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## Product market regulation, firm selection and unemployment

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## Product Market Regulation, Firm Selection and Unemployment

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# Product Market Regulation, Firm Selection and Unemployment

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## ABSTRACT

### Product Market Regulation, Firm Selection and Unemployment<sup>\*</sup>

This paper analyzes the effect of Product Market Regulation (PMR) on unemployment in a search model with heterogeneous multiple-worker firms. In our setup, PMR modifies the distribution of firm productivities, thereby affecting the equilibrium rate of unemployment. We distinguish between PMR related to entry costs and PMR that generates recurrent fixed costs. We find that: (i) higher entry costs raise the rate of unemployment mainly through our novel *selection effect*, (ii) higher fixed costs lower unemployment through the *selection effect* and increase it through the *competition effect* analyzed in Blanchard and Giavazzi (2003). We propose econometric evidence consistent with the unemployment effects of sunk versus recurring costs.

JEL Classification: E24, J63, L16, O00

Keywords: product market regulation, unemployment, search model, firms heterogeneity

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# 1 Introduction

The poor performance of European labor markets is often related to institutional features that deter job creation. Extensive empirical research has tried to identify which institutions matter. Whereas early studies have emphasized labor market flexibility, empirical research have failed to establish a robust link between the time behavior of unemployment rates and changes in labor market regulation. This is why attention has increasingly shifted to Product Market Regulation (henceforth PMR) as an alternative source of institutional inefficiencies.<sup>1</sup>

Cross-country studies document a robust and significantly positive relationship between PMR and unemployment.<sup>2</sup> That evidence corroborates theoretical work by Blanchard and Giavazzi (2003). Their analysis uncovers the negative *competition effect* of PMR on employment. Since regulatory barriers to entry increase the market power of incumbent firms, they find it optimal to restrict output. This depresses labor demand and thus raises the equilibrium rate of unemployment.

We describe in this paper a new channel through which PMR matters for unemployment. Our analysis builds on the extensive empirical literature documenting the existence of significant and persistent productivity differences across firms.<sup>3</sup> When firms are heterogenous, PMR modifies the support of the productivity distribution and consequently the average productivity level in the economy. We show that the equilibrium rate of unemployment is affected by this novel *selection effect* because more efficient firms can afford higher recruitment costs. Accordingly, they post more vacancies so that unemployment is a negative function of the average efficiency of producers. Whether PMR increases or decreases unemployment through this selection effect depends on whether regulations shelter unproductive firms from competition or weed them out. This, in turn, depends on the nature of PMR. When regulations raise the barriers to entry, the higher cost of entering the market must be compensated by a greater likelihood of surviving the innovation stage. Hence, in equilibrium, less productive firms remain in operation so that average productivity and employment fall. In contrast, when regulatory costs add to recurring fixed costs of production, unproductive firms are hurt most and may be forced to exit. Hence, average productivity and employment rise.

In order to analyze this mechanism, we propose a dynamic equilibrium model with monop-

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<sup>1</sup>Blanchard (2005) discusses the recent history of ideas about the determinants of unemployment.

<sup>2</sup>See Bassanini and Duval (2006) for an extensive survey.

<sup>3</sup>See, for example, Olley and Pakes (1996), Cabral and Mata (2003), and in the context of international trade, Del Gatto *et al.* (2006).

olistic competition in the goods market and search frictions in the labor market. Since the competition effect is well understood in the literature and does not depend on firm heterogeneity, we achieve maximum transparency on the novel elements by closing the interactions between market power and firm entry. As in the standard Mortensen-Pissarides framework, search frictions are captured by an aggregate matching function and wages are set through pairwise negotiation between the firm and its employees. An additional complication of the model is due to the fact that firms enjoy market power. In other words, marginal revenues are decreasing in the number of employees. Bertola and Caballero (1994), Stole and Zwiebel (1996a, 1996b), and more recently, Wolinsky (2000) have shown that individual bargaining generates an *over-employment effect* whereby monopolistic firms hire workers above the level at which employment costs equal marginal revenues. Given that this mechanism greatly complicates the analysis in a stochastic environment, we hold firm productivities constant over time.<sup>4</sup>

Our model is closely related to Ebell and Haefke (2006) who introduce monopolistic competition into a dynamic search model of unemployment with individual bargaining. They, however, do not allow for firm heterogeneity. We embed their approach into Melitz's (2003) model of industry equilibrium with heterogeneous firms. While Melitz considers an open economy without allowing for unemployment, we abstract from international trade and focus on labor market outcomes.<sup>5</sup> The structure of the equilibrium turns out to be recursive and can be described by the graphical tools familiar from the Pissarides (2000) textbook treatment.

As in Melitz (2003), the entry process of firms is a simplified version of Hopenhayn (1992). Firms are ex-ante identical but differ ex-post with respect to their productivity. The timing of the model is such that firms learn about their productivity only after developing a new variety. They first have to decide whether or not to sink the costs required for inventing a variety. Then, once uncertainty is resolved, they decide whether or not to engage in production. Accordingly, two types of costs are important: (i) sunk *entry costs* related to the introduction of new varieties,

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<sup>4</sup>See Bertola and Garibaldi (2001), Cahuc *et al.* (2004), and Koeniger and Prat (2006) for models with stochastic idiosyncratic productivities.

<sup>5</sup>Several authors discuss the role of labor market imperfections in the Melitz (2003) model. Egger and Krickemeier (2006) introduce fair wages and focus on the effect of international trade on wage inequality. In their framework, unemployment is invariant to changes in PMR. More closely related to our work is Janiak (2006) who augments the Melitz model with Pissarides-type labor market frictions. His objective is to analyze the effect of trade liberalization on unemployment. In contrast to us, Janiak assumes that aggregate productivity increases with the number of varieties. The resulting model may exhibit multiple equilibria (or none). In our set-up, existence of a unique equilibrium is ensured without additional restrictions on the elasticity of substitution between varieties.

(ii) *fixed costs* associated to the production process.

We show that these two types of PMR have opposite effects on firm selection. On the one hand, higher entry costs lower average productivity because they allow inefficient producers to stay in the market. On the other hand, higher fixed costs force less productive firms to exit the market. Then we introduce the competition effect stressed in Blanchard and Giavazzi (2003) by allowing firms' market power to depend negatively on the number of competitors. We find that the competition effect reinforces the negative selection effect of entry costs and offsets the positive selection effect of fixed costs. Parametrizing the model using US data establishes that entry costs affect unemployment mainly through the selection channel. This finding complements the work of Ebell and Haefke (2006) who show that, in a model without firm heterogeneity, changes in barriers to entry result in a quantitatively small PMR-unemployment nexus because they lead to offsetting adjustments of the competition and over-employment effects. Conversely, we find that the competition effect of fixed costs is quantitatively important since it counteracts and even dominates the opposite selection effect.

Then we use OECD data on administrative regulatory costs compiled by Conway *et al.* (2005) to empirically distinguish between sunk startup costs on the one hand, and fixed costs associated to the operation of firms on the other. We document that regulatory reforms have been more successful in reducing the latter type of costs than the former. We present some econometric evidence based on cross-country unemployment regressions. While regulatory startup costs and unemployment rates are linearly positively related, we find a concave increasing relationship with respect to red tape costs. Without offering a formal test of our model, this findings are in line with our theory.

The remainder of the paper is organized as follows. Section 2 introduces the theoretical setup, section 3 characterizes the simultaneous equilibrium on product and labor markets, section 4 calibrates the model towards U.S. data, section 5 provides some econometric cross-country evidence, and section 6 concludes.

## 2 The model

### 2.1 Setup

**Final output producers.** There is a single final consumption good,  $Y$ . Labor is the unique factor of production. It is inelastically supplied by a unit mass of worker-consumers whose

utility is assumed linear in  $Y$ . Using a continuum of intermediate inputs, a large number of firms produce the final consumption good under conditions of perfect competition.

Denoting the quantity of such an input  $q(\omega)$ , we posit the same production function as Blanchard and Giavazzi (2003)

$$Y = \left[ M^{-(1-\rho(M))} \int_{\omega \in \Omega} q(\omega)^{\rho(M)} d\omega \right]^{\frac{1}{\rho(M)}}, \quad 0 < \rho < 1, \quad (1)$$

where the measure of the set  $\Omega$  is the mass  $M$  of available intermediate inputs and  $\rho(\cdot)$  is a non-decreasing function of  $M$ . The normalization by  $M^{-(1-\rho(M))}$  ensures that an increase in the variety of intermediate inputs does not improve the efficiency of the production process. This assumption is necessary to rule out size effects which would generate a negative correlation between unemployment and the size of the economy. Since empirical evidence does not document such a relationship, size effects are not a desirable property of the model. The price index dual to (1) is

$$P = \left[ \frac{1}{M} \int_{\omega \in \Omega} p(\omega)^{-\sigma(M)} d\omega \right]^{\frac{1}{1-\sigma(M)}}, \quad (2)$$

where  $\sigma(M) \equiv 1/(1-\rho(M)) > 1$  denotes the elasticity of substitution between any two varieties of inputs, and  $p(\omega)$  is the price of input  $\omega$ .

We choose the final output good as the numéraire, so that  $P = 1$ . Given this normalization, final output producers demand intermediary inputs according to

$$q(\omega) = \frac{Y}{M} p(\omega)^{-\sigma(M)}. \quad (3)$$

**Intermediate inputs producers.** At the intermediate inputs level, a continuum of monopolistically competitive firms produce each a unique variety. Thus we may also index firms by  $\omega$ . Firms differ with respect to their labor productivity  $\varphi(\omega)$  so that the conditional labor demand of firm  $\omega$  is given by  $l(\omega) = q(\omega)/\varphi(\omega)$ . In order to produce strictly positive output quantities, firms need to incur flow fixed costs that have two components: a minimum factor input  $f_T$  which is essentially a technology parameter, and red tape costs  $f_R$  implied by administrative procedures. These costs are identical across firms and are measured in terms of the final output good. Given that both types of costs have similar economic effects, we lump them together into a single parameter  $f \equiv f_T + f_R$ . Denoting  $w(\omega)$  the wage rate of firm  $\omega$  in terms of the numéraire, total production costs of a firm are equal to:  $w(\omega)q(\omega)/\varphi(\omega) + f$ .

