The cost of employment protection in the presence of match-specific learning [1]

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Abstract

This paper studies the effects of the introduction of employment protection policies that raise the costs of dismissal. Macroeconomists studying these policies have thus far focused primarily on their effect on the flexibility of firms in adjusting their employment. This study highlights that in the presence of worker heterogeneity and match-specific learning, these policies have an important effect on average productivity by influencing productivity as a function of tenure and the tenure distribution of employed workers. Moreover, this productivity effect is different depending on the nature of the learning process that is the source of productivity gains with tenure, whether it entails learning-by-doing or learning about match quality. Using structural estimates from a previous study that imply that learning about match quality is the dominant learning process, I show that by hindering experimentation in the economy, the imposition of dismissal costs reduces average productivity by 3.2%. Moreover, I show that even if the first-best policy of removing these dismissal costs completely is not available, removing dismissal costs for low-tenure workers through the liberalization of the use of fixed-term contracts can undo most of the above productivity loss.

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1 Introduction

The 1950s through the 1970s have seen an increase in the cost of employment termination in many European countries as governments were attempting to protect employees from the adverse effects of unemployment. During 1980s and 1990s this increase has been partially reversed as governments strived to increase labor-market flexibility following the rise in the average level of unemployment during the 1970s. Effective costs of termination declined as the use of fixed-term contracts with little or no termination costs spread, following the liberalization of their applicability. These two labor market policies, the imposition of dismissal costs then their partial removal by allowing the use of fixed-term contracts for low-tenure workers, are, for the purposes of this study, termed dismissal cost policies.

This paper discusses the new insights that can be gained by explicitly incorporating match-specific learning into the evaluation of dismissal cost policies. Match-specific learning leads to productivity gains with tenure, which means that it is crucial to consider such learning in the evaluation of the productivity effect of dismissal cost policies since these change the average tenure structure in the economy.

It is important to note that productivity gains accumulate differently depending on the nature of the learning process. In particular, match-specific learning can take on two distinct forms: match-specific *learning-by-doing* (which I will refer to simply as learning-by-doing from now on) and *learning about match quality.* Match-specific *learning-by-doing* means that, as time on the job increases, the worker accumulates more match-specific expertise and hence becomes more productive. Examples of such learning-by-doing are a worker learning how to operate a unique machine used in the production process or a manager learning how to motivate a particular member of her team. *Learning about match quality* means that a worker-firm pair learn over their time together how good the particular employment match is in an environment where different workers have different-quality matches with their employers. Learning after a match has been formed means that the matching process is able to reject bad matches only partially. Some bad matches are weeded out in the matching process, but even after a match has been formed, the worker and the employer cannot be certain that the match is a good one. This is because some aspects of the match can only be discovered after the employment relationship has been established. Such aspects include the compatibility of the worker with her coworkers or the attractiveness to the worker of the long-term career opportunities available at the firm.

In the case of learning-by-doing, the productivity of each worker increases with tenure. On the contrary, in the case of learning about match quality, the productivity of a worker is the same across tenure, and average productivity increases due to the process of selection that favors good-quality matches. Due to the difference in productivity gains, it is important to distinguish these two different learning processes in order to get an accurate evaluation of a policy's productivity effect.

This paper uses the model developed in Nagypál (2001) that incorporates these two sources of match-specific learning to ask the question of how an economy's average productivity is affected by the imposition of dismissal costs. I find that, given the structural parameter estimates derived in Nagypál (2001), the effect of imposing a cost of dismissal equal to six weeks' worth of average revenue is to reduce average productivity by 3.2%. I then ask how much of this productivity loss can be eliminated by removing dismissal costs for low-tenure workers by the introduction of fixed-term contracts. I find that more than 80% of the productivity loss is eliminated by the removal of dismissal costs for workers with less than two years of tenure.

To put this paper into perspective with respect to the existing literature, it is useful to distinguish between two justifications for the removal of dismissal costs either all together or partially, via the use of fixed-term contracts.[3] First, lower dismissal costs provide more flexibility to firms in responding to idiosyncratic and aggregate shocks; the *flexibility* ex-

[3]For an informal discussion see, for example, Brewster, Mayne, and Tregaskis (1997).

planation. Second, lower dismissal costs allow firms to "experiment" with workers without incurring substantial costs of separation should they find the match to be unsuitable; the *experimentation* explanation.

