which keep hiring, this is $C(v_h) = c_0 v_h^\alpha$. The hiring costs are 0 for old establishments which stop hiring.

A.8.3 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. Conditional on establishment survival, each permanent job in place in period τ is destroyed at the beginning of period $\tau+1$ with probability $G(R(z))$; each destruction entails the firing cost F, and no firing cost is paid when the establishment itself is destroyed (Appendix A.1.1). Therefore, using again equation (A.53), which defines total employment, we can compute total firing costs:

$$\begin{aligned}\mathcal{F} = F(1-\mu)\Bigg\{ &\sum_{\tau=1}^{\infty} \Phi(1-\mu)^{\tau}(1-\rho)^{\tau-1} \int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_\ell)}^{\infty} L_p^{\tau}(z,\pi_\ell)\, G(R(z))\, d\Psi_a(z)\, d\Gamma(a) \\ &+ \rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^{\tau} \int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_h)}^{\infty} L_p^{\tau}(z,\pi_\ell,\pi_h)\, G(R(z))\, d\Psi_a(z)\, d\Gamma(a) \\ &+ \rho \sum_{\tau_\ell=2}^{\infty}(1-\rho)^{\tau_\ell-2} \sum_{\tau=\tau_\ell}^{\infty} \Phi(1-\mu)^{\tau} \int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_\ell)}^{\bar{z}(\pi_h)} L_{p0}^{\tau}(z,\pi_\ell,\pi_h)\, G(R(z))\, d\Psi_a(z)\, d\Gamma(a) \Bigg\}.\end{aligned} \tag{A.65}$$

A.9 Job flows

This section 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.

A.9.1 Permanent job destruction

Conditional on establishment survival, each permanent job in a type-(z,π_i), $i=h,\ell$, establishment is destroyed at the beginning of the following period with probability $G(R(z))$. The destruction rates below therefore relate the destructions occurring in a given period, generated by the previous-period stocks of surviving establishments, to current permanent employment, using the number of permanent jobs in each establishment and the age distribution of establishments.

Average permanent job destruction rate in young establishments. Using the definition of the number of permanent jobs in type-(z,π_ℓ) establishments of age τ, provided by equation (A.39), and the age distribution of establishments, provided in Appendix A.4.1, we find that the permanent job destruction rate in young establishments firms is:

$$pd_\ell = \frac{(1-\mu)(1-\rho)\sum_{\tau=1}^{\infty}\Phi(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_\ell)}^{\infty} L_p^{\tau}(z,\pi_\ell)\, G(R(z))\, d\Psi_a(z)\, d\Gamma(a)}{\sum_{\tau=1}^{\infty}\Phi(1-\mu)^{\tau}(1-\rho)^{\tau-1}\int_{a_{\min}}^{\infty}\int_{\bar{z}(\pi_\ell)}^{\infty} L_p^{\tau}(z,\pi_\ell)\, d\Psi_a(z)\, d\Gamma(a)}$$

A.9.2 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, π_i) establishments. Therefore, the average conversion rate of temporary jobs in type-(z, π_i) establishments is:

$$tc_i = \frac{\int_{a_{\min}}^{\infty} \int_{\bar{z}(\pi_i)}^{\infty} (1-\pi_i) m(\theta(z, \pi_i)) v(z, \pi_i) \left[1 - G(T(z))\right] \mathrm{d}\Psi_a(\mathrm{z})\ \mathrm{d}\Gamma(a)}{\int_{a_{\min}}^{\infty} \int_{\bar{z}(\pi_i)}^{\infty} (1-\pi_i) m(\theta(z, \pi_i)) v(z, \pi_i) \mathrm{d}\Psi_a(\mathrm{z})\ \mathrm{d}\Gamma(a)}.$$

A.10 Efficiency of the decentralized equilibrium in the absence of job protection

This appendix shows that, absent job protection, the decentralized equilibrium is constrained efficient: the allocation supported by free entry, directed search, and the surplus split induced by wage posting solves the problem of a benevolent planner facing the same matching, establishment-destruction, and population frictions. We first characterize the decentralized equilibrium, then state the planner's dynamic program and derive its marginal optimality conditions, and finally show that the two systems coincide. Throughout, we set $\pi = 0$ and $F = 0$, so that $T(z) = R(z)$, temporary and permanent contracts carry the same surplus, $S_t(z) = S_p(z) \equiv S(z)$, and the model reduces to a standard directed-search model with endogenous job destruction.

Timing. The timing follows Section 3.2 exactly. Within period t: (i) matches form through vacancies posted in period $t-1$; (ii) match-specific productivity is observed, with new matches starting at ε_u and continuing matches drawing $\varepsilon' \sim G$; (iii) matches with productivity below the retention threshold are destroyed; (iv) retained and newly created matches produce; (v) establishments post vacancies for period $t+1$ at cost $C(v(z))$; and (vi) establishments are destroyed with probability μ. Thus, a vacancy posted in period t produces a match in period $t+1$ only if the establishment survives, whereas unemployed workers direct their search among surviving establishments. The return to a posted vacancy is therefore discounted by $\beta(1-\mu)$, while the return to allocating a searcher to an active submarket is discounted by β only. This timing is common to the decentralized economy and to the planner.

A.10.1 Decentralized equilibrium

No-arbitrage and the wage-posting split. Under directed search with perfect mobility across z-markets, the value of unemployment W_u is equalized across active segments:

$$W_u = b + \beta\, \theta(z) m(\theta(z)) [W(z) - W_u] + \beta[1 - \theta(z) m(\theta(z))] W_u. \tag{A.66}$$

Condition (A.66) is the constraint faced by a firm posting terms $W(z)$: any pair (W, θ) offered must deliver the market value W_u to searchers. Differentiating it at fixed W_u gives $\partial\theta/\partial W =$

$-\theta/\{(1-\eta)[W(z)-W_u]\}$, where

$$\eta(\theta) \equiv -\frac{\theta m'(\theta)}{m(\theta)} \in (0,1) \tag{A.67}$$

is the elasticity of the matching function with respect to unemployment.[23] The firm posts $W(z)$ to maximize the value of a vacancy. Using $J = S - (W - W_u)$ yields the Hosios split

$$W(z) - W_u = \eta\, S(z), \qquad J(z) = (1-\eta)\, S(z), \tag{A.68}$$

and, after substitution into (A.66),

$$\theta(z) m(\theta(z)) = \frac{(1-\beta)W_u - b}{\beta\, \eta\, S(z)}. \tag{A.69}$$

Surplus and reservation threshold. The surplus of a continuing match satisfies

$$S^c(\varepsilon, z) = \varepsilon z - (1-\beta)W_u + \beta(1-\mu) \int \max\{S^c(\varepsilon', z), 0\}\, dG(\varepsilon').$$

The reservation productivity $R(z)$, defined by $S^c(R(z), z) = 0$, therefore satisfies

$$zR(z) = (1-\beta)W_u - \beta(1-\mu) z \int_{R(z)}^{\varepsilon_u} [\varepsilon - R(z)]\, dG(\varepsilon). \tag{A.70}$$

Moreover, $S^c(\varepsilon, z) = z[\varepsilon - R(z)]$ for $\varepsilon \geq R(z)$, and the surplus of a starting match is

$$S(z) = z[\varepsilon_u - R(z)]. \tag{A.71}$$

Vacancy creation and entry. The zero-value condition for a marginal vacancy gives

$$C'(v(z)) = \beta(1-\mu) m(\theta(z)) J(z) = \beta(1-\mu) m(\theta(z))(1-\eta) S(z). \tag{A.72}$$

An establishment is created if and only if $\Pi(z) \geq 0$, which, as shown in Appendix A.3.1, is equivalent to $S(z) \geq 0$. Hence the productivity cutoff $\bar{z}$ satisfies $R(\bar{z}) = \varepsilon_u$, and the corresponding ability cutoff is $a_{\min} = \inf\{a : \Psi_a(\bar{z}) < 1\}$. The equilibrium $(W_u, \bar{z}, a_{\min}, \{v(z), \theta(z), R(z)\})$ is closed by labor-market clearing, $N - U = L$, which determines W_u.

A.10.2 The planner's problem

Recursive formulation. The planner faces the same matching technology, the same destruction process for establishments, and the same timing as decentralized agents; in particular she cannot observe ε before a match is formed, cannot match workers and vacancies outside the

[23] In general η depends on θ and hence on z; all conditions below are understood to be evaluated at the relevant $\theta(z)$. In the calibration m is Cobb–Douglas, so η is constant.

matching technology, and is constrained by the population N. Let the aggregate state be

$$\sigma_t = (dn_t(z,a),\, \{d\ell_t(\varepsilon,z)\},\, U_t),$$

where $dn_t(z,a)$ is the measure of active establishments, $d\ell_t(\varepsilon,z)$ the measure of matches of current productivity ε in type-z establishments, and U_t the stock of unemployed workers, with

$$dn_{t+1} = (1-\mu)\, dn_t + dn_{t+1}^{new}, \qquad dn_{t+1}^{new} = \phi E\, \mathbf{1}_{\{a \geq a_{\min,t}^p,\, z \geq \bar{z}_t^p\}}\, d\Psi_a(z)\, d\Gamma(a),$$

and with $d\ell_t$ evolving according to the employment laws of motion derived in Appendix A.4, which incorporate new matches, establishment destruction, productivity draws, and the retention rule. These laws of motion, together with the accounting identity for unemployment below, fully determine the transition from σ_t to σ_{t+1}. We do not reproduce them here because they are identical to those used to construct aggregate employment in Appendix A.4. The planner chooses the entry cutoffs $(\bar{z}_t^p, a_{\min,t}^p)$ and, for each active submarket, vacancies $v_t(z)$, queue lengths $u_t(z)$ and retention thresholds $R_t(z)$ to maximize

$$\mathcal{S}(\sigma_t) = \max\Big\{F_t + \beta\, \mathcal{S}(\sigma_{t+1})\Big\}, \qquad F_t = \iint [Y_t(z) + b\, u_t(z) - C(v_t(z))] dn_t, \tag{A.73}$$

subject to the laws of motion above and to

$$U_t = \iint u_t(z)\, dn_t, \qquad N = U_t + \iint L_t(z)\, dn_t, \tag{A.74}$$

where $L_t(z)$ is the stock of matches in a type-z establishment implied by $d\ell_t(\varepsilon,z)$. Equivalently, $N = \iint [u_t(z) + L_t(z)]\, dn_t$.