As usual in models of monopolistic competition, intermediate input producers take aggregate variables such as the price level  $P$  or the number of varieties  $M$  as given, thereby effectively



perceiving an iso-elastic demand schedule for their products. When  $\rho'(M) > 0$ , an increase in the number of input producers raises the equilibrium elasticity of demand and thus erodes their market power. This captures in a stylized way that competition becomes fiercer as new producers enter the market. For clarity of exposition, we initially neutralize the interactions between market power and firm entry by restricting our attention to the case where  $\rho'(M) = 0$ . This allows us to isolate the *selection effect*. We consider the general model with both selection and competition effect in section 5.2. Accordingly, we hereafter drop the dependence of  $\sigma$  on  $M$ .

**Labor market.** Search frictions impede trade in the labor market. Following the search-matching literature, we postulate that marginal recruitment costs are increasing at the aggregate level because of congestion externalities. From the point of view of the firm, however, the cost of recruiting a worker is constant. The aggregate matching function exhibits constant returns to scale so that the contact rates between firms and workers solely depend on the ratio  $\theta$  of vacancies,  $v$ , to job seekers,  $u$ . Firms post vacancies which are filled at the rate  $m(\theta)$ , and job seekers meet firms at the rate  $\theta m(\theta)$ . The vacancy filling rate  $m(\theta)$  is a decreasing function of the vacancy-unemployment ratio  $\theta$ . The cost of posting vacancies is proportional to the parameter  $c$ , so that increasing employment by  $\Delta$  entails spending  $\Delta(c/m(\theta))$  in recruitment costs. The adjustment cost function for labor is therefore linear and depends on aggregate conditions through  $m(\theta)$ .

## 2.2 Pricing behavior on product markets

Time is discrete. All payments are made at the end of the time period. Afterwards and before the beginning of the next period, firms and workers are hit by idiosyncratic shocks. In each period, a measure  $\delta$  of intermediate producers exits the market. Jobs are also destroyed because of match-specific shocks which occur with probability  $\chi$ . Under the assumption of independence between these two sources of job separation, the actual rate of job separation per period  $s = \delta + \chi - \delta\chi$ .

The market value of an intermediate inputs producer with productivity  $\varphi$  is therefore given by

$$\begin{aligned}
J(l, \varphi) &= \max_v \frac{1}{1+r} \{p(q)q - w(l, \varphi)l - f - cv + (1-\delta)J(l', \varphi)\} \\
\text{s.t. (i)} \quad p(q) &= \left(\frac{Y}{M}\right)^{\frac{1}{\sigma}} q^{-\frac{1}{\sigma}} \\
(ii) \quad q &= \varphi l \\
(iii) \quad l' &= (1-\chi)l + m(\theta)v
\end{aligned}$$

where  $r$  is the exogenous discount rate and  $l'$  is the level of employment in the next period. Constraint (i) is the demand curve faced by a generic intermediate inputs producer, (ii) is the firm production function, and (iii) gives the law of motion of employment at the firm level. Firms enjoy monopoly power in product markets. In the labor market, firms face workers locked in by search frictions and thus act as local monopsonists.

The first order condition for the optimal number of vacancies  $v$  reads

$$\frac{c}{m(\theta)} = (1-\delta) \frac{\partial J(l', \varphi)}{\partial l'}. \quad (4)$$

Quite intuitively, profit maximization implies that the firm sets the shadow value of labor equal to the recruitment cost. Substituting the constraints into the expression of the firm's asset value and differentiating with respect to  $l$  yields the shadow value of labor

$$\begin{aligned}
\frac{\partial J(l, \varphi)}{\partial l} &= \frac{1}{1+r} \left[ \left(\frac{\sigma-1}{\sigma}\right) \varphi p(l, \varphi) - w(l, \varphi) - \frac{\partial w(l, \varphi)}{\partial l} l + (1-\delta) \frac{\partial J(l', \varphi)}{\partial l} (1-\chi) \right] \\
&= \frac{1}{1+r} \left[ \left(\frac{\sigma-1}{\sigma}\right) \varphi p(l, \varphi) - w(l, \varphi) - \frac{\partial w(l, \varphi)}{\partial l} l + \frac{c}{m(\theta)} (1-\chi) \right]. \quad (5)
\end{aligned}$$

The second equality follows from the optimality condition (4). The first term in the square brackets corresponds to marginal revenues, the second and third terms give the marginal costs of expanding the labor force while the fourth term is the steady-state recruiting cost. The cost of the marginal worker differs from the wage since the firm takes into account the effect of additional employment on the wage of previously employed (inframarginal) workers. As explained in Bertola and Caballero (1994) and Stole and Zwiebel (1996a; 1996b), this leads to “over-employment” relative to the benchmark case where the firm takes the wage as given.

The optimality condition (4) is satisfied for a unique level of employment because it does not directly depend on the level of the control variable  $v$ . Thus the size of continuing firms remains constant through time, so that  $l = l'$  in (5). Accordingly, we can replace the first order condition

(4) on the left-hand side of (5) to obtain the following pricing rule

$$p(l, \varphi) = \frac{1}{\varphi} \left( \frac{\sigma}{\sigma - 1} \right) \left[ w(l, \varphi) + \frac{\partial w(l, \varphi)}{\partial l} l + \frac{c}{m(\theta)} \left( \frac{r + s}{1 - \delta} \right) \right]. \quad (6)$$

Without search frictions and local monopsony power on the labor market, the optimal price would just be the markup,  $\sigma/(1 - \sigma)$ , times marginal costs,  $w/\varphi$ . In the present case, marginal costs are modified to account for the *over-employment effect* and recruitment costs.

### 2.3 Wage bargaining

Let  $E(\varphi)$  and  $U$  denote the asset values of a worker employed at a firm with productivity  $\varphi$  and of an unemployed worker, respectively. The advantage of holding a job over unemployment is equal to the difference between the wage and the opportunity cost of employment  $rU$ . The surplus from being employed by a firm with productivity  $\varphi$  is therefore equal to

$$E(\varphi) - U = \frac{w(l, \varphi) - rU}{r + s}. \quad (7)$$

Before production takes place, employees and the firm can engage in an arbitrary number of pairwise negotiations. Wage contracts are unenforceable: the firm may fire any employee and symmetrically any employee may decide to quit. In other words, prior to production, individual negotiations over wage contracts can be re-opened by any worker or the firm. Stole and Zwiebel (1996a) formally characterize the *stable* division of production into wages and profits such that renegotiating does not improve neither the firm's nor the workers' pay-offs. They show that the stable profile can be derived as the unique subgame perfect equilibrium of an extensive form game where the firm and workers play the alternating-offer bargaining game of Binmore *et al.* (1986) *within* each bargaining session.<sup>6</sup> We consider the continuous limit of the stable profile. It is characterized by the following Nash-bargaining condition

$$(1 - \beta)(E(\varphi) - U) = \beta \left( \frac{\partial J(l, \varphi)}{\partial l} - V \right), \quad (8)$$

where  $V$  is the value of an unfilled vacancy and  $\beta \in [0, 1]$  is the bargaining power of the worker.<sup>7</sup> In equilibrium, there are no arbitrage opportunities and so firms post vacancies until  $V = 0$ . Individual bargaining implies that each employee is treated as the marginal worker. This is why

<sup>6</sup>Stole and Zwiebel (1996a) also establish that the stable outcome can be characterized by the Shapley value of a corresponding cooperative game. This interpretation is the one favored by Acemoglu and Hawkins (2006).

<sup>7</sup>One can endogenize the bargaining power by explicitly modeling the bargaining game. For instance, in Binmore *et al.* (1986),  $\beta$  is equal to the ratio of the firm's and worker's discount factors.

the value of the job for the firm is equal to the shadow value of labor. Given that the level of employment of a given firm remains constant through time, the first line of (5) is equivalent to

$$\frac{\partial J(l, \varphi)}{\partial l} = \left( \frac{1}{r+s} \right) \left[ \left( \frac{\sigma-1}{\sigma} \right) \varphi p(l, \varphi) - w(l, \varphi) - \frac{\partial w(l, \varphi)}{\partial l} l \right],$$

Reinserting this expression together with (7) into (8) yields

$$\begin{aligned} w(l, \varphi) &= \beta \left( \frac{\sigma-1}{\sigma} \right) \varphi p(l, \varphi) + (1-\beta)rU - \beta \frac{\partial w(l, \varphi)}{\partial l} l \\ &= \beta \left[ \left( \frac{\sigma-1}{\sigma} \right) \varphi \left( \frac{Y}{M} \right)^{\frac{1}{\sigma}} (\varphi l)^{-\frac{1}{\sigma}} - \frac{\partial w(l, \varphi)}{\partial l} l \right] + (1-\beta)rU. \end{aligned} \quad (9)$$

The wage rate is a weighted average of the workers' outside option  $rU$  and of the marginal revenue of employing an additional worker, where respective bargaining shares are used as weighting factors. Equation (9) is a linear differential equation in  $l$ . One can verify by direct substitution that its solution reads<sup>8</sup>

$$w(l, \varphi) = (1-\beta)rU + \beta \varphi p(l, \varphi) \left( \frac{\sigma-1}{\sigma-\beta} \right). \quad (10)$$

This equation is the counterpart of the *Wage Curve* in the standard search-matching model. In order to derive the counterpart of the *Job Creation* condition, we reinsert the demand function (3) into (10) and differentiate the resulting equation with respect to  $l$ , which yields

$$\frac{\partial w(l, \varphi)}{\partial l} l = -\frac{1}{\sigma} \left[ \beta \varphi p(l, \varphi) \left( \frac{\sigma-1}{\sigma-\beta} \right) \right].$$

This expression allows us to substitute  $(\partial w(l, \varphi) / \partial l) l$  in (6) and, after a few simplifications, to obtain

$$w(l, \varphi) = \varphi p(l, \varphi) \left( \frac{\sigma-1}{\sigma-\beta} \right) - \left( \frac{r+s}{1-\delta} \right) \frac{c}{m(\theta)}. \quad (11)$$

As in the standard search-matching model, the *Job Creation* condition states that wages are decreasing in the severity of labor market frictions. Finally, we express the *Wage Curve* as a function of  $\theta$  by replacing (10) into (11), so that

$$w(l, \varphi) = rU + \left( \frac{\beta}{1-\beta} \right) \left( \frac{r+s}{1-\delta} \right) \frac{c}{m(\theta)}. \quad (12)$$

The *Wage Curve* highlights that wages are constant across firms. This result concurs with the finding in Stole and Zwiebel (1996a) and Wolinsky (2000) according to which multiple-worker

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<sup>8</sup>See Bertola and Garibaldi (2001) or Ebell and Haefke (2006) for a detailed solution of this ODE by the method of variation of parameters. Note also the similarity of expression (10) to equation (17) in Bertola and Caballero (1994).

firms exploit their monopsony power until employees are paid their outside option. The workers' outside option is constant across firms as it depends solely on aggregate outcomes. In our set-up with search frictions, the outside option is augmented by the recruitment costs that the firm would have to pay if it were to replace the worker. Accordingly, the surplus extracted by employees is increasing in the severity of labor market frictions.