The crucial assumption behind the *flexibility* explanation is that there are decreasing returns to labor which make it optimal for a firm to cut back employment when faced with an adverse shock to its production function. This is a very natural assumption, and the *flexibility* explanation is at the heart of most work on dismissal costs and fixed-term contracts (see, for example, Hopenhayn and Rogerson (1993), Bentolila and Saint-Paul (1992), Cabrales and Hopenhayn (1997) and Aguirregabiria and Alonso-Borrego (1999)). The natural unit of observation in such an analysis is the firm which has a particular production function characterized by decreasing returns to labor input. Models in this class assume that there is perfect substitutability between different workers, so that the labor input of a firm can be summarized by the efficient units of labor employed. Heterogeneity across workers is allowed only to the extent that there are differences in the efficient units of labor that different workers represent. For instance, when discussing fixed-term contracts, Bentolila and Saint-Paul (1992), Cabrales and Hopenhayn (1997) and Aguirregabiria and Alonso-Borrego (1999) all assume that permanent workers have productivity unity, while temporary workers have productivity $\eta < 1$.[4] The firm-based approach has difficulty incorporating the *experimentation* explanation, which requires more complex heterogeneity that is not present in these models. The firm-based approach is more suitable for evaluating the effect of dismissal cost policies on aggregate employment, job creation and destruction. To the extent that the loss of flexibility reduces productivity, these models highlight one possible effect of dismissal costs on productivity. In the presence of dismissal costs, firms are forced to depart from the policy of equating marginal product with marginal cost in every period,

[4]The assumption that temporary workers are less productive than permanent ones relies on the observation that, given the nature of fixed-term contracts, workers on fixed-term contracts have lower tenure at the employing firm than workers on permanent contracts, and that low-tenure workers tend to be less productive than their high-tenure counterparts as documented by Topel (1991). I argue that there are different mechanisms that can lead to such an increase in productivity with tenure, and determining which one of these mechanisms is at work is important in the evaluation of the effect of dismissal cost policies on average worker productivity.

thereby a decline in average productivity results. Hopenhayn and Rogerson (1993) show this productivity effect to be of the order of 0.8% when dismissal costs are equal to six months' of wages.

A different approach is to take the worker-firm match as the unit of analysis. Such an approach is much more appropriate to address the *experimentation* explanation. At the heart of the *experimentation* explanation are (a) a substantial amount of *ex-ante* heterogeneity in worker characteristics and (b) learning over time about these characteristics, which leads to more *ex-post* heterogeneity as beliefs evolve over time. The match-based approach allows for substantial amount of learning and thus belief heterogeneity to be present in the model. The drawback of the match-based approach, however, is that it assumes either that a firm employs a single worker (as in Mortensen and Pissarides (1994)) or that there are constant returns to labor at any particular firm with no interaction between different workers at the same firm (as in Nagypál (2001)). The match-based approach can incorporate the flexibility explanation only to the extent that in matching models with heterogeneous productivity dismissal costs hinder the relocation of workers from low-productivity firms to high-productivity firms. Mortensen and Pissarides (1999) find that this relocation hindering effect, in the presence of dismissal costs equaling three months' of output, leads to a 1.77% reduction in productivity. The match-based approach is more suitable for evaluating the effect of dismissal cost policies on how well workers and firms are matched to each other and hence on the productivity of the average employed worker. By incorporating learning about match quality into the match-based approach, I am able to address the *experimentation* explanation and introduce a substantial amount of heterogeneity into the model. The importance of heterogeneity is supported by the findings of Serrano (1998). He reports that, for Spain, there is simultaneous hiring and separation of workers on fixed-term contracts at 67.6% of firms on a quarterly basis; which implies that there is a substantial amount of heterogeneity among workers on fixed-term contracts. Note that, in the firm-based approach, there is no possibility of such simultaneous hiring and separation of workers on fixed-term contracts beyond the possibility that firms replace those workers on fixed-term contracts who have reached the maximum contract length. Serrano also finds that there is simultaneous separation from fixed-term and permanent contract workers at 33% of firms, which implies that workers on permanent and fixed-term contracts are not perfect substitutes.