Costates. Rather than evaluating (A.73) at a stationary point — which would only deliver an accounting identity — we work directly with the derivatives of $\mathcal{S}$ with respect to the stocks, i.e. with the costates of the dynamic program. Because the environment is stationary, these are time invariant. Define

$$\Omega_u \equiv \frac{\partial \mathcal{S}(\sigma)}{\partial U}, \qquad \Omega_J(\varepsilon,z) \equiv \frac{\partial \mathcal{S}(\sigma)}{\partial\, d\ell(\varepsilon,z)}, \qquad \Pi^p(z) \equiv \frac{\partial \mathcal{S}(\sigma)}{\partial\, dn(z,a)}, \tag{A.75}$$

the *marginal* social values of an unemployed worker, of a match of current productivity ε in a type-z establishment, and of an active type-z establishment net of the matches it already holds. Because these are marginal values, they already internalize the congestion externalities that an additional worker or an additional vacancy imposes on the submarket in which it is placed. Define the social surplus of a match as

$$\Sigma(\varepsilon,z) \equiv \Omega_J(\varepsilon,z) - \Omega_u.$$

Two properties make the program tractable and justify a submarket-by-submarket treatment. First, per-period payoffs are linear in the number of matches within an establishment, production is εz per match, and the matching technology exhibits constant returns within a submarket; consequently $\mathcal{S}$ is additively separable across matches and across establishments, conditional on the marginal social value of a worker. Second, the only link across submarkets is the allocation of the fixed population of workers. Conditional on Ω_u, the planner's marginal optimality conditions can therefore be characterized submarket by submarket. The value Ω_u is determined jointly with these conditions by the population constraint (A.74). This is the exact counterpart of the decentralized economy, in which W_u is common to all submarkets and is determined by labor-market clearing.

Social surplus and the destruction threshold. Absent job protection, the envelope condition associated with $d\ell(\varepsilon, z)$ gives

$$\Omega_J(\varepsilon, z) = z\varepsilon + \beta\Big\{(1-\mu)\int \max[\Omega_J(\varepsilon', z), \Omega_u]dG(\varepsilon') + \mu\,\Omega_u\Big\},$$

so that the social surplus satisfies

$$\Sigma(\varepsilon, z) = z\varepsilon - (1-\beta)\Omega_u + \beta(1-\mu)\int \max\{\Sigma(\varepsilon', z), 0\}\, dG(\varepsilon'). \tag{A.76}$$

The planner retains a match if and only if its social surplus is nonnegative — note that this is the correct rule precisely because Ω_u is a marginal value, so that returning the worker to the unemployment pool is valued net of the congestion he creates there. The optimal reservation productivity $R^p(z)$ is thus defined by $\Sigma(R^p(z), z) = 0$ and satisfies

$$zR^p(z) = (1-\beta)\Omega_u - \beta(1-\mu)z\int_{R^p(z)}^{\varepsilon_u} [\varepsilon - R^p(z)]\, dG(\varepsilon), \qquad \Sigma(\varepsilon, z) = z[\varepsilon - R^p(z)] \text{ for } \varepsilon \geq R^p(z). \tag{A.77}$$

In particular $\Sigma(\varepsilon_u, z) = z[\varepsilon_u - R^p(z)]$ is the social surplus of a starting match.

Matching externalities. For $M(u, v) = v\,m(v/u)$ and η defined in (A.67),

$$M_v(u, v) = m(\theta)(1-\eta), \qquad M_u(u, v) = \eta\,\theta m(\theta), \qquad \theta = v/u, \tag{A.78}$$

which are the net effects of an additional vacancy and of an additional searcher once congestion is taken into account.

Optimal vacancy creation. The costate of an active type-z establishment satisfies

$$\Pi^p(z) = \max_v\Big\{-C(v) + \beta(1-\mu)[M(u^p(z), v)\,\Sigma(\varepsilon_u, z) + \Pi^p(z)]\Big\}, \tag{A.79}$$

since each match formed raises social welfare by $\Omega_J(\varepsilon_u, z)$ and removes one worker from the unemployment pool, whose marginal value is Ω_u. An additional vacancy costs $C'(v^p(z))$ today and, conditional on establishment survival, creates $M_v(u^p(z), v^p(z))$ additional matches next period. The first-order condition of (A.79) is therefore

$$C'(v^p(z)) = \beta(1-\mu)M_v(u^p(z), v^p(z))\,\Sigma(\varepsilon_u, z), \tag{A.80}$$

or, using (A.78),

$$C'(v^p(z)) = \beta(1-\mu)m(\theta^p(z))(1-\eta)\,\Sigma(\varepsilon_u, z). \tag{A.81}$$

Optimal allocation of unemployed workers. The envelope condition associated with U, together with the optimal allocation of searchers across submarkets, gives

$$(1-\beta)\Omega_u = b + \beta M_u(u^p(z), v^p(z))\,\Sigma(\varepsilon_u, z), \qquad \forall z \geq \bar{z}^p \text{ with } u^p(z) > 0, \tag{A.82}$$

with the inequality $(1-\beta)\Omega_u \geq b + \beta M_u \Sigma(\varepsilon_u, z)$ in inactive submarkets, where $u^p(z) = 0$. Using (A.78), (A.82) becomes

$$(1-\beta)\Omega_u = b + \beta\eta\,\theta^p(z)m(\theta^p(z))\,\Sigma(\varepsilon_u, z), \qquad \forall z \geq \bar{z}^p. \tag{A.83}$$

This is the planner's social no-arbitrage condition: it equalizes the marginal social value of a searcher across active submarkets, with η the congestion correction on the worker side.

Entry. Since establishment opportunities are costless draws, an establishment is economically active if and only if the planner chooses $v^p(z) > 0$. Solving (A.79) gives

$$\Pi^p(z) = \frac{\beta(1-\mu)\,v^p(z)m(\theta^p(z))\,\Sigma(\varepsilon_u, z) - C(v^p(z))}{1-\beta(1-\mu)}.$$

For $\Sigma(\varepsilon_u, z) > 0$, convexity of C, together with $C(0) = 0$, implies $C(v) \leq vC'(v)$. Using (A.81),

$$vC'(v) = \beta(1-\mu)vm(\theta)(1-\eta)\Sigma(\varepsilon_u, z) < \beta(1-\mu)vm(\theta)\Sigma(\varepsilon_u, z),$$

so $\Pi^p(z) > 0$. If $\Sigma(\varepsilon_u, z) \leq 0$, the optimal choice is $v^p(z) = 0$, and the establishment remains inactive. Adopting the convention that inactive establishments are not created, the productivity cutoff satisfies

$$\Sigma(\varepsilon_u, \bar{z}^p) = 0 \quad \Longleftrightarrow \quad R^p(\bar{z}^p) = \varepsilon_u. \tag{A.84}$$

Thus,

$$v^p(z) > 0 \quad \Longleftrightarrow \quad \Pi^p(z) > 0 \quad \Longleftrightarrow \quad \Sigma(\varepsilon_u, z) > 0.$$

The corresponding ability cutoff is $a^p_{\min} = \inf\{a : \Psi_a(\bar{z}^p) < 1\}$. Activating an additional establishment has no first-order effect on the other active submarkets: by (A.82), the marginal social value of a searcher is equalized across them, so reallocating searchers toward the new establishment is welfare-neutral at the margin. Finally, the population constraint (A.74), equivalently $N = U + L$, determines Ω_u.

Stationary distribution. Once the optimal dynamic conditions have been obtained, the stationary stock of establishments follows from the law of motion,

$$dn_e^p(z,a) = \frac{\phi E}{\mu}\,\mathbf{1}_{\{a\geq a^p_{\min},\, z\geq \bar{z}^p\}}\,d\Psi_a(z)\,d\Gamma(a). \tag{A.85}$$

This expression is a stationary accounting identity used to compute aggregates; it plays no role in the derivation of the optimality conditions above.

A.10.3 Efficiency of the decentralized equilibrium

Proposition. *When $\pi = 0$ and $F = 0$, the decentralized equilibrium satisfies the planner's optimality conditions; if the planner's system admits a unique solution, the two allocations coincide.*

To see this, compare the two systems under the mapping

$$W_u \leftrightarrow \Omega_u, \qquad S(z) \leftrightarrow \Sigma(\varepsilon_u, z), \qquad R(z) \leftrightarrow R^p(z), \qquad v(z) \leftrightarrow v^p(z),$$
$$\theta(z) \leftrightarrow \theta^p(z), \qquad \bar{z} \leftrightarrow \bar{z}^p, \qquad a_{\min} \leftrightarrow a^p_{\min}.$$

The decentralized and planner conditions are identical:

Object	**Decentralized**	**Planner**
Destruction	$zR = (1-\beta)W_u - \beta(1-\mu)z\int(\varepsilon - R)dG$ (A.70)	$zR^p = (1-\beta)\Omega_u - \beta(1-\mu)z\int(\varepsilon - R^p)dG$ (A.77)
Surplus	$S(z) = z[\varepsilon_u - R(z)]$ (A.71)	$\Sigma(\varepsilon_u, z) = z[\varepsilon_u - R^p(z)]$ (A.77)
Vacancies	$C'(v) = \beta(1-\mu)m(\theta)(1-\eta)S$ (A.72)	$C'(v^p) = \beta(1-\mu)m(\theta^p)(1-\eta)\Sigma(\varepsilon_u, z)$ (A.81)
No-arbitrage	$(1-\beta)W_u = b + \beta\eta\theta m(\theta)S$ (A.69)	$(1-\beta)\Omega_u = b + \beta\eta\theta^p m(\theta^p)\Sigma(\varepsilon_u, z)$ (A.83)
Establishment entry	$R(\bar{z}) = \varepsilon_u$	$R^p(\bar{z}^p) = \varepsilon_u$ (A.84)
Firm entry	$a_{\min} = \inf\{a : \Psi_a(\bar{z}) < 1\}$	$a^p_{\min} = \inf\{a : \Psi_a(\bar{z}^p) < 1\}$
Clearing	$N = U + L$	$N = U + L$ (A.74)

The equality of the vacancy conditions follows from the wage-posting (Hosios) split: firms receive the share $1-\eta$ of the match surplus, which is exactly the elasticity of the matching function with respect to vacancies, while workers receive the complementary share η, equal to the elasticity with respect to unemployment. Free entry, optimal destruction, and labor-market clearing then reproduce the planner's remaining conditions. Under the maintained concavity of the matching technology and convexity of vacancy costs, these conditions characterize the planner's optimum. Hence, whenever the planner's allocation is unique, it coincides with the decentralized equilibrium. Thus, absent job protection, directed search decentralizes the constrained-efficient allocation.

B Empirical appendix: RDD analysis of the impact of the reform on large firms

This appendix presents the tables for the benchmark RD estimates of the impact of the reform on large firms before presenting the additional adjustment margin beside the creation of new establishments and the validation and falsification tests.

To assess the robustness of our results, we performed the four types of falsification and validation tests recommended by Cattaneo & Titiunik (2022). These tests show that (i) The distribution of firm size in January 2009 has no statistically significant discontinuity at the cutoff, suggesting that firms did not manipulate their workforce size before the reform's enactment in February 2009; (ii) Treated units are similar to control units in terms of observable characteristics, such as sales, social capital, number of establishments, number of new establishments, number of FTC hires in new establishments, and total hires in new establishments around the 750 cutoff before the reform; (iii) The discontinuity in the number of fixed-term contract hires at new establishments, observed at the 750-employee threshold in 2009-2010, does not appear at other thresholds—such as 200 or 400 employees—during this same period. This confirms that the discontinuity observed at the 750-employee threshold is indeed a consequence of the February 2009 reform; and (iv) "Donut hole" estimates consistently indicate a negative impact of the reform on hiring in new establishments, driven by a decline in fixed-term contract hires and a reduction in the number of new establishments among large firms, with no positive effect on the number of new permanent jobs. (iii) and (iv) are documented in Figure 3. Other placebo tests at thresholds of 150, 250, 350, 450, and 550 yield results consistent with those presented in Figure 3, as do "donut hole" estimates with widths of 5, 10 and 15, around the cutoff.