In the remainder of the paper, we make use of (12) to drop the dependence of  $w$  on  $l$  and  $\varphi$ . Let us also mention for future reference that equations (11) and (12) imply that prices are a linear function of  $\varphi$ , so that  $p(\varphi_1)\varphi_1 = p(\varphi_2)\varphi_2$ .

## 2.4 Firm entry and exit

The entry process follows Hopenhayn (1992) and comes in two stages. First, prospective entrants have to develop a new intermediate good variety. By sinking  $f_I$  units of the final output good, they acquire a new blueprint with certainty. To set up shop, firms have to pay  $f_S$  in regulatory startup costs. Since their respective roles in the model are identical, we set the total costs of entry  $f_E \equiv f_I + f_S$ . Only after firms have sunk  $f_E$ , do they discover their productivity levels. Hence, sinking  $f_E$  gives access to three things: a blueprint, a regulatory permit to start operations, and a productivity draw.

As in Melitz (2003), the firm-specific value of  $\varphi$  is constant through time and uncorrelated to the destruction rate  $\delta$ , which is identical across firms. Firms draw their productivity from a differentiable sampling distribution with c.d.f.  $G(\varphi)$  and p.d.f.  $g(\varphi)$ . For simplicity, we consider that  $g(\varphi)$  is defined over the positive real line. The distribution is known to prospective entrants. Free entry therefore requires that *expected* profits be zero. Since  $f_E$  is sunk, firms which draw a realization of  $\varphi$  too low to cover the fixed costs  $f$  do not find it optimal to start production at all. This gives a second relation, the *zero cutoff profit* (ZCP) condition, which ensures that the marginal entrant makes zero profits.

Before turning to an analysis of these conditions, we need to define the average productivity level. Let  $\mu(\varphi)$  denote the ex-post distribution of productivity among *active* firms, i.e., conditional on a productivity draw that makes entry into the market worthwhile. Let  $\varphi^*$  denote the productivity of the marginal entrant. Following Melitz (2003), we define an average productivity level  $\tilde{\varphi}$ , which has the property that the quantity  $q(\tilde{\varphi})$  is equal to average output per firm  $Y/M$ . Given the demand function (3), this choice implies  $p(\tilde{\varphi}) = P = 1$ . Using the proportionality of optimal prices to simplify the aggregate price index given in (2), we obtain an explicit expression

for the average productivity level

$$\tilde{\varphi}(\varphi^*) \equiv \left[ \int_0^{+\infty} \varphi^{\sigma-1} \mu(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}} = \left[ \frac{\int_{\varphi^*}^{+\infty} \varphi^{\sigma-1} g(\varphi) d\varphi}{1 - G(\varphi^*)} \right]^{\frac{1}{\sigma-1}}, \quad (13)$$

where the second equality follows from the definition of  $\mu(\varphi)$ . The above expression gives a mechanical link between the average productivity  $\tilde{\varphi}$  and the cutoff productivity  $\varphi^*$ . Notice that  $d\tilde{\varphi}(\varphi^*)/d\varphi^* > 0$  iff  $\tilde{\varphi} > \varphi^*$ , which always holds true. Accordingly, we hereafter leave implicit the dependence of  $\tilde{\varphi}$  on  $\varphi^*$ . We may now use the definition of  $\tilde{\varphi}$  to analyze the *zero cutoff profit* and *free entry* conditions.<sup>9</sup> Let  $\pi(\varphi)$  denote the optimal profit per period as a function of the firm's productivity, so that

$$\pi(\varphi) = p(\varphi)\varphi l(\varphi) - w l(\varphi) - \left( \frac{c}{m(\theta)} \right) \chi l(\varphi) - f = l(\varphi) \left( \tilde{\varphi} - w - \left( \frac{c}{m(\theta)} \right) \chi \right) - f, \quad (14)$$

where the second equality follows from  $p(\varphi)\varphi = p(\tilde{\varphi})\tilde{\varphi} = \tilde{\varphi}$ . By definition, the market value of firms with a productivity above  $\varphi^*$  is positive. At the margin, the cutoff productivity  $\varphi^*$  is such that

$$\frac{\pi(\varphi^*)}{r + \delta} - \frac{cl(\varphi^*)}{m(\theta)} = 0, \quad (15)$$

since  $\pi(\varphi^*)$  is the stream of operating profits and  $cl(\varphi^*)/m(\theta)$  is the firm's total recruitment costs at the time of entry into the market. Notice that, due to the linearity of the adjustment cost function, entering firms jump to their optimal levels of employment. Gradual convergence can be restored either by considering that recruitment costs are convex in the number of posted vacancies, as in Bertola and Caballero (1994), or by assuming that firms can post only one vacancy, as in Acemoglu and Hawkins (2007). These modifications greatly complicate the aggregation procedure since then the workers' outside option depends on the cross-sectional distribution of wages.<sup>10</sup> Given that this mechanism is not material to our analysis, we adopt a more parsimonious specification where, as in Melitz (2003), convergence to optimal employment is achieved within the first period of activity.

The proportionality of prices enables us to relate the operating profits of the cutoff firm  $\varphi^*$  and of the average firm  $\tilde{\varphi}$

$$\frac{\pi(\tilde{\varphi}) + f}{\pi(\varphi^*) + f} = \frac{l(\tilde{\varphi})}{l(\varphi^*)} = \left( \frac{\tilde{\varphi}}{\varphi^*} \right)^{\sigma-1}.$$

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<sup>9</sup>Note that the model features quasi rents in equilibrium as firms with  $\varphi > \varphi^*$  will make strictly positive profits. These profits are completely absorbed *in expectations* by the costs of entry paid by firms that end up with productivity levels  $\varphi < \varphi^*$ . The fundamental assumption in the background of the model is thus that of perfect financial markets.

<sup>10</sup>See Koeniger and Prat (2007) for an analysis of a model with firm entry and convex adjustment costs.

Reinserting this expression into (15) yields the *zero cutoff profit (ZCP)* condition

$$\pi(\tilde{\varphi}) = (r + \delta) \left( \frac{c}{m(\theta)} \right) l(\tilde{\varphi}) + f \left( \left( \frac{\tilde{\varphi}}{\varphi^*} \right)^{\sigma-1} - 1 \right). \quad (\text{ZCP})$$

The *free entry (FE)* condition ensures that the entry costs  $f_E$  match the expected discounted stream of profits of firms participating in the entry stage. Given that the cost of entry is paid upfront, free entry is satisfied if

$$f_E = \int_{\varphi^*}^{+\infty} \left( \frac{\pi(\varphi)}{r + \delta} - \frac{cl(\varphi)}{m(\theta)} \right) g(\varphi) d\varphi = (1 - G(\varphi^*)) \left( \frac{\pi(\tilde{\varphi})}{r + \delta} - l(\tilde{\varphi}) \left( \frac{c}{m(\theta)} \right) \right). \quad (\text{FE})$$

The FE condition yields a second relationship between average profits and  $\varphi^*$ . Average profits are weakly increasing in the cut-off productivity: with increasing  $\varphi^*$ , successful productivity draws become less likely, so that entering firms need to be compensated by higher average profits. Combining (ZCP) and (FE) we find that in equilibrium

$$\left( \frac{\tilde{\varphi}}{\varphi^*} \right)^{\sigma-1} = (r + \delta) \frac{f_E/f}{1 - G(\varphi^*)} + 1. \quad (16)$$

This condition is similar to equation (12) in Melitz (2003). In order to show that there exists a unique equilibrium cutoff productivity  $\varphi^*$  such that (FE) and (ZCP) are simultaneously satisfied, we replace  $\tilde{\varphi}$  by its definition in equation (13) to obtain

$$\left[ \int_{\varphi^*}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi \right] (\varphi^*)^{1-\sigma} + G(\varphi^*) = 1 + (r + \delta) \frac{f_E}{f}. \quad (17)$$

Differentiating the left-hand side with respect to  $\varphi^*$  shows that it is monotonically decreasing from infinity to zero for  $\varphi^* \in (0, +\infty)$ . This establishes the existence and uniqueness of  $\varphi^*$ , and consequently  $\tilde{\varphi}$ , are established. Given the expression on the right-hand side, this also implies that  $\varphi^*$  is increasing in  $f$  and decreasing in  $f_E$ .

Plotting the equilibrium in the  $\{\varphi, \pi(\tilde{\varphi}(\varphi))\}$  space proves useful in interpreting the opposite effects of entry and fixed costs. As shown in Figure 1, the (FE) curve shifts up when entry costs increase. The new equilibrium moves along the (ZCP) locus so that  $\varphi^*$  decreases. Symmetrically, higher fixed costs of production raise the (ZCP) condition. But this has an opposite effect on  $\varphi^*$  since the (ZCP) curve cuts the (FE) curve from above.<sup>11</sup> Hence, fixed costs of production increase the average productivity while entry costs decrease it. Notice that Figure 1 illustrates

<sup>11</sup>When the sampling distribution is Pareto, as in section 5, the (FE) locus is horizontal. This, however, does not modify the qualitative effects discussed in this paragraph.