Using the match-based approach with learning, this paper shows that dismissal costs can have a productivity-reducing effect by hindering experimentation, despite the fact that dismissal costs shift the tenure distribution towards workers of higher tenure who tend to be more productive. Of course, this productivity effect coexists in reality with the productivity effect due to the loss of flexibility, but it is prohibitively difficult to write down a tractable model that would incorporate both. The difficulty in unifying the firm-based and the match-based approaches is that a model where a single firm is employing many workers with heterogeneous characteristics and beliefs who are not possible to aggregate into a single measure of efficient units of labor is not tractable, due to the very large state space that would arise.

With respect to the literature on fixed-term contracts, this work addresses several issues not treated in the existing literature. First, I am explicit about the source of productivity differentials between workers on fixed-term contracts and those on permanent contracts, while in the above mentioned works such a difference exists by assumption. Second, I explicitly model the institutional feature that workers on fixed-term contracts need to be promoted to permanent contracts after a specified period of time if the firm wishes to continue employment, a fact that most models (with the exception of Aguirregabiria and Alonso-Borrego (1999)) do not take into account, but rather treat workers on fixed-term contracts and those on permanent contracts as two separate classes of workers.

2 Employment protection policies

Raising the cost of dismissals between the 1950s and the 1970s has been an important policy tool of European governments in their attempt to discourage job destruction and thereby protect employed workers from the adverse effect of unemployment. The different countries differ in the exact details of their employment protection legislation, but in general, it is common in European countries to dictate by law the circumstances under which a firm can terminate a worker, and often it is costly for the firm to demonstrate that such circumstances are met. Also, dismissal often requires advance notification of the worker, the trade unions, and the Ministry of Labor. Keeping a worker employed for a specified amount of time after notification is also costly for the firm. Additionally, firms incur costs associated with negotiating with unions about terminations and the potential costs of litigation in the labor courts.

Since most of these costs are non-monetary in nature, it is rather difficult to assess their size, though the consensus view is that these costs are substantial and affect separation decisions substantially. Also, because of the difficulty of measurement, it is hard to assess how these costs differ across heterogeneous groups of workers, across tenure, and so on. Despite the difficulty of measurement, there have been several attempts to construct indicators that reflect the strictness of employment protection in different countries. Table 1 reports employment protection indexes constructed by the OECD (1999). It is clear from the Table that employment protection is much stronger in continental European countries, especially in the southern European countries along with France and Germany, as compared to the US, UK, Ireland, or Canada. While the OECD index includes the extent of severance payments, in this study I exclude these and interpret dismissal costs as the costs that are expended when a separation takes place when there are severe regulations regarding the circumstances under which such termination can take place and regarding the procedures that need to be observed in case of termination.[5]

As unemployment across Europe rose during the 1970s, it was argued more and more that dismissal costs not only reduce job destruction, but they also have a negative impact

[5]Some researchers (see, for example, Blanchard and Wolfers (2000)), when discussing dismissal costs, identify these costs as severance payment: the sum of money for which an employee is eligible upon termination, where this sum is normally a function of the length of employment before termination. In this case, it is relatively easy to measure dismissal costs as a function of tenure for a given worker, since it is specified in the legal code or in the employment contract of the worker. Thinking of dismissal costs as severance payment is problematic, however. As Lazear (1990) points out, in the efficient-separations framework, transfer payments between the two parties do not affect allocation decisions since a separation takes place only if the *joint* surplus of the relationship falls below zero. This leads to the conclusion that, for severance payments to have an effect on allocations, one has to depart from the efficient-separations framework. This is troublesome, however, since it means going to a framework in which there are gains from trade that are left unexploited.