B.1 Summary statistics of Portuguese firms in 2008

Table B.1.1: **Firm-level summary statistics pre-reform (2008)**

	Large firms	Small firms	Difference
Share of fixed-term hires	0.66	0.72	-0.06
			(0.04)
Firm size	1130.24	206.54	923.70***
			(14.21)
Fixed-term and permanent hires	47.83	9.62	38.21***
			(2.96)
Number of new establishments	6.10	1.40	4.70***
			(0.43)
Firm age	28.68	32.16	-3.48
			(4.20)
Total annual sales (in millions)	248.14	32.94	215.20***
			(19.01)
Farming and extracting industries	0.01	0.01	-0.00
			(0.01)
Food, clothing	0.09	0.17	-0.09**
			(0.03)
Chemicals, metals, electrics	0.10	0.15	-0.06
			(0.03)
Other manufacturing	0.05	0.04	0.01
			(0.02)
Construction, trade	0.23	0.25	-0.02
			(0.04)
Hotels, restaurants	0.10	0.07	0.03
			(0.02)
Information, financial, real estate	0.09	0.05	0.04*
			(0.02)
Administrative services	0.07	0.06	0.01
			(0.02)
Education, health	0.26	0.16	0.09**
			(0.03)
Other services	0.01	0.03	-0.01
			(0.01)
Lisbon headquarters	0.55	0.32	0.23***
			(0.04)
Porto headquarters	0.12	0.18	-0.05
			(0.03)
Braga headquarters	0.05	0.09	-0.04
			(0.02)
N	145	2,709	2,854

Notes: "Large firms" are those with at least 750 and no more than 2,000 employees in January 2009. "Small firms" are those with at least 100 but fewer than 750 employees. The column 'Difference' displays estimates of a mean equality t-test across the first two columns' averages (standard errors in parentheses). Firm age is measured in years since the creation of the firm. 'Fixed-term and permanent hires' indicates the number of hires by new establishments (created between October 2006 and October 2008) of each type of firms ('small' or 'large'). Variables whose averages are displayed in levels are winsorized at the 1^{st} and 99^{th} percentiles. Significance levels: * 0.10, ** 0.05, *** 0.01. Calculations based on the Quadros de Pessoal dataset.

B.2 Tables: main estimates and robustness tests

Table B.2.1: **Effects of the reform on targeted firms: main RD estimates with optimal bandwidth method**

	#FTC hires	Total hires	#OEC hires	#New Estabs
Size $\geq$ 750	-1.008	-0.660	0.037	-0.489
	(0.397)	(0.372)	(0.482)	(0.279)
Industry F.E.	Yes	Yes	Yes	Yes
Robust 95% CI	[-1.799 ; -.024]	[-1.883 ; -.011]	[-1.35 ; 1.17]	[-1.085 ; .249]
Non-normalized mean	5.72	16.88	11.16	3.25
%Δ	-73.85	-50.79	6.00	-50.65
N	2,854	2,854	2,854	2,854

Notes: The table displays regression results from Equation (18) for the following dependent variables at the firm level: fixed-term hires, total hires, open-ended contract hires and number of new establishments, respectively. Those are outcomes in young establishments of the firm, where employment equals hires. Dependent variables are divided by their standard deviation. Robust 95% confidence intervals are reported in brackets following Calonico et al. (2017). The bottom panel presents dependent variables' baseline mean (in levels), their percent change relative to the mean baseline level based on the RD estimate, and the total number of observations, respectively. We report RD estimates using the following options of the user-written command *rdrobust* Calonico et al. (2017): order 1 polynomials on each side of the cutoff; common MSE-optimal bandwidth selector for the RD treatment effect estimator Calonico, Cattaneo & Farrell (2019); and triangular kernel controlling for ten one-digit industry effects. A heteroskedasticity-robust nearest neighbor standard error estimator with a minimum of 3 neighbors is used Calonico et al. (2017). Calculations are based on Quadros de Pessoal data.

Table B.2.2: **Robustness: RD estimate on targeted firms with fixed bandwidth**

	#FTC hires	Total hires	#OEC hires	#New Estabs
Size $\geq$ 750	-0.963	-0.613	-0.044	-0.574
	(0.261)	(0.355)	(0.438)	(0.241)
Industry F.E.	Yes	Yes	Yes	Yes
Robust 95% CI	[-2.203 ; -.549]	[-1.827 ; .035]	[-1.14 ; .952]	[-1.666 ; .027]
Non-normalized mean	5.72	16.88	11.16	3.25
%Δ	-72.94	-48.93	-6.33	-54.65
N	2,854	2,854	2,854	2,854

Notes: The table displays regression results from equation 18 for the following dependent variables at the firm level: fixed-term hires, total hires, open-ended contract hires and number of new establishments, respectively. Those are outcomes in young establishments of the firm, where employment equals hires. Regressions are based solely on observations within the manually specified firm size bandwidth of 600 to 1200 employees. Dependent variables are divided by their standard deviation. Robust 95% confidence intervals are reported in brackets following Calonico et al. (2017). The bottom panel presents dependent variables' baseline mean (in levels), their percent change relative to the mean baseline level based on the RD estimate, and the total number of observations, respectively. We report RD estimates using the following options of the user-written command *rdrobust* Calonico et al. (2017): order 1 polynomials on each side of the cutoff; and triangular kernel controlling for ten one-digit industry effects. A heteroskedasticity-robust nearest neighbor standard error estimator with a minimum of 3 neighbors is used Calonico et al. (2017). Calculations are based on Quadros de Pessoal data.

Table B.2.3: **Robustness: RD estimate on targeted firms with donut**

	#FTC hires	Total hires	#OEC hires	#New Estabs
Size $\geq$ 750	-1.408	-1.141	-0.994	-0.410
	(0.438)	(0.419)	(0.855)	(0.436)
Industry F.E.	Yes	Yes	Yes	Yes
Robust 95% CI	[-2.434 ; -.035]	[-2.423 ; -.409]	[-3.243 ; .791]	[-1.16 ; 1.113]
Non-normalized mean	6.64	10.95	4.31	5.11
%Δ	-77.27	-73.19	-79.43	-35.44
N	2,832	2,832	2,832	2,832

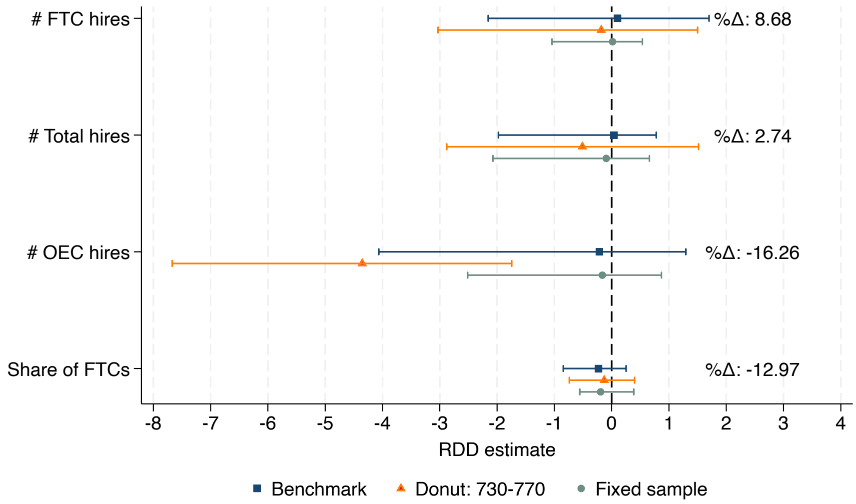
Notes: The table displays regression results from equation 18 for the following dependent variables at the firm level: fixed-term hires, total hires, open-ended contract hires and number of new establishments, respectively. Those are outcomes in young establishments of the firm, where employment equals hires. Observations within a range of 20 employees on both sides of the 750 employees cutoff are dropped. Dependent variables are divided by their standard deviation. Robust 95% confidence intervals are reported in brackets following Calonico et al. (2017). The bottom panel presents dependent variables' baseline mean (in levels), their percent change relative to the mean baseline level based on the RD estimate, and the total number of observations, respectively. We report RD estimates using the following options of the user-written command *rdrobust* Calonico et al. (2017): order 1 polynomials on each side of the cutoff; common MSE-optimal bandwidth selector for the RD treatment effect estimator Calonico, Cattaneo & Farrell (2019); and triangular kernel controlling for ten one-digit industry effects. A heteroskedasticity-robust nearest neighbor standard error estimator with a minimum of 3 neighbors is used Calonico et al. (2017). Calculations are based on Quadros de Pessoal data.

B.3 Additional adjustment margins

This section shows that the reform did not significantly affect either job creation in the older establishments of large firms or the activity of their subsidiaries.

B.3.1 Effects on old establishments

Figure B.3.1: **RD estimates: New hires in old establishments in 2009-2010.**



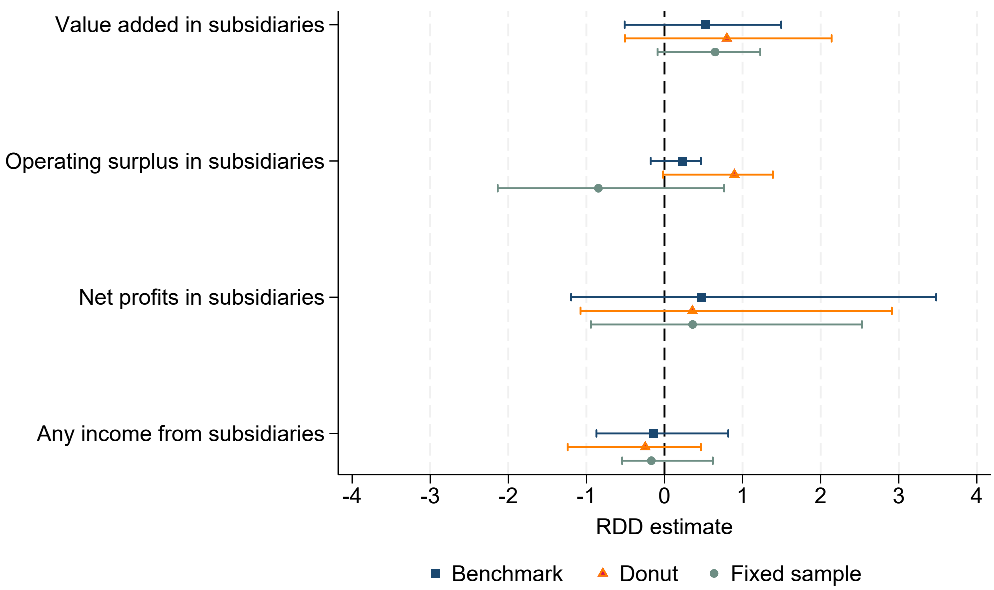
Notes: This figure reports regression discontinuity estimates and 95% confidence intervals for α_1 in Equation 18. The vertical axis lists four firm-level outcomes: (i) the number of new hires under fixed-term contracts, (ii) total new hires, (iii) the number of new hires under open-ended contracts, and (iv) the share of FTCs. Outcomes are computed across old establishments only. The figure reports results across three sets of specifications. The blue squares are estimates from our benchmark specification, described in Section 4.4.1. The orange triangles exclude firms with size between 730 and 770 employees. The green circles use a fixed bandwidth from 600 to 1200 employees instead of the optimal one. Percent changes relative to the baseline mean are printed for each variable. Variables are normalized by their standard deviation. Calculations are based on Quadros de Pessoal data.