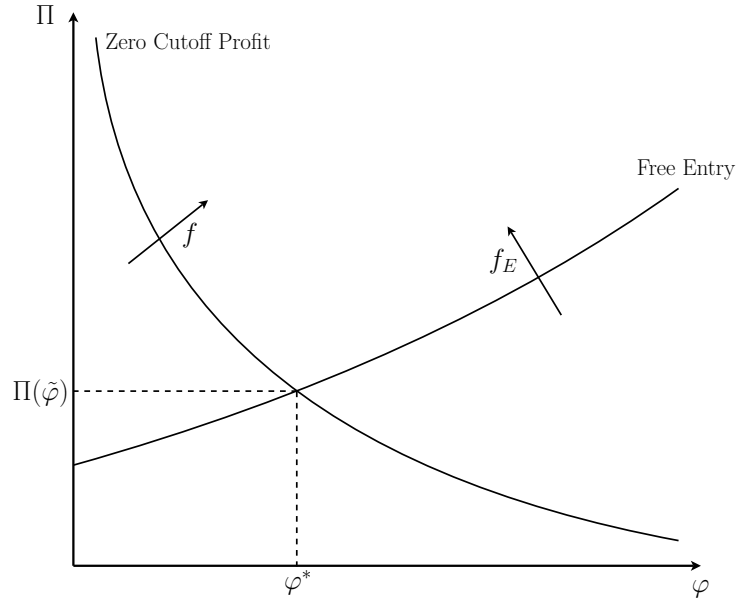


Figure 1: Equilibrium threshold productivity

the cases where the ZCP condition is monotonically decreasing from infinity to zero. This holds true when  $g(\phi)\phi/[1 - G(\phi)]$  diverges to infinity on  $(0, +\infty)$ , a condition which is satisfied by several common families of distribution.<sup>12</sup> Melitz (2003) shows, however, that the ZCP curve cuts the FE curve from above in the  $\{\varphi, \pi(\tilde{\varphi}(\varphi))\}$  plane for arbitrary family of differentiable distributions. Thus the qualitative effects discussed above are generally true.

The *selection effect* of fixed production costs is quite intuitive: fixed costs reduce profits so that firms with a low productivity are forced to exit the market. The adverse *selection effect* of entry costs arises because, for a given average level of expected profits  $\pi(\tilde{\varphi})$ , higher entry costs must be compensated by an increase in the likelihood of entering the market. The next section shows that these opposite effects on  $\tilde{\varphi}$  have unambiguous implications for the rate of unemployment: the higher the fixed costs and the lower the entry costs, the smaller is the equilibrium rate of unemployment. On the other hand, when  $\sigma'(M) > 0$ , both fixed and entry costs also shift up the (*FE*) condition through their negative equilibrium effects on the mass  $M$  of operating firms, which endows intermediate input producers with higher market power. This leads to a decrease in  $\varphi^*$  because operating firms are more profitable. Accordingly, the *competition effect* reinforces the negative *selection effect* of entry costs and offsets the positive

<sup>12</sup>See footnote 15 in Melitz (2003).



selection effect of fixed costs.<sup>13</sup>

Finally, notice that the cut-off productivity  $\varphi^*$  does not depend on the labor market tightness. This is because  $\theta$  shifts up ( $FE$ ) and ( $ZCP$ ) by the same amount, so that the equilibrium value of  $\varphi^*$  remains unchanged. The structure of the equilibrium is therefore recursive: we can solve first for the productivity threshold for given values of the product market parameters  $\{f, f_E, \sigma, r, \delta, g(\varphi)\}$  and then use the equilibrium value of  $\varphi^*$  to characterize labor market outcomes.

### 3 Equilibrium

We have the following set of equilibrium conditions. First, the definition of the average productivity given in (13) together with (17) determine  $\tilde{\varphi}$  and  $\varphi^*$  as a function of exogenous parameters only. Given  $\tilde{\varphi}$ , the wage and job creation curves displayed in (11) and (12) can be solved jointly to yield equilibrium values of the wage rate  $w$  and labor market tightness  $\theta$ . In order to express the equilibrium tightness as a function of the fundamental parameters, we decompose the asset equations for  $E$  and  $U$

$$\begin{aligned} rU &= b + \theta m(\theta) \int_{\varphi^*}^{+\infty} (E(\varphi) - U) \mu(\varphi) d\varphi, \\ rE(\varphi) &= w + s(U - E(\varphi)) , \end{aligned}$$

where  $b$  is the flow value of non market activity. Using the Nash-bargaining condition (8) together with  $(1 - \delta)(\partial J(l, \varphi)/\partial l) = c/m(\theta)$ , yields the standard expression for the opportunity cost of employment

$$rU = b + \left( \frac{\beta}{1 - \beta} \right) \frac{c\theta}{1 - \delta} .$$

Reinserting that latter expression into (11), (12) and using the normalization  $p(\varphi)\varphi = \tilde{\varphi}$  we obtain

$$\begin{aligned} W : \quad w &= b + \left( \frac{\beta}{1 - \beta} \right) \frac{c\theta}{1 - \delta} + \left( \frac{\beta}{1 - \beta} \right) \left( \frac{r+s}{1 - \delta} \right) \frac{c}{m(\theta)} \\ JC : \quad w &= \tilde{\varphi} \left( \frac{\sigma - 1}{\sigma - \beta} \right) - \left( \frac{r+s}{1 - \delta} \right) \frac{c}{m(\theta)} . \end{aligned} \tag{18}$$

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<sup>13</sup>Note that the specification of production function (1) chosen by Blanchard and Giavazzi (2003) and adopted by us rules out that aggregate productivity depends directly on the number of available inputs (such as in some endogenous growth models), since the love of variety channel has been shut off. This choice has advantages, as discussed above. It also implies that there is no intrinsic value of having more varieties. Allowing for the variety channel opens the way for a well-known (and somewhat trivial) scale effect, through which an increase in  $f$  would lower unemployment, as the number of varieties produced goes up.

The *Job Creation (JC)* condition is a decreasing function of  $\theta$  whereas the *Wage curve (W)* is increasing. Thus, if  $b < \left(\frac{\sigma-1}{\sigma-\beta}\right) \int_0^\infty \varphi dG(\varphi)$ , the model has a unique equilibrium.<sup>14</sup> Figure 2 shows how those two curves pin down the equilibrium value of  $\theta$ . Once  $\theta$  is known, the unemployment rate can be solved for via the standard Beveridge curve

$$u = \frac{s}{s + \theta m(\theta)}. \quad (19)$$

The JC curve provides a relationship between average productivity and the wage rate, thereby allowing changes in the composition of firms to affect the unemployment rate. A higher average productivity  $\tilde{\varphi}$  shifts the JC curve up and leaves the W curve unchanged.<sup>15</sup> It follows that  $\tilde{\varphi}$  raises  $\theta$  and so lowers the equilibrium rate of unemployment.<sup>16</sup>

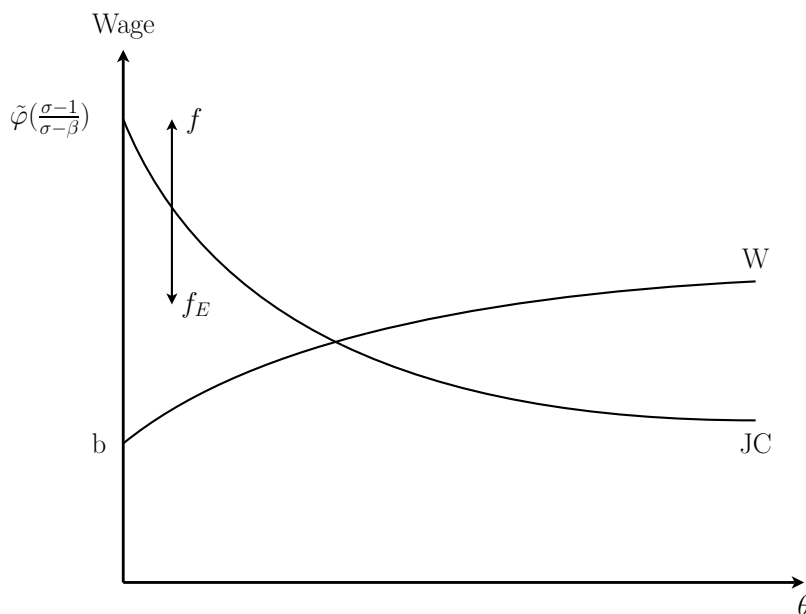


Figure 2: Equilibrium labor market tightness.

<sup>14</sup>Given that  $\tilde{\varphi} > \int_0^\infty \varphi dG(\varphi)$ , the existence condition proposed in the main text is sufficient but not necessary.

<sup>15</sup>This discussion and Figure 2 highlight that our results would hold if wages were taken as exogenous. The crucial feature is that the Wage Curve does not shift upward with  $\tilde{\varphi}$ . This would not be true if wages were perfectly indexed to the firm's idiosyncratic productivity, as in the *fair wage* model analyzed by Egger and Kreickemeier (2006).

<sup>16</sup>On the other hand, the labor share of aggregate output does not directly depend on the average productivity. To see this, multiply both sides of (JC) by  $(1 - u)$ . Recognizing that  $\tilde{\varphi}(1 - u) = Y$ , we find that the sum of wage payments equals a constant share,  $(\sigma - 1) / (\sigma - \beta)$ , of total revenues net of recruitment costs. Thus when workers have no bargaining power, the labor share is equal to the inverse of the mark-up:  $(\sigma - 1) / \sigma$ .

The negative relationship between  $\tilde{\varphi}$  and  $u$  is due to the fact that labor costs increase by less than average productivity. These costs consist of wages and recruitment costs. As explained before, the over-hiring effect implies that wages are not indexed to firms' productivities, which explains why the *Wage curve* does not shift up when  $\tilde{\varphi}$  increases. Furthermore, the recruitment costs of a given firm as compared to its revenues decrease with  $\tilde{\varphi}$  because the prices charged by intermediate inputs producers are increasing in the average productivity level.<sup>17</sup> This is why active firms post more vacancies, so that the equilibrium vacancy-unemployment ratio increases. Notice that this mechanism share similarities to the effect in the standard search-matching model of an increase in match productivity (see Pissarides, 2000, page 20). Yet, it does not lead to the same undesirable negative correlation between growth and unemployment because firm heterogeneity allows us to distinguish the average productivity from the aggregate price level.<sup>18</sup>

We close the characterization of the equilibrium by deriving the equilibrium mass of operating firms. First, we use the (*ZCP*) condition to solve for the average firm size  $l(\tilde{\varphi})$ . Reinserting the expression of firm's profits (14) into (15), we obtain

$$l(\varphi^*) \left( \tilde{\varphi} - w - (r + \delta + \chi) \frac{c}{m(\theta)} \right) = f .$$

Inserting the (*JC*) condition and recognizing that  $l(\varphi) = (\varphi/\varphi^*)^{\sigma-1} l(\varphi^*)$ , yields

$$l(\tilde{\varphi}) = \left( \frac{\tilde{\varphi}}{\varphi^*} \right)^{\sigma-1} \left( \frac{f}{\tilde{\varphi} \left( \frac{1-\beta}{\sigma-\beta} \right) + \frac{c}{m(\theta)} \frac{\delta(r+\delta)}{1-\delta}} \right) = \frac{(r + \delta) \frac{f_E}{1-G(\varphi^*)} + f}{\tilde{\varphi} \left( \frac{1-\beta}{\sigma-\beta} \right) + \frac{c}{m(\theta)} \frac{\delta(r+\delta)}{1-\delta}} . \quad (20)$$

where the second equality follows from the equilibrium condition (16). Finally, the mass of operating firms ensures that the aggregate identity  $Ml(\tilde{\varphi}) = 1 - u$  is satisfied, so that

$$M = \left( \frac{\theta m(\theta)}{s + \theta m(\theta)} \right) \left( \frac{\tilde{\varphi} \left( \frac{1-\beta}{\sigma-\beta} \right) + \frac{c}{m(\theta)} \frac{\delta(r+\delta)}{1-\delta}}{(r + \delta) \frac{f_E}{1-G(\varphi^*)} + f} \right) . \quad (21)$$

Equation (21) makes it clear that, for a given level of employment, both startup and fixed costs have negative direct effects on the mass of operating firms. Since fixed costs concurrently increase  $\theta$  and  $\tilde{\varphi}$ , their overall effect on  $M$  is a priori ambiguous. Next section, where we simulate the model, shows that these countervailing effects are of second-order for reasonable parameter values.