	Strictness of protection of regular employment against dismissals		Strictness of regulation regarding temporary employment	
	late 1980s	late 1990s	late 1980s	late 1990s
Europe				
Austria	2.6	2.6	1.8	1.8
Belgium	1.5	1.5	4.6	2.8
Denmark	1.6	1.6	2.6	0.9
Finland	2.7	2.1	1.9	1.9
France	2.3	2.3	3.1	3.6
Germany	2.7	2.8	3.8	2.3
Greece	2.5	2.4	4.8	4.8
Italy	2.8	2.8	5.4	3.8
Netherlands	3.1	3.1	2.4	1.2
Norway	2.4	2.4	3.5	2.8
Portugal	4.8	4.3	3.4	3.0
Spain	3.9	2.6	3.5	3.5
Sweden	2.8	2.8	4.1	1.6
Switzerland	1.2	1.2	0.9	0.9
Anglo-Saxon countries				
Canada	0.9	0.9	0.3	0.3
Ireland	1.6	1.6	0.3	0.3
UK	0.8	0.8	0.3	0.3
US	0.2	0.2	0.3	0.3

Table 1: Extent of protection of regular workers against dismissal and of strictness of regulation regarding temporary employment — the scores range from 0 to 6 with higher values representing stricter regulation

Source: *OECD Employment Outlook*, 1999, OECD, Paris.

on job creation, and that this negative effect outweighs the positive employment-protection effect. Subsequently, many European governments attempted to increase labor-market flexibility and thereby alleviate the negative effects of dismissal costs on job creation. Since removing the protection of regular employees was politically very difficult, employment protection measures regarding regular employees have remained at similar levels between the late 1980s and the late 1990s, with most of the easing of regulation taking place with regards to temporary employment, as documented by Table 1.

One of the primary measures was the liberalization of the rules under which firms could hire workers on fixed-term contracts. During this period, new legislation regarding these contracts was implemented in France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. These fixed-term contracts differ from the more commonly used permanent contracts in that there is no significant dismissal cost associated with them. While ending a permanent contract often requires advance notification of the union and of the Ministry of Labor and there is the possibility of appeal to the labor courts, there are normally no such requirements for fixed-term contracts.

Despite these advantages, the use of fixed-term contracts traditionally was limited for two reasons. First, the principle of causality applied to these contracts, which meant that they could only be used in employment relationships where the nature of the relationship was temporary or seasonal. Second, while these contracts could be signed for short periods of time, they could be renewed only up to a maximum length (generally between one and three years). Afterwards, if the firm wished to keep the worker, continued employment had to take place under a permanent contract. The main policy change in the 1980s with regards to these fixed-term contracts was the removal of the principle of causality. This meant that any worker could be employed on a fixed-term contract, and not just the small fraction of the labor force that represented seasonal or temporary workers. Also, there were changes in the length of time for which fixed-term contracts could be signed.

Due to differences in the institutional details, the use of fixed-term contracts is different across countries. Table 2 reports the fraction of the labor force employed on a fixed-term contract in different European countries in the early 1980s and in the mid-1990s, provid-

	1983	1996		1983	1996
Austria	:	8.0%	Italy	6.6%	7.5%
Belgium	5.4%	5.9%	Luxembourg	3.2%	2.6%
Denmark	:	11.2%	Netherlands	5.8%	12.0%
Finland	:	17.3%	Portugal	:	10.4%
France	3.3%	12.5%	Spain	:	33.6%
Germany	:	11.0%	Sweden	:	11.6%
Greece	16.2%	11.0%	UK	5.5%	6.9%
Ireland	6.1%	9.2%			

Table 2: Fraction of labor force employed on a fixed-term contract in different European countries in 1983 and 1996
(Source: Eurostat - Labor Force Survey)

ing some evidence that the use of fixed-term contracts generally increased during this time period. One country where the use of fixed-term contracts is prevalent is Spain, which explains why many researchers discussing fixed-term contracts focus on the Spanish experience (for example Bentolila and Saint-Paul (1992), Cabrales and Hopenhayn (1997) and Aguirregabiria and Alonso-Borrego (1999)). The Spanish numbers are even more striking when one considers that 98% of new hires were employed on fixed-term contracts (see Bentolila and Saint-Paul (1992)).