B.3.2 Effects on the creation of small firms by large firms

This section is devoted to the analysis of the impact of the reform on the outcome of subsidiaries and associated firms of large firms. We investigate if firms circumvented the reform by creating new firms or expanding existing firms that were originally part of the same holding group. We do this by merging to our data additional variables from a different data set, SCIE. This firm-level, yearly data set is compiled by Statistics Portugal (INE), including accounting and financial information on all firms in Portugal, and can be merged to QP through common firm identifiers. Specifically, we consider a variable in this data set indicating the 'gains and losses from subsidiaries and associated firms and joint activities' in 2010. While this variable does not indicate the number of such subsidiary firms or their number of employees, it provides information on the potential relevance of such affiliated firms. We then estimate similar regression discontinuity models as those used in our main specification, considering different transformations of this novel variable.

Figure B.3.2 presents our results, considering the extensive and intensive margins. In the first case, we take as our dependent variable a dummy variable equal to one if the SCIE variable above is different from zero. This will be a sufficient condition to indicate that the firm has at least one subsidiary or associated firm or joint activity. Our results indicate that the 750-employee threshold has no effect on non-zero subsidiary gains and losses. Similarly, when considering different extensive margins (ratios of such earnings/losses by different measures of the main firm financial results - net profits, gross operating surplus, and gross added value) we again find statistically insignificant results. In conclusion, our evidence does not support an alternative potential explanation that larger firms circumvented the new restriction in the usage of fixed-term contracts by expanding their affiliates instead of creating new establishments. If anything, our results suggest that this channel may also have been negatively affected by the reform. This result is in line with the view that large firms typically expand their businesses using their own brands.

Figure B.3.2: **RD estimates: Potential effects on subsidiaries**



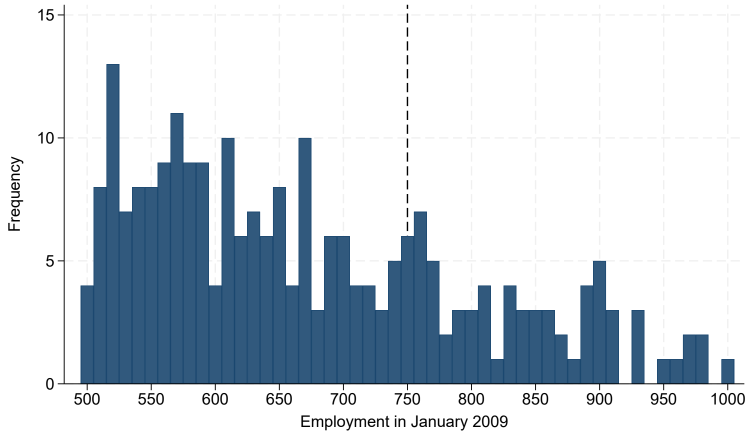
Notes: This figure reports regression discontinuity estimates and 95% confidence intervals for α_1 in Equation 18. The vertical axis lists four firm-level outcomes: (i) value added in subsidiaries, (ii) operating surplus in subsidiaries, (iii) net profits in subsidiaries, and (iv) receiving any income from subsidiaries. The figure reports results across three sets of specifications. The blue squares are estimates from our benchmark specification, described in Section 4.4.1. The orange triangles exclude firms with size between 730 and 770 employees. The green circles use a fixed bandwidth from 600 to 1200 employees instead of the optimal one. Percent changes relative to the baseline mean are printed for each variable. Variables are normalized by their standard deviation. Calculations are based on Quadros de Pessoal data.

B.4 Additional falsification tests

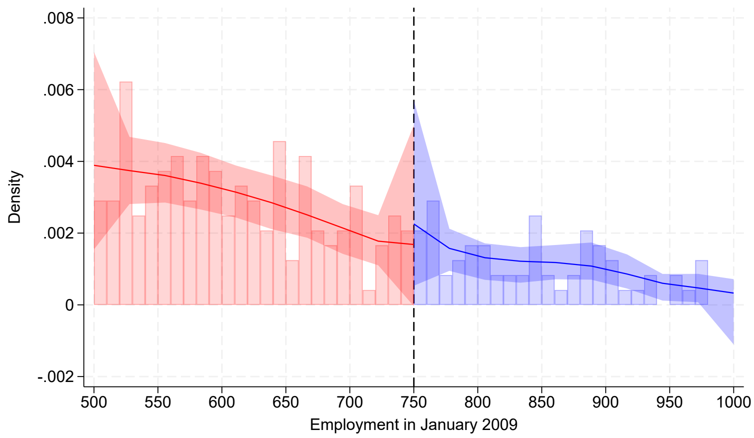
This section presents the pre-reform distribution of firm size in January 2009 and the comparison of observable characteristics of treated units and control units.

Figure B.4.1: **Distribution of January 2009 firm sizes and manipulation test plot**

(a) Distribution

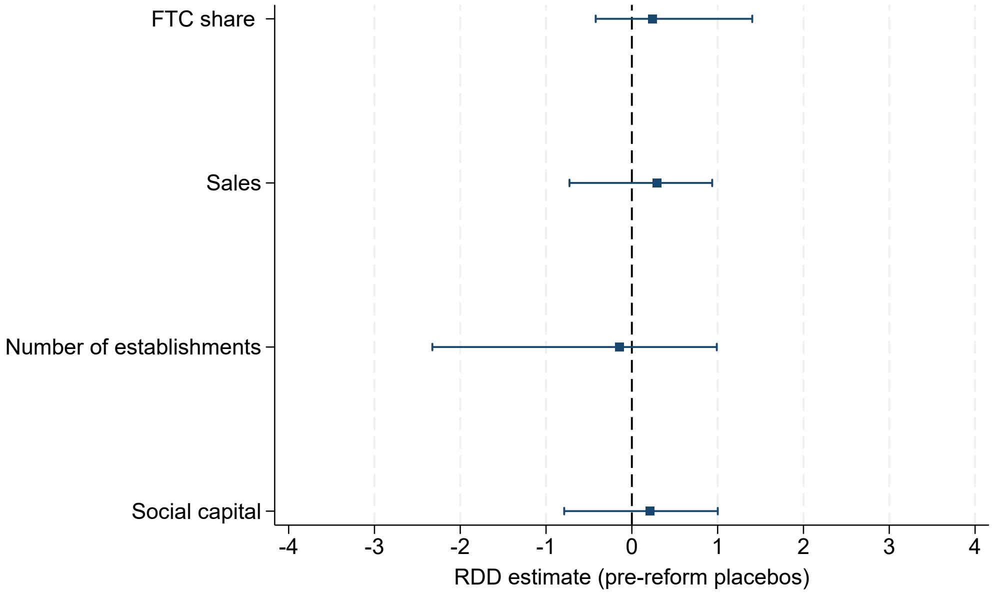


(b) Manipulation test



Notes: Firm size is measured by the total number of employees of each firm in January 2009. Panel (a) presents the distribution The bottom panel displays a manipulation test plot based on density discontinuity using local-polynomial density estimators as outlined in Cattaneo et al. (2018). Both figures' histograms are constructed with a 10 employees width. When performing the manipulation test using the *rddensity* command from Cattaneo et al. (2018), with default options (local quadratic approximation and local cubic approximation to construct the bias-corrected density estimators), the p-value associated with the null hypothesis of continuity in the density at the 750-employee cutoff is 0.72. Further investigation with alternative polynomial approximations, density estimation methods, kernels, and variance estimators yields consistent results. Further RD falsification tests presented in Figure B.4.2 show that treated units are similar to control units in terms of observable characteristics around the 750 cutoff before the reform. Own calculations based on the Quadros de Pessoal dataset.

Figure B.4.2: **RD falsification tests in 2008 (pre-reform): additional outcomes**

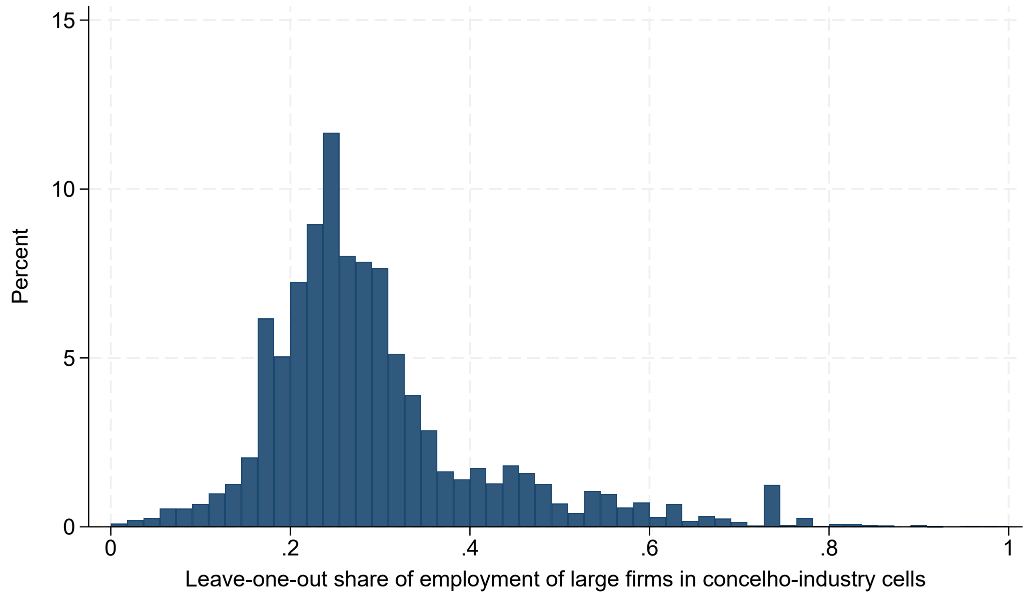


Notes: This figure reports regression discontinuity estimates and 95% confidence intervals for α_1 in Equation 18. All outcomes are measured in 2008, before the reform. The outcomes are the share of fixed-term contracts, sales, the number of establishments, and social capital in 2008. Dependent variables are divided by their standard deviation. The blue squares are estimates from our benchmark specification, described in Section 4.4.1. Calculations are based on 'Quadros de Pessoal' data.