<sup>17</sup>To see this formally, consider the equality  $p(\varphi)\varphi = \tilde{\varphi}$ .

<sup>18</sup>In other words, to derive a balanced growth path, we do not need to assume that the cost of posting a vacancy  $c$  is proportional to the average productivity, as in the standard search-matching model. In our set-up, the natural normalization is given by the aggregate price index.

## 4 Quantitative analysis

In this section, we calibrate the model to match the statistics of interest for the U.S. economy. Then we simulate the model in order to perform comparative statics which illustrate how PMR costs associated to startup and those related to the production process affect the rate of unemployment.<sup>19</sup> The purpose of this section is to gain a sense of the magnitudes involved and to sort out ambiguities.

We generalize our theoretical setup to allow for the *competition effect* analyzed by Blanchard and Giavazzi (2003). More precisely, we extend the model by introducing a function,  $h : M \rightarrow \sigma$ , such that the elasticity of substitution  $\sigma$  increases in the number of intermediate producers. To solve the extended model, we can proceed as before. First, we fix the elasticity  $\sigma$  and compute the equilibrium mass of producers  $M$ . Given that a higher elasticity of substitution makes market entry less attractive, this yields a downward-sloping locus  $M(\sigma)$ . The equilibrium of the model is given by the point where this locus intersects the exogenous upward-sloping function  $h^{-1}(\sigma)$ . Hence the uniqueness of the equilibrium is preserved.

We first run a baseline exercise in which only the selection effect is present, and then generalize the analysis to simultaneously allow for the Blanchard-Giavazzi competition effect. Our results confirm Ebell and Haefke's (2006) finding: entry regulation only weakly affects unemployment rates through the competition effect. Rather, the relationship between entry costs and unemployment is almost entirely driven by the selection effect. In contrast, fixed costs increase unemployment only due to the competition effect which dominates the opposite selection effect.

### 4.1 Parametrization

**Productivity distribution.** We assume that firms sample their productivity from a Pareto distribution, so that

$$G(\varphi) = 1 - \left(\frac{\bar{\varphi}}{\varphi}\right)^\gamma .$$

The shape parameter  $\gamma > 0$  measures the rate of decay of the sampling distribution and  $\bar{\varphi} > 0$  is the minimum possible value of  $\varphi$ . This parametric assumption is standard in the literature on heterogeneous firms (see Axtell (2001), and Helpman *et al.* (2004)). It is justified by the observation that the log-density of firms' log-sizes is well approximated by an affine function.

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<sup>19</sup>Note that we confine ourselves to analysis of the steady state.

Reinserting the expression of  $G(\varphi)$  into (13) yields

$$\tilde{\varphi} = \left( \frac{\gamma}{\gamma + 1 - \sigma} \right)^{\frac{1}{\sigma-1}} \varphi^*. \quad (22)$$

As expected, the average productivity  $\tilde{\varphi}$  is an increasing function of the cut-off productivity  $\varphi^*$ . Notice that this expression implies that, for the the average productivity to be bounded, the rate of decay  $\gamma$  has to be higher than  $\sigma - 1$ . Using (22) to simplify the equilibrium condition (16), we obtain

$$\varphi^* = \left( \left( \frac{\sigma - 1}{\gamma + 1 - \sigma} \right) \left( \frac{1}{r + \delta} \right) \frac{f}{f_E} \right)^{\frac{1}{\gamma}} \bar{\varphi}.$$

By definition,  $\varphi^*$  has to be greater than  $\bar{\varphi}$ , so that the term on the right-hand side must be greater than one. For reasons explained before,  $\varphi^*$  is increasing in  $f$  and decreasing in  $f_E$ . The effect of  $f/f_E$  on average productivity is larger the higher the elasticity of substitution  $\sigma$ . The reason for this is that a higher  $\sigma$  corresponds to a lower markup, which makes it more difficult for low productivity firms to survive.

In order to parametrize  $g(\varphi)$ , we notice that the density of firm size  $S(l)$  is given by<sup>20</sup>

$$S(l) = \mu(\varphi) \frac{d\varphi}{dl} = \frac{\gamma}{\varphi} \left( \frac{\varphi^*}{\varphi} \right)^\gamma \left( \frac{\varphi}{(\sigma - 1)l} \right) = \left( \frac{\gamma}{\sigma - 1} \right) \left( \frac{l^*}{l} \right)^{\frac{\gamma}{\sigma-1}} \left( \frac{1}{l} \right).$$

Thus employment levels are also Pareto distributed with a rate of decay equal to  $\gamma/(\sigma - 1)$ . Empirical evidence suggests that the Zipf distribution accurately approximates the dispersion of firm sizes. This implies that the rate of decay should be close to one. We target the value estimated by Axtell (2001) using the 1997 data from the U.S. Census Bureau, so that  $\gamma = 1.098(\sigma - 1)$ .<sup>21</sup>

In order to pin down the value of the lower bound of the distribution, we notice that the absolute value of  $\varphi$  is intrinsically meaningless. Hence we can set, without loss of generality,  $\bar{\varphi}$  so as to normalize to one the mean of the sampling distribution. Since

$$E[\varphi] = \int_{\bar{\varphi}}^{+\infty} \varphi g(\varphi) d\varphi = \left( \frac{\gamma}{\gamma - 1} \right) \bar{\varphi},$$

it follows that  $\bar{\varphi} = (\gamma - 1)/\gamma$ .

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<sup>20</sup>The expression of  $l(\varphi)$  follows from reinserting (22) into (20) to obtain

$$l(\varphi) = \varphi^{\sigma-1} \tilde{\varphi}^{1-\sigma} \left( \frac{\gamma}{\gamma + 1 - \sigma} \right) \left( \frac{f}{\tilde{\varphi} \left( \frac{1-\beta}{\sigma-\beta} \right) + \frac{c}{m(\theta)} \frac{\delta(r+\delta)}{1-\delta}} \right).$$

<sup>21</sup>We use the estimates in Axtell (2001) for the restricted sample without firm of size 0.

**Matching function.** Given that wages are paid at the end of each period, we set the time interval to one month. The matching function is assumed to be Cobb-Douglas

$$m(\theta) = m_0 \theta^{-\alpha} . \quad (23)$$

We follow the standard practice in the search-matching literature and set the elasticity parameter  $\alpha$  to 0.5. In the absence of well-established estimates, we set the bargaining power  $\beta = \alpha$ .<sup>22</sup>

To calibrate the scale parameter  $m_0$ , we use empirical estimates of the job finding rate and labor market tightness. Given the CRS property of the matching function, the equilibrium tightness must be equal to the ratio of these two rates. Shimer (2005) estimates the monthly rate at which workers find a job to be equal to 0.45. Hall (2005) finds an average ratio of vacancies to unemployed workers of 0.539 over the period going from 2000 to 2002. Accordingly, we match an equilibrium tightness of 0.5 by setting the monthly job filling rate to 0.9. Reinserting these values into (23), we find that  $m_0 = 0.636$ .

**Separation shocks.** Job separations occur either because the firm leaves the market or because the match itself is destroyed. We consider that the first type of shock arrives at a Poisson rate of 0.916% per month. This implies that the annual gross rate of firm turnover is equal to 22%, as suggested by the estimates in Bartelsman *et al.* (2004). The match-specific shocks account for the job separations which are left unexplained by the firm-specific shock. Given that Shimer (2005) estimates the monthly rate of job separation to be 0.034, it follows that the rate of arrival of match-specific shocks  $\chi$  should be equal to 0.025 per month.

**Elasticity of substitution.** Here we need to distinguish between our two scenarios: the first, where only the selection effect is active, and the second, where we allow for the additional Blanchard-Giavazzi competition channel. In the first case, we use the implied mark-up to parametrize the elasticity of substitution  $\sigma$ . There exists some disagreement in the empirical literature about the actual value of the aggregate mark-up. Most of the estimates lie between 5% and 15%. We choose a conservative number and target an equilibrium mark-up of 5%. This value accords well with the estimates in Martins *et al.* (1996) and with the evidence discussed in Rotemberg and Woodford (1995) according to which aggregate real profits are close to

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<sup>22</sup>The equality of the bargaining power and matching function elasticity is known as the ‘‘Hosios condition’’ in the search-matching literature. Note, however, that in our case this condition is not sufficient to ensure an efficient allocation because of the over-hiring externality.

Table 1: *Parameter Values*

<i>Parameter</i>	<i>Interpretation</i>	<i>Value</i>	<i>Source</i>
$r$	Discount rate	0.33%	Annual rate 4%
$b$	Value of non-market activity	0.400	Standard
$\alpha$	Elasticity of Matching function	0.500	Standard
$m_0$	Scale of Matching function	0.636	Job finding rate=0.45
$\beta$	Bargaining power	0.500	Standard
$\delta$	Rate of firm exit	0.91%	Firm turnover rate=1.8%
$\chi$	Rate of match-specific separation	2.5%	Job separation rate=3.4%
$\sigma$	Elasticity of substitution	11.000	Mark-up=5%
$\gamma$	Decay of Prod. distribution	10.98	Decay of firm-size distribution=1.098
$\bar{\varphi}$	Support of Prod. distribution	0.9089	Normalization of $E[\varphi]$ to 1
$c$	Cost of posting a vacancy	1.350	Recruitment costs=5.7 weekly wage
$f_E$	Entry costs	39.57	$\theta = 0.5$
$f$	Flow fixed costs	0.116	Average firm size = 21.8

Note: All parameter values and statistics are for monthly time period.

zero. In the model, the mark-up over marginal costs is equal to  $(\sigma - \beta) / (\sigma - 1)$ . As  $\beta = 0.5$ , this implies that the elasticity of substitution  $\sigma = 11$ . This in turn yields a rate of decay  $\gamma = 1.098(\sigma - 1) = 10.98$ .