3 Model

The model used in this paper is very similar to the one introduced in Nagypál (2001), which contains a more detailed exposition.

3.1 Environment

The economy is populated by a continuum of infinitely-lived workers, *ex-ante* identical, of measure one. A worker has to be matched to a firm in order to be able to produce output, which means that firms have some unmodeled input that is essential for production. There is a continuum of potential firms in the economy. Firms are in one of three states. A firm is either matched with a worker and is productive, it has a vacancy open, or it is inactive. The cost per period of keeping a vacancy open is c.

3.1.1 Production technology

The output of a worker-firm match is determined by three key components: learning about match quality, learning-by-doing, and firm-level shocks. I interpret these shocks as price shocks, but they could equally well be firm-productivity shocks.

Let the output of a match τ periods after its formation, $\tau = 0, 1, \ldots$, be

$$q_\tau = x_\tau h(\tau) \qquad \text{where} \qquad h(\tau) = \left(1 - \frac{\sigma_\gamma^2 \sigma_y^2}{\tau\sigma_\gamma^2 + \sigma_y^2} - \sigma_y^2\right)^N \tag{1}$$

Here x_τ is worker productivity at tenure τ. x_τ is drawn from a normal distribution, $N(\mu, \sigma_x^2)$, and is independent across tenure and across workers. μ is the quality of the particular employment match. It is completely match-specific, and is observed neither by the worker nor by the firm at the time the match is formed. When a firm hires a worker, the match quality μ characterizing that particular match is drawn from a normal distribution, $N(\bar{\mu}, \sigma_\mu^2)$. This distribution is the same for all matches and is common knowledge, but the particular realization of μ is unknown. Hence the worker and firm learn about the unknown match quality by observing production outcomes. The evolution of beliefs is governed by Bayes' law. Since the match quality is drawn from a normal distribution and the signals about match quality are also normally distributed, this means that posterior beliefs are also normally distributed. Let this posterior belief of the agents about the match quality μ, after having observed τ signals, be $N(\tilde{\mu}_\tau, \tilde{\sigma}_{\mu\tau}^2)$. This is the *learning about match quality* component of the model.

The function $h(.)$ in (1) represents the *learning-by-doing* component of the model. This functional form for the learning curve arises from a micro-foundation for learning-by-doing developed by Jovanovic and Nyarko (1995,1997). They model learning-by-doing as a dial-setting problem. Each period, the worker sets a dial. The farther away her dial-setting is from the best dial setting, the lower her output. Besides being unknown to the worker, the best dial setting changes over time. The time variation in the best dial setting captures the idea that workers perform different tasks over time; for example, a sales manager is faced with different clients or a researcher with different problems. The best dial setting, however, has a component that is initially unknown, but is constant across time. For example, clients have similar needs, or problems at hand have similar characteristics. At the end of each period, the worker observes what the best dial setting was for that period. This allows her to make inferences about the constant component which, in turn, makes the prediction of next period's best dial setting easier, and the worker becomes more productive. Learning-by-doing is affected by three variables in their model, σ_γ, σ_y, and N. In terms of the dial-setting analogy, σ_γ is the dispersion of the constant component in the best dial setting across matches which measures the amount of initial uncertainty about how to perform a task, σ_y is the dispersion of the best dial setting around its mean which reflects the noisiness of each signal about the constant component, and N is the number of tasks the worker carries out which is a measure of complexity. The potential for productivity growth increases in all three of these variables.