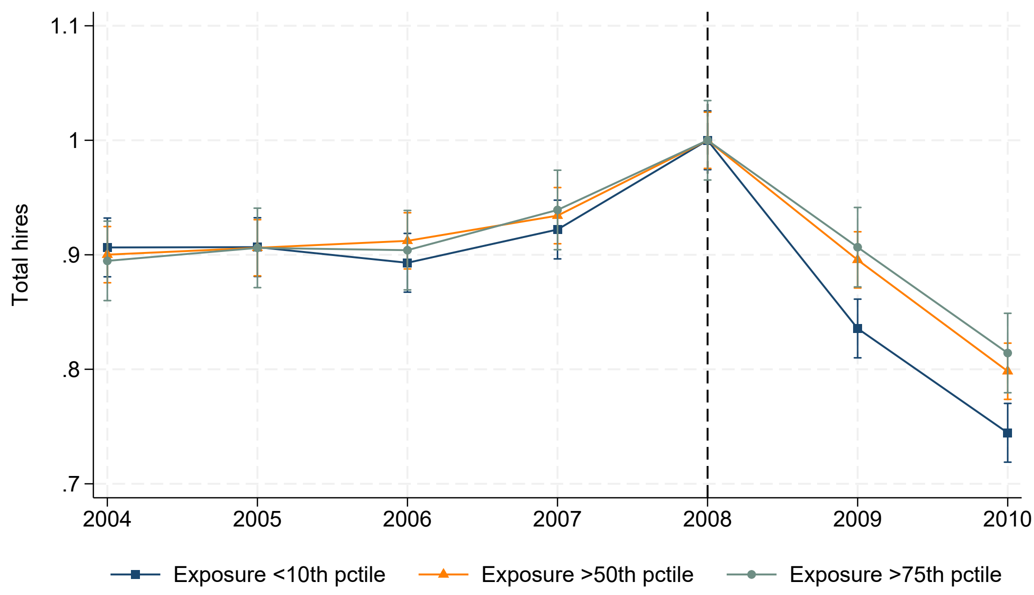
C Empirical appendix: Analysis of indirect effects

Figure C.0.1: **Exposure of small-firm establishments to large firms**

(a) Distribution of the exposure of small-firm establishments to large firms



(b) Raw average total hires

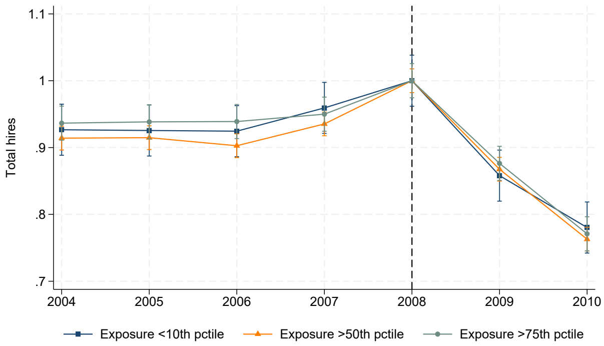


Notes: The sample consists of establishments belonging to firms with fewer than 750 employees, which were not directly targeted by the reform. Exposure is measured by the leave-one-out share of local labor-market employment accounted for by establishments belonging to firms with at least 750 employees, computed annually and averaged over 2002–2008, before the reform. Local labor markets are defined by the interaction of concelho and one-digit industry. Panel (a) displays the distribution of this exposure measure across small-firm establishments. Panel (b) reports raw group averages of total new hires for establishments with exposure in the bottom decile, above the median, and above the 75th percentile. For year t, hires are measured between March of year $t-1$ and October of year t, and each hire is weighted by the number of months of the associated employment spell. Within each exposure group, the outcome is divided by its 2008 mean. Calculations are based on *Quadros de Pessoal* data.

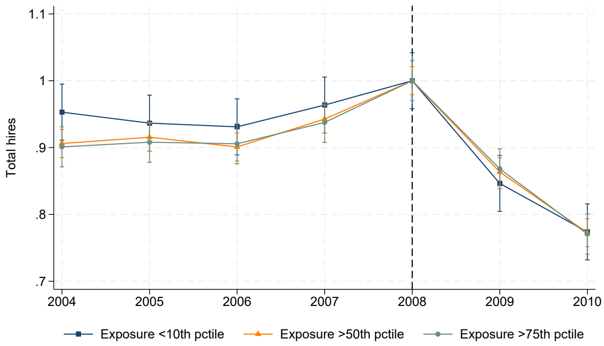
Figure C.0.2: **Placebo analysis: Hires of small-firm establishments depending on their exposure to large firms**

i. Raw averages

(a) Cutoff = 200

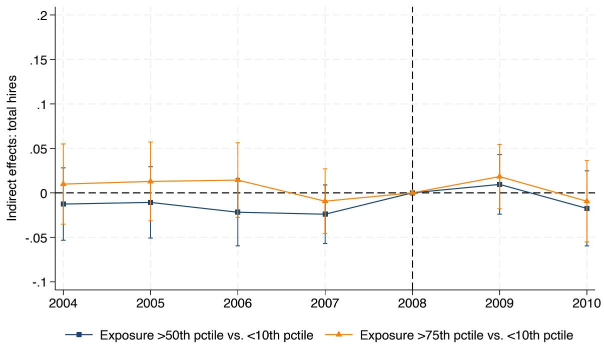


(b) Cutoff = 400

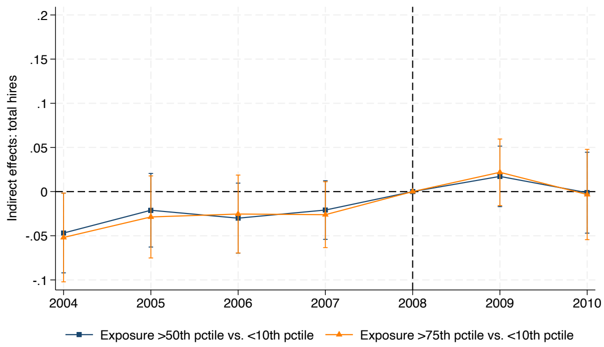


ii. DiD estimates

(c) Cutoff = 200

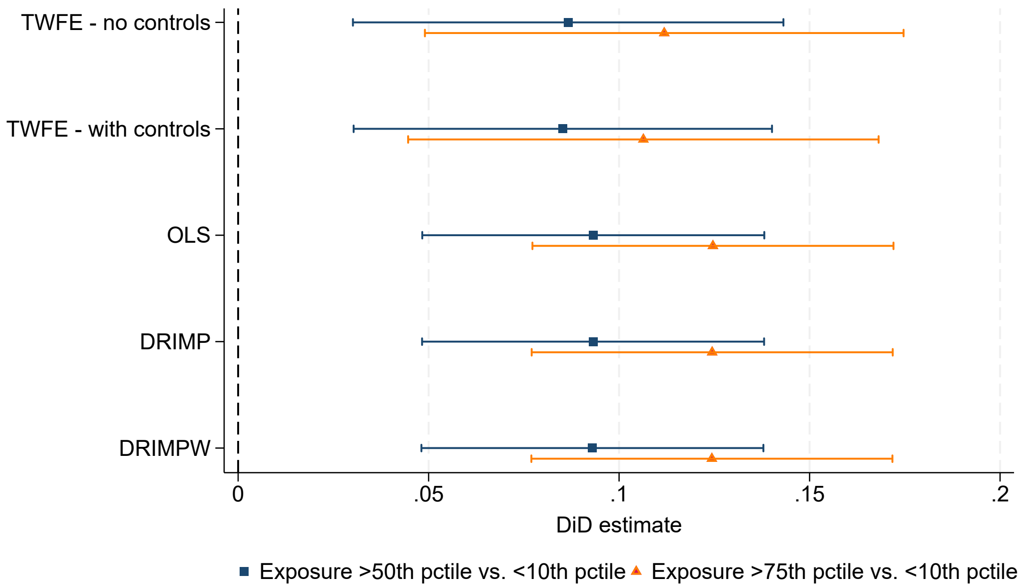


(d) Cutoff = 400



Notes: This figure reports estimates of β_k in Equation (19). The outcome is the total number of hires in establishments belonging to firms with fewer than 750 employees, which were not directly targeted by the reform. For year t, hires are measured between March of year $t-1$ and October of year t, and each hire is weighted by the number of months of the associated employment spell. In particular, the 2010 outcome covers hires occurring between March 2009 and October 2010. The outcome is divided by its 2008 mean within the corresponding exposure group. Exposure is measured by the leave-one-out share of local labor-market employment accounted for by establishments belonging to firms with at least 750 employees, computed annually and averaged over 2002–2008, before the reform. Local labor markets are defined by the interaction of concelho and one-digit industry. The squares compare establishments with exposure above the median to those with exposure in the bottom decile. The triangles compare establishments with exposure above the 75th percentile to those with exposure in the bottom decile. The vertical bars report 95% confidence intervals. Standard errors are clustered at the establishment level. Calculations are based on *Quadros de Pessoal* data.

Figure C.0.3: **DiD estimates of indirect effects with covariates**



Notes: The dependent variable is the total number of hires in establishments belonging to firms with fewer than 750 employees. The figure plots the β_k coefficient from equation (19), with and without interactions between district and year fixed effects and the doubly robust difference-in-differences estimators of Sant'Anna & Zhao (2020). To obtain the doubly robust difference-in-differences estimators the variables were averaged before and after the reform to construct a two-period model. The covariates include indicators for 30 districts. TWFE refers to the estimate of the β coefficient using the two-way fixed effects model. OLS is the outcome regression DiD estimator based on ordinary least squares. DRIMP is the improved doubly robust DiD estimator based on inverse probability tilting and weighted least squares. DRIMPW is the doubly robust DiD estimator based on stabilized inverse probability weighting and ordinary least squares. The vertical bars represent 95% confidence intervals, and standard errors are clustered at the establishment level. Calculations are based on Quadros de Pessoal data.