The quantitative assessment of the competition effect is complicated by the lack of empirical estimates of the correlation between  $M$  and  $\sigma$ . Given this limitation, we choose a functional form for  $\sigma(M)$  that can be parametrized without imposing further restrictions:  $\sigma(M) = \lambda(1 - e^{-\bar{\sigma}M})$ . To parametrize  $\lambda$ , we use the fact that the value of entry is bounded if and only if  $\sigma(M) < 1 + \gamma$ . We ensure that this requirement is satisfied as  $M$  goes to infinity by setting  $\lambda = 1 + \gamma$ . Then the value of  $\bar{\sigma}$  follows from our parametrization where  $\sigma(0.0427) = 11$ , which implies that  $\bar{\sigma} = 58.64$ .

**Cost parameters.** As it is common in the real business cycle literature, we set the interest rate to 4% per year. In order to calibrate the value of non-market activity, we follow Shimer (2005) and set  $b = 0.4$  to match an earnings replacement ratio close to 40%. The cost of posting a vacancy,  $c$ , is set 50% above the vacancy filing rate. Given that the equilibrium wage  $w = 1.137$ , this value yields an average recruitment cost of around 5.7 weeks of workers' earnings, as suggested by empirical estimates.

We still have to determine the value of two parameters: the entry costs,  $f_E$ , and the flow fixed costs,  $f$ . We use their values to match the following two moments. Firstly, we ensure that the equilibrium tightness  $\theta = 0.5$ . Secondly, we target an average firm size equal to 21.8 employees, as estimated by Axtell (2001). These two moments are perfectly matched for the set of parameters reported in Table 1.

The calibrated entry costs are equivalent to 2.82 years of income per capita. This figure can be compared to the assessment by Ebell and Haefke (2006) that regulatory barriers to entry in the US amount to 0.6 month of yearly income. The parametrization therefore suggests that technological innovation costs outweigh entry fees by an order of magnitude.

## 4.2 Simulation results

The upper-panel of Figure 3 reports the equilibrium Job Creation and Wage curves under the assumption that the elasticity of substitution is exogenous. Given that vacancies are filled at a relatively high rate, the effect of  $\theta$  on the average recruitment costs is quite low. This is why the JC curve is nearly horizontal. The impact of the labor market tightness is therefore almost entirely due to its positive effect on the workers' outside option.

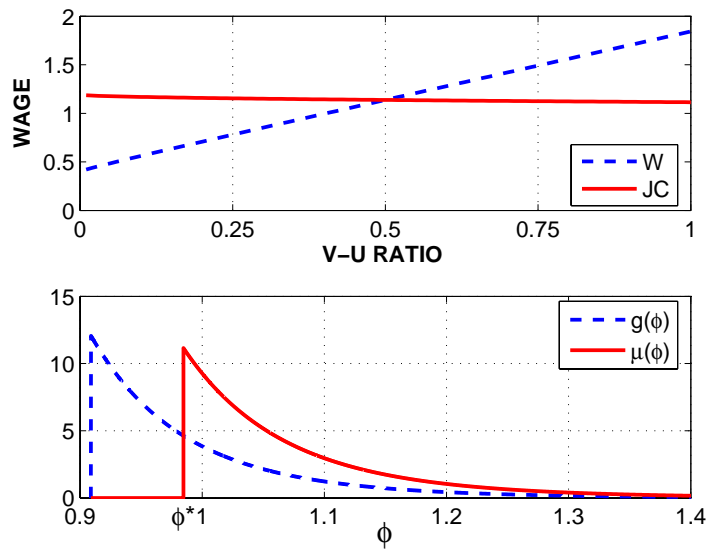


Figure 3: Equilibrium tightness and productivity distribution.

The lower-panel of Figure 3 reports the actual cross-sectional distribution  $\mu(\varphi)$  against the sampling distribution  $g(\varphi)$ . A substantial share of innovations do not lead to market entry since



only 41.5% of the productivity draws are above the entry threshold  $\varphi^* = 0.984$ . This implies that the expected cost of a successful innovation is close to 6.8 years of income per capita. The figure might seem high at first sight, but one has to remember that the entry costs must offset the expected gains from drawing a productivity far in the right tail of the firm distribution.

Figure 4 reports the equilibrium unemployment rate as a function of  $f_E$  and  $f$ . We use the estimates in Ebell and Haefke (2006) to determine the range of variation. More precisely, the lower bound is given by the entry costs in the US, while the upper bound of 8.6 month of yearly income per capita spent in entry fees corresponds to their estimated values for Greece. Due to the absence of estimated fixed costs, we vary red tape costs per year over the same range in order to ease the interpretation of Figure 4.

The relationship between unemployment and entry costs is reported in the upper-panel of Figure 4. As expected, the correlation between unemployment and startup costs is positive. Increasing regulatory entry barriers to the level observed in Greece raises unemployment by around 0.1%. The lower-panel contains the relationship between unemployment and fixed costs. Their effect is of opposite sign and of larger magnitude than that of entry costs. To see why it is the case, consider equation (16). The equilibrium value of  $\varphi^*$  is a function of the ratio  $f/f_E$ . Given that the calibrated fixed costs are an order of magnitude smaller than the entry costs, it is clear that their marginal impact is higher.

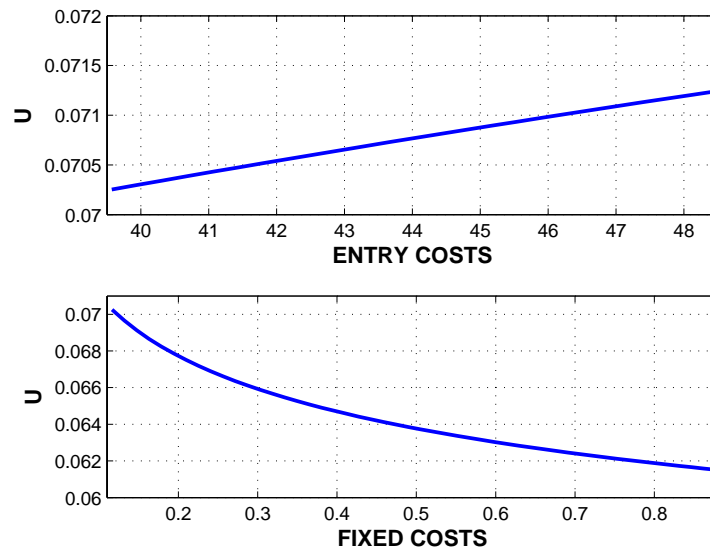


Figure 4: Effects of PMR on unemployment with exogenous  $\sigma$ .

Next, we allow for PMR to affect outcomes through the Blanchard-Giavazzi competition effect along with the selection channel discussed above. The upper-panel of Figure 5 reports the unemployment rate as a function of the entry costs when the elasticity of substitution is variable. Strikingly, the schedule is almost indistinguishable from its counterpart shown in 4, where the competition effect is absent. While it is theoretically obvious that entry costs increase unemployment through the competition effect, the quantitative importance of that effect is negligible due to the countervailing over-hiring externality. Ebell and Haefke (2006) show that this finding holds over a wide range of parameter values. Hence, in an environment where wages are set through bilateral bargaining, the unemployment effect of barriers to entry works almost entirely through the selection channel.

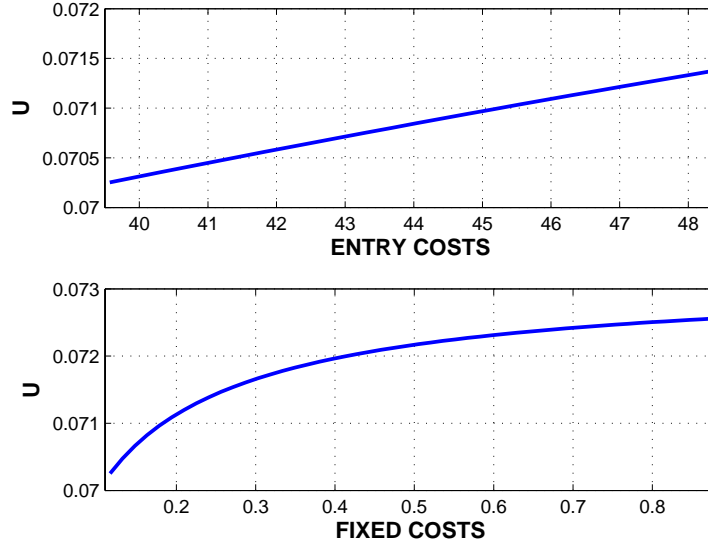


Figure 5: Effects of PMR on unemployment with endogenous  $\sigma$

While the competition effect seems unimportant for entry costs, the lower-panel of Figure 5 suggests that it is quantitatively important for fixed costs. As expected the negative competition effect counteracts the selection effect. This is because fixed costs also reduce the number of producers and so increase the market power of incumbent firms. More surprising is the size of the competition effect, as it reverses the sign of the correlation. To see formally why it is the case, we reinsert the expression of firm size into the definition of  $M$  in equation (21) which yields

$$M = \left( \frac{\theta m(\theta)}{s + \theta m(\theta)} \right) \left( \frac{\gamma + 1 - \sigma}{\gamma} \right) \left( \frac{\tilde{\varphi} \left( \frac{1-\beta}{\sigma-\beta} \right) + \frac{c}{m(\theta)} \frac{\delta(r+\delta)}{1-\delta}}{f} \right).$$

Whereas an increase in  $f$  directly reduces the equilibrium number of producers,<sup>23</sup> higher entry costs  $f_E$  solely have an indirect impact due to the decrease in  $\theta$  and  $\tilde{\varphi}$  discussed in Section 3. This is why the competition effect of fixed costs is much more noticeable. Another interesting feature, which will be substantiated by the empirical analysis in Section 6, is the concave profile of the relationship. As  $f$  increases,  $\varphi^*$  moves to the right of the productivity distribution. Since the distribution becomes thinner, a given change in the entry threshold  $\varphi^*$  is associated to a smaller decrease in  $M$ . As a result, the selection and competition effects eventually cancel out. Before closing this section, we would like to emphasize that our results are mostly qualitative. In the absence of empirical data about the relationship between  $\sigma$  and  $M$ , quantitative predictions remain tentative. Indeed it is easy to modify the parametrization of  $\sigma(M)$  so as to generate an inverted U-shaped relationship between  $f$  and  $u$ . We therefore believe that the main insight from the calibration of the extended model is that red tape costs and unemployment are likely to exhibit an ambiguous correlation, especially when the regulation is particularly stringent.