At tenure τ, the output produced by the match is sold at price p_τ. Every new match starts in the highest price state. When the match is formed, the parties in the match have the opportunity to choose a product line (not explicitly modeled); hence, they can always choose a product line that is facing the most favorable demand conditions (i.e. that is in the highest price state). (This modeling of the initial price state is based on Mortensen and Pissarides (1994).) Once this choice is made at the beginning of the match, it is assumed that there is no possibility of changing it, and the price process follows a first-order finite-state Markov process, i.e., $p_\tau \in \mathcal{P} = \{p_1, .., p_M\}$. The conditional density function describing this Markov process is $\pi(. \mid p_{\tau-1})$, and the corresponding conditional cumulative density function is $\Pi(. \mid p_{\tau-1})$. The price process is persistent, meaning that $\Pi(. \mid p_{\tau-1})$ is decreasing in $p_{\tau-1}$. Moreover, the price process is such that it has a unique invariant distribution, denoted by $\pi(.)$. The price processes of different firms are identically distributed and independent of each other, which together with the assumption of a continuum of firms means that there is no aggregate uncertainty in this economy, and that in any period the distribution of firms across price states is $\pi(.)$. Additionally, each period any match dissolves for exogenous reasons with probability δ. This ensures that workers do not all end up in very productive matches over time where there is no threat of separation.

Timing within a period is as follows. During each period production takes place. At the end of the period, sale price p_τ and output q_τ are observed. Note that, given the functional form for output, this means that productivity x_τ can be inferred. At the end of the period, exogenous separations take place. If the match has not ended due to exogenous reasons, then the agents make decisions whether to continue the match or to separate based on the observation of productivity and price up to tenure τ (denoted by $\mathbf{x_0^\tau}$, and $\mathbf{p_0^\tau}$). The decision is made by comparing the joint value of their outside options with the value of continuing the employment relationship. Moreover, I assume that, if the two parties are indifferent between separation and continuation, then they continue the relationship.

3.1.2 Preferences, bargaining, and dismissal costs

Both firms and workers are maximizing their expected wealth, which is just the discounted sum of their revenues. The common discount factor is β. In an employment relationship, firm and employee make decisions jointly and maximize the surplus of the match.

When unemployed, the worker receives income b. This can be thought of as the value of leisure or the amount of unemployment benefits. When employed, workers capture a share κ of the surplus of the relationship in a Nash bargaining setting.

Finally, I introduce dismissal costs that are represented by the function $f(\tau), \tau = 1, 2, ..., \infty$, which gives the amount of dismissal costs that need to be expended in order to break up a relationship as a function of tenure. I assume that f has a finite limit, i.e., $\lim_{t\to\infty} f(\tau) = \bar{f}$. Moreover, I assume that, when a separation takes place for exogenous reasons, these costs do not have to be incurred (such separations can be thought of as worker-initiated separations following, for example, the move of the worker's spouse to a new city).

3.1.3 Search and matching

Search frictions are summarized by the aggregate matching function, $m(u,v)$, which determines the number of new matches each period as a function of the number of unemployed, u, and the number of vacancies, v. The matching function is assumed to be homogeneous of degree one, which means that given market tightness $\xi = v/u$, the probability of a worker finding an open vacancy in a period can be written as $g(\xi) = m(u,v)/u = m(1,\xi)$. Correspondingly, the probability that a firm with a vacancy fills that vacancy in a given period is $g(\xi)/\xi$. This modeling of the hiring process is more realistic than the one in Nagypál (2001). In Nagypál (2001) I was interested solely in the separation margin, so assuming a very simple hiring process was appropriate to keep the model more tractable given the crucial and more complicated "one firm–many workers" setup. Now, I am interested also in the hiring margin so that I can evaluate the employment effect of different policies, which means that I need a more realistic model of the hiring process, while I do not need the "one firm–many workers" setup.

3.2 Equilibrium

The economy is in a stationary equilibrium when the following conditions apply.

- Agents at tenure τ in existing matches make continuation decisions $\{d_\tau\}$ in order to maximize the surplus of the relationship, where $\{d_\tau\}$ is an adapted process with respect to $\mathcal{F}_\tau = \sigma(\mathbf{x}_\mathbf{0}^\tau, \mathbf{p}_\mathbf{0}^\tau, \tilde{\mu}_0, \tilde{\sigma}_{\mu 0}^2)$.

- Agents have rational expectations: $\tilde{\mu}_0 = \bar{\mu}$ and $\tilde{\sigma}_{\mu 0}^2 = \sigma_\mu^2$.

- There is free entry of firms.

- The distribution of workers across price and belief states and the state of unemployment is constant.