Table C.0.1: **Estimates of indirect effects on small-firm establishments.**

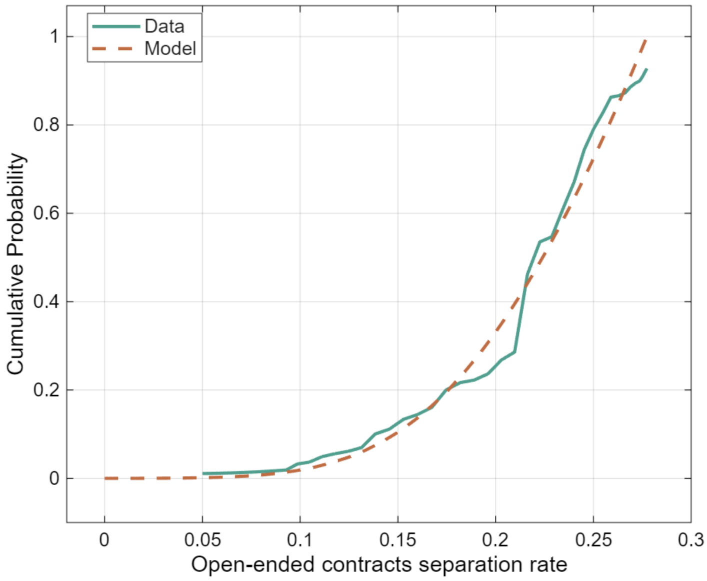
	(1) Exposure: >50th pctile	(2) Exposure: >75th pctile
Exposure × Year		
2004	-0.006	-0.012
	(0.018)	(0.022)
2005	-0.001	-0.001
	(0.017)	(0.020)
2006	0.019	0.011
	(0.016)	(0.019)
2007	0.012	0.017
	(0.013)	(0.017)
2009	0.060***	0.071***
	(0.013)	(0.017)
2010	0.054***	0.070***
	(0.018)	(0.022)
F-test p-value	0.263	0.482
N	1,044,904	752,717

Notes: The table reports estimates of β_k coefficients from Equation (19). The outcome is the number of new hires in establishments belonging to firms with fewer than 750 employees, which are not directly targeted by the reform. The outcome is divided by the mean value of the corresponding group in 2008. The estimates compare the evolution of hires in these establishments across markets with high versus low exposure to large firms. Exposure is measured as the leave-one-out share of local labor market employment accounted for by establishments of large firms, averaged over the years 2002 to 2008, prior to the reform. Markets are defined by the interaction of geography and industry. Column (1) reports estimates in which high exposure is a share above the median and low exposure is a share in the bottom decile. Column (2) reports estimates in which high exposure is a share above the 75th percentile and low exposure is a share in the bottom decile. New hires are measured between March of year $t-1$ and October of year t. Standard errors, in parentheses, are clustered at the establishment level. Calculations are based on Quadros de Pessoal data.

D Estimation procedure

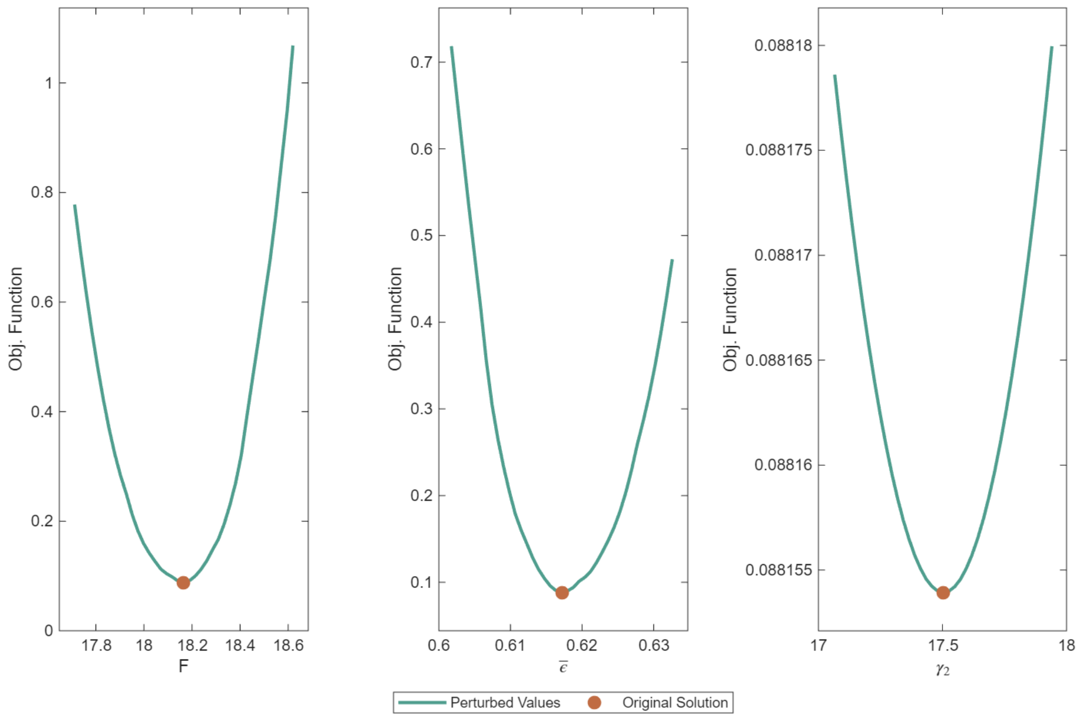
D.1 Model fit

Figure D.1.1: **Targeted moments: Distribution of permanent job separation rates**



Notes: This figure shows the distribution of the separation rates of open-ended contracts in the model and in the data. The data cover 2004-2008. In the model, the distribution is reported for estimated values of the parameters before the 2009 reform.

Figure D.1.2: **Sensitivity of distance between empirical and model moments**

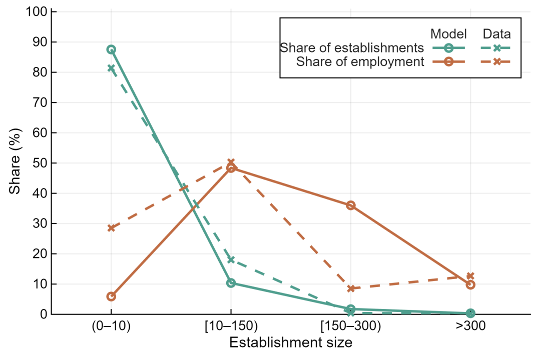


Notes: This figure depicts the distance between the empirical distribution of OEC job separation rates and the corresponding distribution in the model. Each sub-figure shows the distance in which the model distribution is computed at the estimated parameter values, except for the parameter depicted on the x-axis for which we vary the value. The orange circles indicate the estimated value for each parameter. F, $\bar{\epsilon}$ and γ_2 are estimated in Step 2 of the calibration process by minimization of this distance.

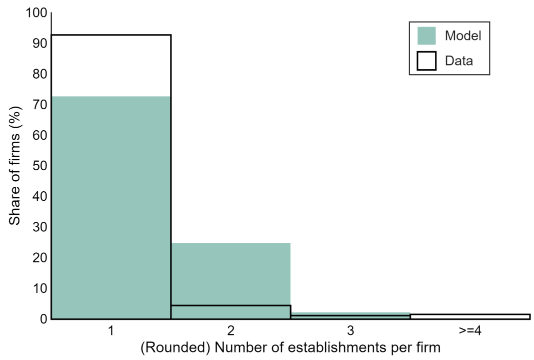
Figure D.1.3: **Untargeted moments: Firms and establishments**

(a) Firm size distribution

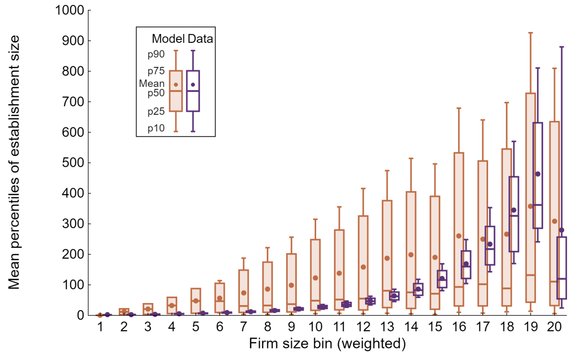
(b) Establishment size distribution



(c) Number of establishment per firm



(d) Relationship between firm size and establishment size



Notes: This figure compares four sets of moments in the estimated structural model and in the data. Panel (a) compares the firm size distribution (unweighted and weighted by employment). Panel (b) compares the establishment size distribution (unweighted and weighted by employment). Panel (c) reports the number of establishments per firm. Panel (d) depicts the establishment size distribution by ventile of firm size.

D.2 Details on the estimation of the policy parameter, π_{reform}

We provide details on the iterative procedure which uses our reduced-form estimate for the number of fixed-term hires in young establishments to calibrate the policy parameter in the model.

In practice, we iterate over candidate values of π_{reform}. For each value, we perform the following steps:

1. In the pre-reform equilibrium, we identify the firm productivity threshold a^{750}, above which firms exceed 750 employees.

2. We implement the reform, setting π_{reform} for young establishments of large firms, and solve for the new general equilibrium. We denote W_u^{reform} the new equilibrium unemployment value (and W_u the pre-reform one).

3. We compute the number of FTC hires in young establishments of a firm with productivity a^{750}, to which π_{reform} applies, in the new equilibrium (i.e., under the new value W_u^{reform}). We denote this $\mathcal{H}_{FTC}^{young}(a^{750}, \pi_{reform}, W_u^{reform})$, which corresponds to the limit from the right-hand side of the cutoff (treated firms).

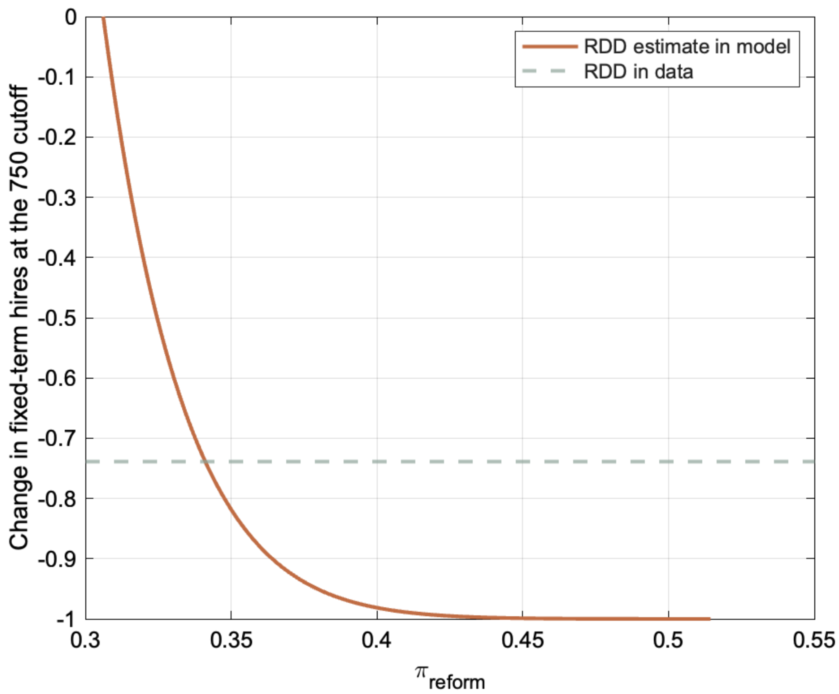
4. We compute the number of FTC hires in young establishments of a firm with productivity a^{750}, to which π_ℓ applies, also in the new equilibrium. This is denoted $\mathcal{H}_{FTC}^{young}(a^{750}, \pi_\ell, W_u^{reform})$, corresponding to the left-hand side of the cutoff (control firms).

5. We calculate the RD estimate in the model as

$$RD^{model}(\pi_{reform}) = \frac{\mathcal{H}_{FTC}^{young}(a^{750}, \pi_{reform}, W_u^{reform}) - \mathcal{H}_{FTC}^{young}(a^{750}, \pi_\ell, W_u^{reform})}{\mathcal{H}_{FTC}^{young}(a^{750}, \pi_\ell, W_u^{reform})}. \quad \text{(D.86)}$$

We iterate over steps 1–5 until we find a value of π_{reform} such that $RD^{model}(\pi_{reform}) = -73.8\%$. Appendix Figure D.2.1 shows that $RD^{model}(\pi_{reform})$ is monotonic in π_{reform}, ensuring a unique solution.