To take stock, we have found that: (i) entry barriers have a significantly positive effect on unemployment, (ii) red tape costs have an ambiguous effect on unemployment. Our model therefore calls for a detailed analysis of the underlying components of aggregate PMR indicators. The next section proposes some preliminary evidence in that direction.

## 5 Empirical analysis

The maintained hypothesis in this paper is that PMR increases the startup cost of businesses and/or the fixed costs of production. Importantly, these two types of costs may have different implications for unemployment. In this section, we discuss recent data that allows to distinguish between the two types of costs. We also present tentative cross-country evidence on the interplay between different components of PMR and unemployment that is consistent with our theoretical predictions. We do not attempt to structurally test our model which would require firm-level data.

### 5.1 Data

A crucial problem in the existing empirical literature is the insufficient time and country coverage as well as the stylized nature of data on labor and product market institutions. In the

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<sup>23</sup>As discussed at the end of Section 3,  $f$  also has a positive effect on  $M$  since it concurrently raises  $\theta$  and  $\tilde{\varphi}$ . But, for our parameter values, these countervailing effects are only of second order.

present context, these difficulties are exacerbated by the need to appropriately decompose PMR into two parts: one associated to *sunk startup costs* and the other related to *recurring fixed costs*. Moreover, we need to empirically separate cross-country differences in administrative cost induced by PMR from differences in technology.

While several authors have proposed aggregate indicators of PMR, we are aware of only one study that allows to address the cross-country variation in the incidence of different types of administrative PMR. Conway *et al.* (2005) have devised for the OECD a hierarchical system of sub-indicators that builds into an aggregate measure of PMR; see figure 6 for an illustration. The authors distinguish between *economic regulation*, such as antitrust policies, international trade and investment rules, or public ownership of firms, and *administrative regulation*, which is built on two sub-indices: (a) regulatory and administrative opacity, and (b) administrative burdens on startups.

In line with our theoretical model we focus on administrative regulation. In particular, we relate recurring regulatory costs to the sub-index (a) and call that measure  $REDTAP_{it}$ . It reflects the “administrative burden of interacting with the government.” We relate regulatory startup costs to subindex (b) and term them  $STARTUP_{it}$ . That measure relates to the “administrative burdens on the creation of corporations and sole proprietor firms” (Conway *et al.*, 2005, p. 9). The data is based on questionnaires, and probably offers the cleanest available way to distinguish between different types of PMR. There are two major drawbacks. First, the data is available for 1998 and 2003 only. Second, the data can only be interpreted in terms of cross-country or time comparisons; the absolute value of the indicators is essentially meaningless.<sup>24</sup>

Figure 7 sets 1998 indices of administrative startup costs and administrative red tape costs against their 2003 values. Clearly the situation has improved or stayed constant over time in all countries. Moreover, the cross-country variance has been fairly large to start with and has shrunk for startup costs but not for red tape costs. Figure 7 also suggests that countries are pursuing vastly different policy approaches. For instance, Austria has relatively high and constant startup costs, while red tape costs are low and falling. Denmark has low startup costs but high red tape costs. Spain, starting from high values has reduced both but red tape by a higher proportion.

The World Bank Doing Business data base also provides information on the administrative cost of starting a business, but it is less helpful in addressing the extent of PMR induced red

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<sup>24</sup>To gain an idea about the magnitudes of startup costs refer to Djankov *et al.* (2002).

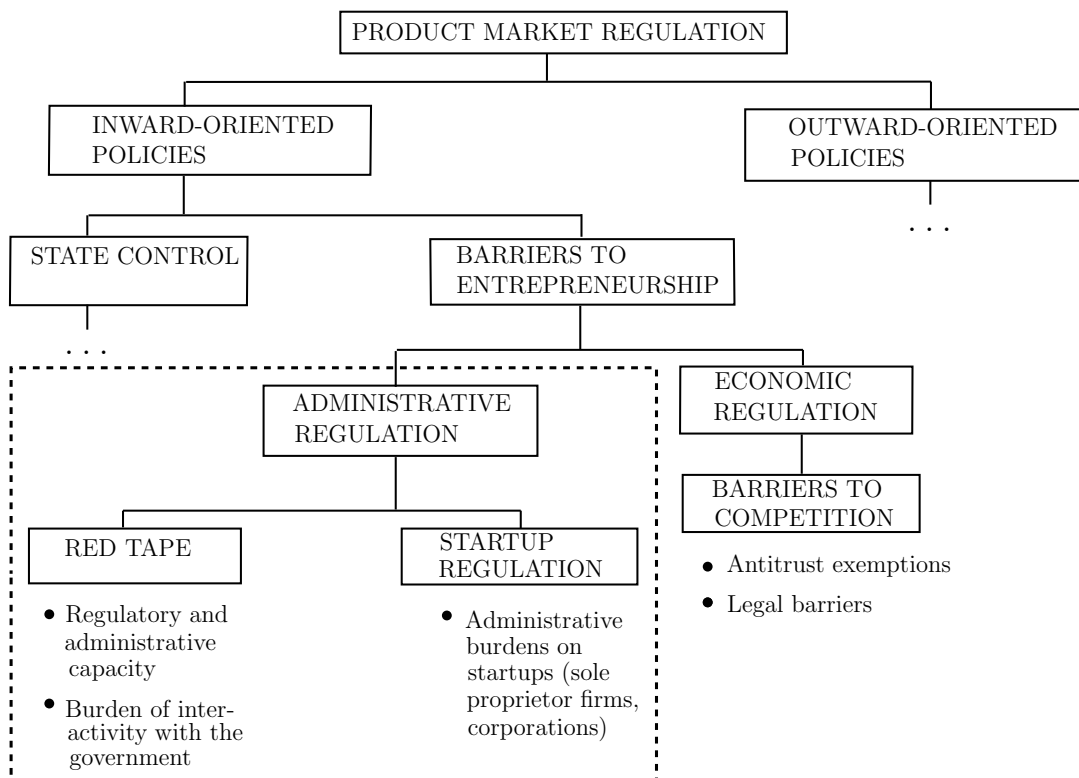
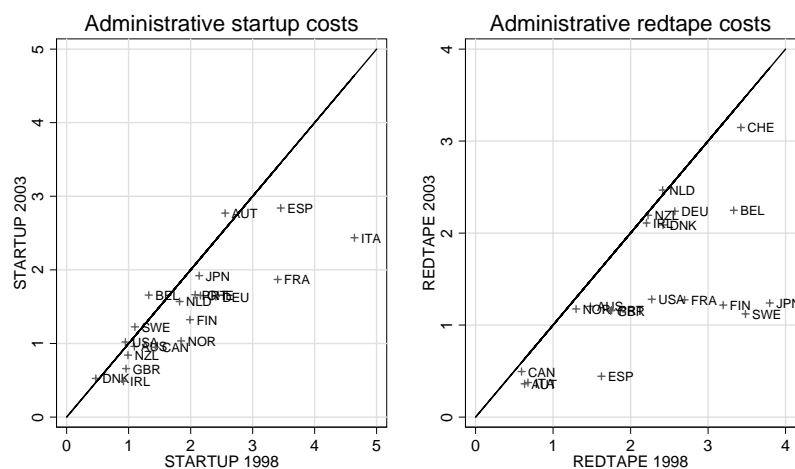


Figure 6: PMR Classification of Conway *et al.* (2005).

tape. Rather, it holds information on the ease of getting credit or on the efficiency of courts, which is not straightforwardly associated to PMR. Moreover, the data is available only for 2005 and 2006 (with the exception of startup costs, where comparable data can be constructed for 1999 from Djankov *et al.* (2002)). Yet, another source of information is the Economic Freedom of the World data base provided by the Fraser Institute. However, these data bases do not allow to disentangle in a clean way sunk and recurring costs associated to PMR and are therefore less appropriate for our analysis. We do, however, offer some robustness checks using those sources.

Information on labor market outcomes and institutions comes from Bassanini and Duval (2006). Those authors have compiled an extensive data set of different indicators of labor market policies, including variables on the incidence of minimum wages, collective bargaining, active labor market policies, employment protection legislation, and so on. Amongst other things, they provide country-specific estimates of the output gap, which allows us to control for cyclical determinants of unemployment. That data is available for 20 high-income OECD countries.<sup>25</sup>

<sup>25</sup>Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Switzerland (CHE), Germany (DEU),



Source: Conway et al. (2005)

Figure 7: Change over time in administrative PMR costs.

Table A1 in the Appendix reports summary statistics.<sup>26</sup> Note that all regulatory variables are scaled such that higher values are associated with higher costs at the firm level. Table A1 shows that the average unemployment rate has fallen from 1998 to 2003 and that the coefficient of variation is lower so that the improvement was relatively homogeneous. It is also transparent that both measures of administrative PMR have improved substantially.

## 5.2 Empirical strategy

Bassanini and Duval (2006) provide an extensive survey of the existing literature on the empirical explanation of cross-country unemployment patterns. We closely follow their empirical strategy and control for unobserved time-invariant cross-sectional heterogeneity by including country fixed effects.<sup>27</sup> In particular, this strategy accounts for unobserved differences in the importance of technology-induced sunk costs relative to recurring fixed costs, or in the parameters governing the size distribution of firms across countries. In all specifications, the dependent variable is the rate of unemployment in the economically active population (aged 15 to 64). Our results are robust to defining the rate of unemployment over the prime age labor market (24 to 54 years)

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Denmark (DNK), Spain (ESP), Finland (FIN), France (FRA), United Kingdom (GBR), Ireland (IRL), Italy (ITA), Japan (JPN), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Portugal (PRT), Sweden (SWE), and United States (USA).

<sup>26</sup>The full data and STATA batch files are available on demand.

<sup>27</sup>Given that we have only two years of data, the fixed effects model is necessarily exactly identical to a specification in first differences.

or the total population.