3.2.1 Separation decisions

At the time of meeting, when $\tau = 0$, agents decide whether to form a match or not. This decision is the same for all workers, since they are *ex-ante* identical having the same prior beliefs $N(\bar{\mu}, \sigma_\mu^2)$, and is based on the comparison of the joint value of continued search, which is the value unemployment U to the worker and the value of a vacancy F to the firm, and the value of forming a relationship. The Bellman equation describing the decision of agents at the time of meeting is

$$V_0 = \max\left\{U + F \ , \ p_M \bar{\mu} h(0) + \beta\left(\delta(U+F) + (1-\delta)EV(p_M, \tilde{\mu}_1, 1)\right)\right\}, \tag{2}$$

where V_0 is the joint value of the worker and the firm at the time of meeting and $EV(p_M, \tilde{\mu}_1, 1)$ is the expected continuation value, to be derived below. The value of forming a relationship is the sum of the expected revenue the first period, which takes into account that all matches start in the highest price state, and the discounted expected continuation value.

Subsequently, each period, the agents in a match decide whether to continue the match or to separate. They base this decision on their belief about the match quality μ and on the price faced by the firm during the last period. The belief about the match quality can be summarized by the posterior mean and variance. Moreover, given Bayesian updating,

$$\tilde{\sigma}_{\mu\tau}^2 = \frac{\sigma_\mu^2 \sigma_x^2}{\tau\sigma_\mu^2 + \sigma_x^2}, \tag{3}$$

meaning that the posterior variance, $\tilde{\sigma}_{\mu\tau}^2$, is a deterministic function of τ, hence τ is a sufficient statistic. This means that the state space at the beginning of period τ, $\tau = 1, 2, ...$, includes $p_{\tau-1}, \tilde{\mu}_\tau$, and τ. The Bellman equation describing the sequential decision problem of the agents is

$$\begin{aligned} V(p_{\tau-1}, \tilde{\mu}_\tau, \tau) = \max\{&U + F - f(\tau)\ , \\ &\sum_{j=1}^{M} \pi(p_j \mid p_{\tau-1})\left[p_j \tilde{\mu}_\tau h(\tau) + \beta\left(\delta(U+F) + (1-\delta)E[V(p_j, \tilde{\mu}_{\tau+1}, \tau+1) \mid \tilde{\mu}_\tau]\right)\right]\}, \end{aligned} \tag{4}$$

where $V(p_{\tau-1}, \tilde{\mu}_\tau, \tau)$ is the joint value of the worker and the firm of being in a particular price and belief state. The first term in the parentheses represents the value of separating taking into account dismissal costs, while the second term is the value of continuing the match in the different price states weighted with the probability of reaching that price state. This has two parts, the expected revenue next period and the continuation value, which takes into account the fact that the match dissolves at the end of next period for exogenous reasons with probability δ.

Given Bayesian updating, posterior beliefs converge asymptotically to the truth. Hence $\lim_{\tau \to \infty} \tilde{\mu}_\tau = \mu$. Also note that $\lim_{\tau \to \infty} h(\tau) = (1 - \sigma_y^2)^N \equiv \bar{h}$. Asymptotically then,

$$V(p, \mu) = \max \left\{ U + F - \bar{f} \, , \, \sum_{j=1}^{M} \pi(p_j \mid p) \left[p_j \mu \bar{h} + \beta \left(\delta(U + F) + (1 - \delta) V(p_j, \mu) \right) \right] \right\}. \quad (5)$$

The above is a system of M equations in $V(p, \mu)$, $p \in \mathcal{P}$, that can be solved analytically for given μ. For details see Nagypál (2001). Approximating the value function in (4) at a very large tenure τ_{max} with the asymptotic value function in (5), the problem can be solved by iterating backwards.

I can then derive the optimal separation decision $d(p_{\tau-1}, \tilde{\mu}_\tau, \tau)$ from the value function. $d(.)$ is unity if the firm and worker decide to separate and zero otherwise. Also, recall that indifference is resolved in favor of continuation.