Figure D.2.1: **Calibration of π_{reform} using the RD estimate for FTCs**



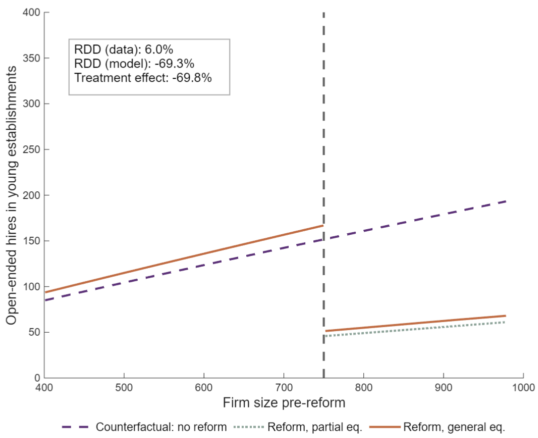
Notes: This figure shows the model equivalent of the regression discontinuity estimate for various values of π_{reform} (on the x-axis). For each potential value of π_{reform} applying to young establishments of large firms, we compute the new model equilibrium. Then, we measure the number of FTCs in young establishments of firms of size 750 (where this size cutoff is computed in the absence of the reform, as for our RD design). We then estimate the local % change in FTCs at the cutoff using Equation D.86. The dashed green line reports our estimate in the reduced form. The intersection of this line with the orange curve pins down the value of π_{reform} used to implement the reform in the model.

E Quantitative exercises

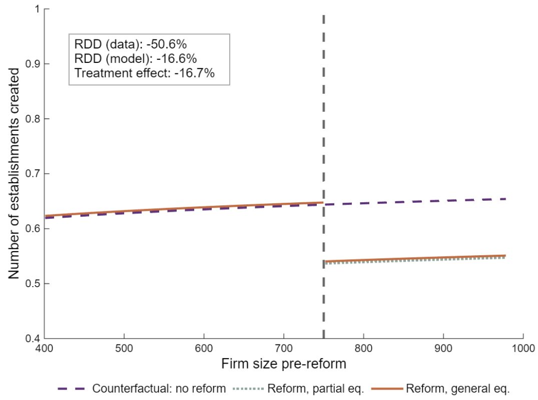
E.1 Simulated-RD: Additional outcomes

Figure E.1.1: **Regression discontinuity estimates in the model: Additional outcomes**

(a) Number of open-ended hires



(b) Number of new establishments



Notes: This figure depicts the equivalent of the regression discontinuity in our estimated structural model. We plot the number of open-ended contracts in young establishments (panel (a)) and the number of new establishments (panel (b)) as a function of firm size. Firm size is computed in the pre-reform equilibrium (i.e. the equivalent of the situation pre-2009 in Portugal), as in our main RD specification. The dashed purple line shows the outcomes before the introduction of a discontinuity in EPL at size 750. The dotted green line shows the outcomes for firms affected by the reform when π_{reform} applies but without allowing any general equilibrium adjustment (i.e. the value of W_u is the pre-reform one). In partial equilibrium, only the outcome of firms larger than 750 employees is affected. The solid orange line depicts outcomes in the post-reform general equilibrium (i.e. π_{reform} applies to large firms and W_u has adjusted). "RDD (data)" reports the percent change in the outcome from the empirical reduced form (also in Figure 3). "RDD (model)" reports the corresponding value in the model, taking the difference in outcomes at the 750 cutoff between the two sides of the orange line and dividing by the left-side value. "Treatment effect" reports the difference at the cutoff between the partial equilibrium outcome (dotted green line) and the counterfactual without the reform (dashed purple line), divided by the counterfactual.

E.2 Employment effects allowing firms to bunch at the cutoff

We now describe how we construct Estimate 5 in panel (c) of Figure 6, along with the necessary assumptions. In this specification, we allow the cutoff value for a which determines whether the reform applies to adjust endogenously. This permits some high-productivity firms to optimally choose a size of 749 in order to remain below the reform threshold and avoid its consequences. While we do not observe clear evidence of bunching in the firm size distribution in the data, such avoidance behavior may be more likely to emerge in the long run.

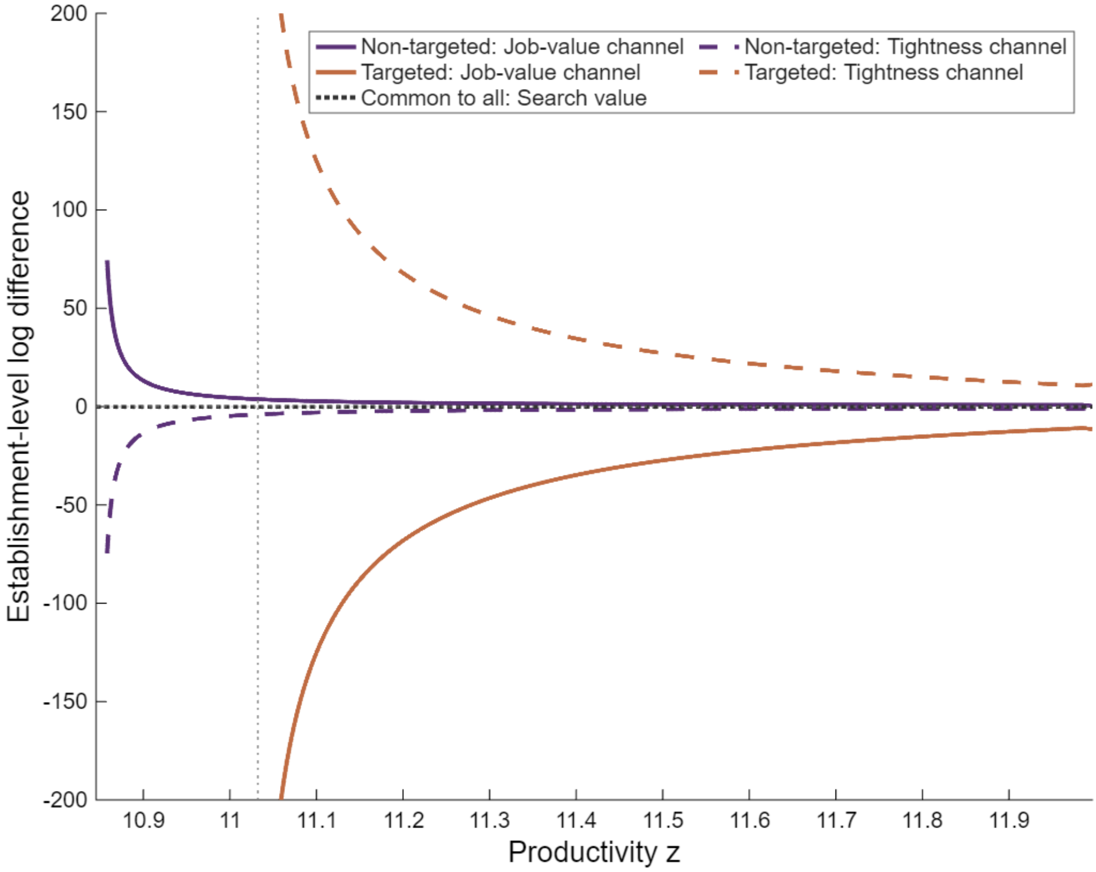
To incorporate this mechanism, we compute the support of productivity values a such that, absent the policy, firms with productivity in this range would employ more than 750 workers, but with the reform in place, optimally choose to bunch at 749 and remain untreated. We define two cutoff values to identify this support:(i) a^{750} is the least productive firm that would employ more than 750 workers *without* the reform;(ii) a^{749} is the most productive firm that would employ fewer than 750 workers *with* the reform. Therefore, $a^{750} \leq a^{749}$. Firms with productivity in the interval $[a^{750}, a^{749}]$ bunch at 749 to avoid the reform. Importantly, these two cutoffs are jointly determined in equilibrium along with the other endogenous variables. The resulting equilibrium is characterized by the following seven equations in seven unknowns:

$$
\begin{aligned}
L(a^{750}, \pi_\ell, \pi_h, \bar{z}(\pi_\ell), \bar{z}(\pi_h), W_u) &= 750 \\
L(a^{749}, \pi_{reform}, \pi_h, \bar{z}(\pi_{reform}), \bar{z}(\pi_h), W_u) &= 749 \\
\bar{z}(\pi_\ell) &= \{z|S(z, \pi_\ell) = 0\} \\
\bar{z}(\pi_h) &= \{z|S(z, \pi_h) = 0\} \\
\bar{z}(\pi_{reform}) &= \{z|S(z, \pi_{reform}) = 0\} \\
a_{min} \times \delta &= \bar{z}(\pi_\ell) \\
\mathcal{N} - \mathcal{L}(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h), \bar{z}(\pi_{reform}), a_{min}, a^{749}, a^{750}) &= U(W_u, \bar{z}(\pi_\ell), \bar{z}(\pi_h), \bar{z}(\pi_{reform}), a_{min}, a^{749})
\end{aligned}
$$

To compute total employment, $\mathcal{L}(.)$, we assign a size of 749 to all firms with productivity in $[a^{750}, a^{749}]$. By construction, those are the bunching firms. We do not need to know how this bunching is split across establishments to compute $\mathcal{L}(.)$, only that the firm size is 749 once aggregating. Calculating total unemployment, $\mathcal{U}(.)$, requires an additional assumption about how worker queues reorganize across establishments. To compute unemployment per establishment for bunching firms, $u(.)$, we assume that unemployed workers perceive the same expected utility from searching at these establishments as they would from searching at a firm of size 749 absent bunching—that is, a firm with productivity a^{750}. This assumption reflects the limited information available to job seekers: they observe firm size and job postings, but not the underlying productivity. As a result, they cannot differentiate a firm of size 749 due to bunching from a firm of size 749 not caused by reform avoidance. This additional assumption permits us to aggregate $u(.)$ across all establishments.

E.3 Decomposition of channels

Figure E.3.1: **Establishment-level decomposition of employment effects**

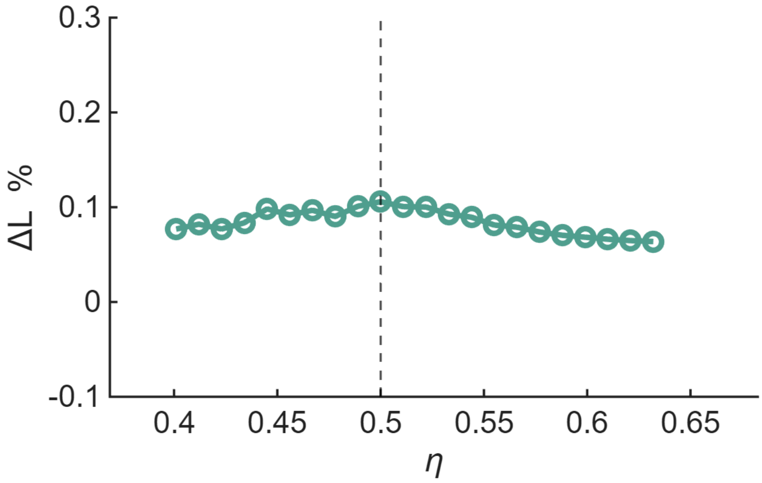


Notes: This figure reports the quantitative decomposition of Equation 14 establishment by establishment, for estimated values of the model parameters. Each curve reports a log difference between the post- and pre-reform equilibria. The solid curves display the job value channel, $\Delta \ln[W(z,\pi) - W_u]$. The dashed curves display the tightness channel, $\Delta \ln[\theta(z,\pi)\, m(z,\pi)]$. Orange is for the young establishments of firms targeted by the reform, and purple for the young establishments of firms not targeted. The horizontal dotted gray line additionally reports $\Delta \ln[(1-\beta)W_u - b]$, which is common across all submarkets. Targeted establishments are those belonging to firms with employment above 750.