Our main specification is

$$u_{it} = \bar{u} + \beta_1 STARTUP_{it} + \beta_2 REDTAPE_{it} + X_{it}\gamma' + \nu_i + \nu_t + \varepsilon_{it}, \quad (24)$$

where  $STARTUP_{it}$  refers to administrative startup costs,  $REDTAPE_{it}$  measures recurring administrative regulatory costs,  $X_{it}$  is a vector collecting labor market covariates,  $\nu_i$  is a set of country dummies,  $\nu_t$  is a time dummy (for 2003) and  $\varepsilon_{it}$  is an error term with the usual properties. We are mainly interested by estimates of  $\beta_1$  and  $\beta_2$  since our theoretical analysis and calibration exercise predict that  $\beta_1$  should be positive and that  $\beta_2$  should be ambiguous.

### 5.3 Results

We present our main empirical findings in Table 2. All regressions use country fixed effects. Standard errors are corrected for clustering at the country level. Our most preferred (and most general) models are those shown in columns (5) and (7). Our main findings are:

(i) Evidence on the importance of *labor market institutions* is mixed. As in Bassanini and Duval (2006), employment protection legislation (*EPL*) has the wrong sign, but is anyway not statistically significant. Union density (*UNDENS*) does not turn out to exhibit a robust effect neither, as it becomes non-significant when an aggregate measure of PMR is introduced. This, too, is in line with earlier empirical research. Other potential variables describing labor market regulation, such as unemployment benefits, replacement rates, or active labor market policies only marginally improve the F-statistic and do neither exhibit robust sign patterns nor do they feature statistical significance. Since degrees of freedom are scarce in our setup, we do not use these variables. The unemployment effects of our variables of interest *STARTUP* or *REDTAPE* do not depend on including or excluding those variables.

(ii) *Aggregate conditions* are important. We use a single variable, the output gap, to capture macroeconomic conditions. This variable turns out highly significant. A one standard deviation change in the output gap (i.e., of 1.3, see the summary statistics in the Appendix) leads to a change in the unemployment rate of 0.6 to 0.9 points, depending on the point estimates presented in columns (1) to (7).

(iii) *Product market regulation* is highly relevant. In column (2) we include the aggregate measure of product market regulation into the regression. Remember that this measure lumps together economic and administrative regulation. Our results suggest that a one standard de-

Table 2: *Baseline fixed-effects regression results*

Dependent variable: Unemployment rate in economically active population							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGGPMR		3.740*** (1.03)					
STARTUP			1.634** (0.61)	1.674*** (0.41)	1.431*** (0.45)	0.985** (0.39)	0.711* (0.41)
REDTAPE				0.990** (0.47)	0.743 (0.50)	6.322*** (2.14)	6.042** (2.46)
REDTAPE <sup>2</sup>						-1.170** (0.46)	-1.159** (0.52)
UNDENS	0.600*** (0.13)	0.118 (0.13)	0.420*** (0.093)		0.304*** (0.081)		0.277** (0.10)
EPL	-2.993 (1.91)	-0.423 (1.25)	-0.883 (1.72)		-0.390 (1.65)		-1.771 (1.38)
GAP	-0.427*** (0.14)	-0.703*** (0.18)	-0.507*** (0.15)	-0.518*** (0.17)	-0.562*** (0.18)	-0.522*** (0.16)	-0.526*** (0.15)
Constant	-8.488* (4.89)	-2.704 (3.02)	-9.178* (4.69)	2.092* (1.08)	-7.086* (4.03)	-1.573 (1.72)	-6.898* (3.52)
Adjusted $R^2$	0.34	0.68	0.51	0.53	0.57	0.68	0.72
RMSE	1.060	0.743	0.915	0.895	0.854	0.740	0.691
F	8.553	12.63	9.251	8.098	10.70	16.76	13.38

Robust standard errors in parentheses (corrected for within group clustering);  
\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . All regressions include country fixed effects (not shown).  
Number of observations is 40. Panel is balanced.

viation improvement (i.e., reduction) in that index reduces the unemployment rate on average by 1.14 points ( $-3.74 \times 0.3$ ). This strong effect is known from the literature, see Bassanini and Duval (2006) for a survey.<sup>28</sup>

(iv) *Entry regulation* increases unemployment. In columns (3) to (5), we use STARTUP as an additional covariate. A one standard deviation improvement in the startup cost index leads to a reduction in unemployment rate of about 1.41 points ( $-1.634 \times 0.87$ ). The size and direction of this effect is robust to dropping the labor market variables UNDENS and EPL. In columns (4) and (5), our measure of red tape (REDTAPE) is added to the regression. Whether that variable is significant or not depends on whether the regression includes the standard labor market variables or not. However, in line with our theoretical expectations, the variable has the

<sup>28</sup>In their larger sample with yearly observations, those authors find that a one standard deviation decrease in the PMR index lowers unemployment by about 0.8 points.



right sign in both columns. Moreover, the effect of STARTUP is only marginally affected by including REDTAPE.

(v) *Red tape* regulation affects unemployment positively, but its marginal effect is decreasing. In columns (6) and (7) we have added the square term of REDTAPE. This modification of the baseline regression turns out to reduce the importance of STARTUP substantially: the unemployment reduction due to a one standard deviation decrease in STARTUP is now only 0.62 points on average ( $0.71 \times 0.87$ ). However, our measure of red tape becomes hugely important quantitatively: on average, a decrease of REDTAPE by one standard deviation leads to a reduction in the unemployment rate of 3.24 points ( $(6.042 - 2 \times 1.159) \times 0.87$ ). Even more interestingly, the unemployment rate is concave in REDTAPE, which is in line with the results of our calibration exercise showed in figure 5.

The overall picture emerging from our analysis of OECD data—tentative as it is—is consistent with the predictions of our theoretical model. Note that coefficients of interest are identified only by within-group variation. Hence, our results suggest that countries which have reduced administrative startup costs most aggressively have benefited from significant employment gains. By contrast, countries which have put emphasis on reducing regulatory costs for incumbent firms have gained little.

#### 5.4 Robustness checks

In their literature overview, Bassanini and Duval (2006) find that PMR matter in an economically and statistically significant way. They seem to be more important than labor market institutions and turn up significant in almost all specifications. Whether our results are similarly robust remains to be seen. The key problem is that a neat decomposition of administrative regulation into a sunk and a recurring part is possible only with the data set proposed by Conway *et al.* (2005).

We have experimented using the startup cost measure developed by Djankov *et al.* (2002) and updated by the World Bank in its Doing Business database. That measure relates to the cost in percent of per capita income of opening a generic enterprise. It includes official costs (such as stamp taxes) and the time cost incurred by management. Djankov *et al.* provide data for 1999, while the World Bank has similar data for 2005 on its web page.<sup>29</sup> Unfortunately, the

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<sup>29</sup>Djankov *et al.* (2002) and the World Bank report the official costs of registering a new business and the time spent in this undertaking. Djankov *et al.* (2002) proposes a method to aggregate these two measures into total startup costs as a percentage of per capita income. We apply the same method to the more recent World Bank

Doing business database does not provide a possibility to build a proxy for red tape PMR costs.

Table 3: *Robustness check*

Dep. var.: Unemployment rate in econ. active population		
	(1)	(2)
STARTUP (World Bank)	0.0745*** (0.023)	0.0674** (0.024)
REDTAPE	5.614** (1.98)	5.294** (2.27)
REDTAPE <sup>2</sup>	-0.983** (0.43)	-0.971* (0.49)
Adjusted $R^2$	0.71	0.76
RMSE	0.706	0.638

Robust standard errors in parentheses (corrected for within group clustering); \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . All regressions include a measure of the output gap, country fixed effects, and a constant (all not shown). Column (2) contains additional variables on labor market institutions (EPL, UNDENS). Number of observations is 40. Panel is balanced.

In Table 3 we redo columns (6) and (7) of Table 2 with the World Bank measure of startup costs instead of the one produced by Conway *et al.* (2005). To save place, we suppress the estimated coefficients of the other covariates, which turn out almost exactly the same as in Table 2. Also the results concerning our PMR measures are entirely robust to using the alternative measure of startup costs: qualitatively the picture is unchanged - startup costs and red tape costs both increase the rate of unemployment, but the partial derivative of unemployment with respect to REDTAPE is decreasing.

## 6 Conclusion

This paper has described an additional channel through which PMR matters for unemployment. When firms differ with respect to their productivity levels, PMR affects the average efficiency of producers and consequently the equilibrium rate of unemployment. This selection effect complements the competition effect analyzed in Blanchard and Giavazzi (2003). The model allows us to distinguish between regulation of startups on the one hand, and regulation of data.

incumbent firms on the other. Our analysis suggests that entry regulation matters more for unemployment than administrative regulation of incumbents.

Over the last decade, governments have alleviated the burden of PMR throughout the OECD. The reduction of regulatory costs has been more pronounced for recurring fixed costs rather than for startup costs. Given our results, this suggests that European policy-makers have been partly neglecting the more promising channel through which product market reform could lower unemployment rates. Our theory therefore pleads for more rigorous empirical analysis of the labor market effects of different types of PMR, where one dividing line might be between startup costs and those that occur through the operative phase. We do not claim that our empirical results in that direction are conclusive. Better data on sunk versus non-sunk components of administrative regulation will help to sharpen the econometrics. We are confident, however, that opening up the black box of aggregate PMR measures sheds interesting lights on the unemployment effects of regulation.

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## A Summary statistics

Table A1. *Summary Statistics*

Variable	Description	1998		2003	
		Mean	Std. Dev.	Mean	Std. Dev.
u	Unemployment rate <sup>a</sup>	7.67	3.79	6.52	2.18
STARTUP	Admin. burdens on startup <sup>b</sup>	1.89	1.04	1.45	0.69
STARTUP (WB)	Admin. burdens on startup <sup>d</sup>	21.24	16.69	14.02	10.40
REDTAPE	Regulatory and administrative opacity <sup>b</sup>	2.19	0.97	1.45	0.77
REDTAPE2	Regulatory and administrative opacity <sup>b</sup>	5.70	4.25	2.67	2.56
PMR	Aggregate index of PMR <sup>b</sup>	1.85	0.38	1.33	0.23
GAP	Output gap <sup>a</sup>	-0.12	1.37	-1.21	1.24
UNDENS	Union density (percent) <sup>a</sup>	36.48	21.77	34.62	21.74
EPL	Employment protection legislation <sup>a</sup>	2.04	0.93	2.04	0.89

Sources: <sup>a</sup>Bassanini and Duval (2006), <sup>b</sup>Conway *et al.* (2005), <sup>c</sup>Fraser Institute EFW Index, <sup>d</sup>World Bank (Doing Business).