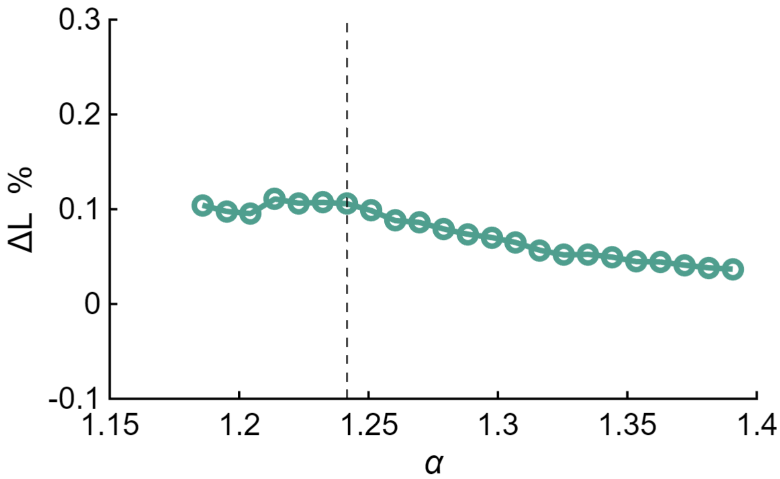
E.4 Sensitivity analysis

Figure E.4.1: **Sensitivity analysis of employment effects of the 2009 reform**

(a) Elasticity of the matching function, η



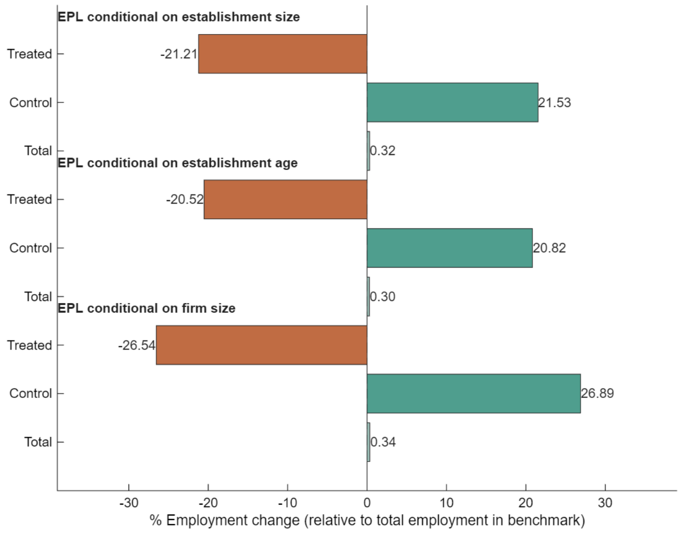
(b) Elasticities of the vacancy cost function, α



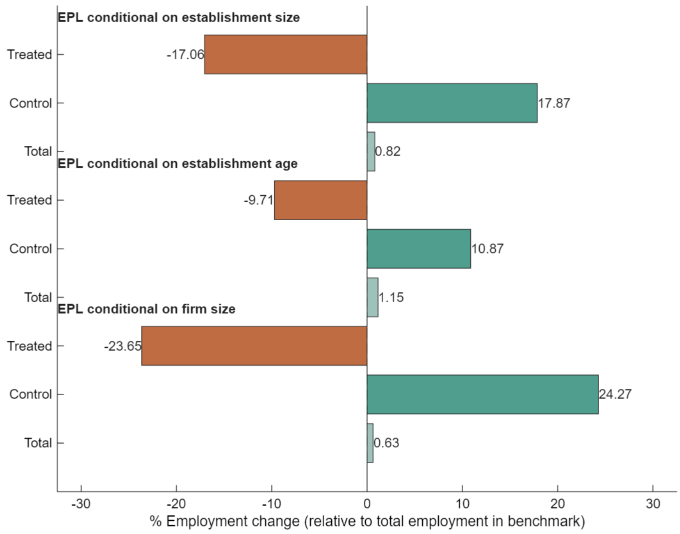
Notes: This figure shows the employment effect of the reform in the model, computed as the percent change in aggregate employment post- versus pre-reform, for alternative parameter values. The dashed vertical line indicates the baseline value of the parameter and the corresponding baseline employment effect, as reported in Figure 6. Panel (a) reports the employment effect of the reform across different values of the elasticity of the matching function, η, for increments around the baseline value of $\eta = 0.5$, holding all other parameters at their baseline values, as reported in Table 1. Panel (b) reports the employment effect of the reform across different values of the elasticity of the vacancy cost function, α, for increments around the baseline value of $\alpha = 1.2417$, holding all other parameters at their baseline values.

E.5 Counterfactuals: EPL reforms by size or age

Figure E.5.1: **Changes in π and in F by characteristics**



(a) Increase in π for targeted units



(b) Increase in F for targeted units

Notes: This figure reports the employment changes in response to different EPL reforms. We vary the definition of targeted units and consider three versions: targeted units are (i) large establishments, (ii) old establishments, and (iii) large firms. In all counterfactuals, cutoffs are set so that 40% of pre-reform employment is targeted. In panel (a), we consider a restriction on the use of fixed-term contracts and implement π_{reform} for all targeted units. In panel (b), we consider an increase in firing costs for open-ended contracts in targeted units. The proportional increase in F equals that in π, i.e., 11% for targeted units. The numbers report the change in employment by group and in total, as a fraction of pre-reform total employment. In the benchmark pre-reform equilibrium, π and F are common to all units.

F Appendix: Labor market regulations related to firm and establishment characteristics

Table F.0.1: **Employment protection legislation by firm or establishment characteristics across OECD countries**

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Australia	–	Employees of small businesses (<15) cannot claim unfair dismissal in first 12 months; collective dismissal: 15+ workers.	–	–	–	–
Austria	–	–	–	<20 employees exempt from collective dismissals. <5 employees: no works council required.	–	–
Belgium	–	–	–	<20 employees exempt from collective dismissals	–	–
Canada	–	Collective dismissal varies by province (e.g., 50+ employees in 4 weeks federally; 10+ in Quebec over 2 months)	–	–	–	–
Chile	–	–	–	–	TWA workers can be used for new businesses	–
Colombia	–	–	–	<10 employees exempt from collective dismissals	–	–
Costa Rica	-	-	-	-	-	-
Czech Republic	-	-	-	<20 employees exempt from collective dismissals	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Denmark	-	-	-	Firms with ≤20 employees are exempt from requirements for collective dismissals. Additional delays in cases of collective dismissal: negotiations with unions before informing the Regional Labour Market Council (at least 21 days in firms >100 workers or that seek to dismiss over half of staff)	-	-
Estonia	-	-	-	-	-	-
Finland	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
France	-	-	-	Firms with <50 employees face milder requirements for collective dismissals. Delay between negotiation meetings vary by firm size: firm size >50, delay between two meetings cannot be longer than 2 weeks. Firm size <50 not specified	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Germany	-	General dismissal protection generally applies only above 10 employees. Collective-dismissal requirements apply only above 20 employees.	-	Firms< 20 employees exempt from requirements for collective dismissals.	Fixed-term contracts without specifying an objective reason are possible up to 2 years or up to 4 years if an employer launches a new business.	
Greece	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
Hungary	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
Iceland	-	-	-	Firms with less than 20 employees are exempt from requirements for collective dismissals	-	-
Ireland	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
Israel	-	-	-	-	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Italy	-	-	-	Firms with <15 employees are exempt from requirements for collective dismissals. Employees in firms ≤15, hired since 7 Mar 2015, may receive up to 6 months' pay for unlawful dismissal.	-	-
Japan	-	-	-	-	-	-
South Korea	-	Workplaces ≤ 4 are exempted from dismissals' provisions except for prior notice or notice allowance.	-	-	-	-
Latvia	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
Lithuania	-	Workplaces with average number of employees <20 are exempt from requirements for collective dismissals	-	-	-	-
Luxembourg	-	-	-	In firms ≥150, dismissals require notifying worker representatives and an interview; works councils are mandatory in firms ≥150 in the last 3 years.	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Mexico	-	-	-	-	-	-
Netherlands	-	-	-	Until 2020 small firms (<25 employees) were – under certain conditions - allowed to pay a lower transition allowance in case they are forced to dismiss for financial reasons	-	-
New Zealand	-	-	-	-	-	-
Norway	-	-	-	-	-	-
Poland	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-
Portugal	A fixed term contract may also be signed for the launch of a new activity of an undefined duration, as well as the start-up of a company or establishment belonging to a company<750 workers	-	-	-	A fixed term contract may also be signed for the launch of a new activity of an undefined duration, as well as the start-up of a company or establishment belonging to a company<750 workers	-
Slovak Republic	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Slovenia	-	-	Employment contracts may be concluded for fixed terms when this involves cases provided by a sector-level collective agreement for small employers (≤ 10 employees).	Firms with <20 employees are exempt from requirements for collective dismissals. Shorter notice periods are allowed for small employers (≤10 employees) by collective agreement. TWA employment cannot exceed 25% of employment at the user firm, except if a collective agreement establishes otherwise.	-	-
Spain	-	-	-	For firms < 25 employees, FOGASA covers 8 days' pay for valid dismissals but not for unfair ones; trial periods can last up to three months, while larger firms (≥ 25 employees) bear full severance costs.	-	-
Sweden	-	-	-	-	-	-

Country	Establishment size		Firm size		Establishment age	
	FTC	*OEC*	*FTC*	*OEC*	*FTC*	*OEC*
Switzerland	-	-	-	Firms with <20 employees are exempt from requirements for collective dismissals. Obligation to negotiate a social plan for firms with more than 250 employees.	-	-
Turkey	–	–	–	Firms <20 employees are exempt from requirements for collective dismissals. Only employees in firms with 30+ employees and 6+ months' tenure have unfair dismissal protections; smaller firms (<30 employees) owe limited compensation but no reinstatement.	–	–
United Kingdom	-	-	-	-	-	-
United States	-	-	-	Firms with less than 100 employees are exempt from requirements for collective dismissals.	-	-

Notes: The table displays employment protection legislation (EPL) across OECD countries in terms of establishment size, firm size, and establishment age, respectively. For each of those dimensions, the table presents the according regulation applied upon workers under fixed-term contracts (FTC) and open-ended contracts (OEC). Source: OECD Indicators of Employment Protection, 2019.