3.2.2 Hiring decisions

With regards to the value of a vacancy and that of unemployment, the altered setup leads to different equilibrium outcomes compared to the model of Nagypál (2001). The value of a vacancy can be determined by the following equation:

$$F = -c + \beta \left[g(\xi)/\xi (1 - \kappa) \left(V_0 - U - F \right) + F \right]. \quad (6)$$

Given that inactive firms are free to enter and open new vacancies and firms with vacancies are free to exit if keeping the vacancy open is not profitable, the value of a vacancy in equilibrium is equal to 0, hence $F = 0$. This then means that

$$V_0 - U = \frac{c \xi}{\beta g(\xi)(1 - \kappa)}. \quad (7)$$

The value of unemployment is simply

$$U = b + \beta \left[g(\xi)\kappa \left(V_0 - U \right) + U \right], \tag{8}$$

or, given Equation (7),

$$U = \frac{1}{1-\beta} \left[b + \frac{c\xi\kappa}{1-\kappa} \right]. \tag{9}$$

4 Policy experiments

In this section I compare economies in a stationary equilibrium: one with no dismissal costs and one with dismissal costs. I choose the dismissal cost function to be of the simplest form. I assume that dismissal costs are the same across tenure, i.e., $f(\tau) = \bar{f}$ for $\tau = 1, 2, ...\infty$.

As I show below, I find that the introduction of dismissal costs leads to substantial loss of productivity because it hinders experimentation. An interesting question is how much of this productivity loss can be eliminated by removing dismissal costs for workers for whom experimentation is the most important, that is, for low-tenure workers. Such a policy can possibly be easier to implement than the complete removal of dismissal costs, since it retains the protection provided by dismissal costs for the large fraction of the labor force that has higher tenure than the maximum fixed-term contract length (normally, around two years.)

To study this question, I introduce fixed-term contracts as a third possible policy alternative. I model these contracts by assuming that dismissal costs are zero if the tenure of the relationship is no greater than T; i.e., $f(\tau) = 0$ if $\tau = 1, 2, ..., T$ and $f(\tau) = \bar{f}$ if $\tau = T+1, T+2, ...\infty$. T is chosen to be 24, which implies that the maximum duration of a fixed-term contract is two years.

I solve the above model numerically. For the matching function, I use the commonly used Cobb-Douglas specification, $g(\xi) = \eta\xi^{\omega}$. I approximate the value function as in Nagypál (2001) taking into account dismissal costs. Here, unlike in Nagypál (2001) where the bargaining share of the worker was zero, I have to calculate the equilibrium value of the market tightness recursively. This is straightforward, as it is easy to show that, given the value of unemployment in Equation (9), the left hand side of Equation (7) is decreasing in ξ, while the right hand side is increasing in ξ, thus a simple bisection method suffices.

With respect to the choice of the parameters of the model, for the parameters that were not estimated in Nagypál (2001) due to the computational complexity of the problem, I use the same values as I used there. In particular, $\bar{\mu}$ is normalized to be equal to 1. I assume that the price process follows a symmetric two-state Markov process, where the price can take on the values $p_l = 1$ and $p_h = 2$, and that the probability of remaining in the same state is $\rho = 0.95$ implying that on average prices change every 20 periods. The discount factor β is set equal to 0.99, implying that a period corresponds roughly to one month in the model. The parameters of the matching function are set so that the elasticity of the matching function with respect to market tightness, ω, is 0.5, in line with empirical estimates, and the job-finding rate when there are equal number of vacancies and unemployed workers, η, is 30% on a monthly basis. The worker's share of the surplus, κ, is set equal to the elasticity of the matching function with respect to unemployment, ω, thereby the Hosios condition holds. For other values of κ, it would be theoretically possible for dismissal cost policies to be welfare improving as they might correct for the presence of matching externalities, an issue that I do not address here.

To see how the different learning processes lead to different policy evaluations, I first consider two polar cases: that of only learning-by-doing and that of only learning about match quality. I then evaluate the policy scenarios given the estimated parameters from Nagypál (2001). Table 3 gives the value of the parameters used in each of the three cases.

4.1 Only learning-by-doing

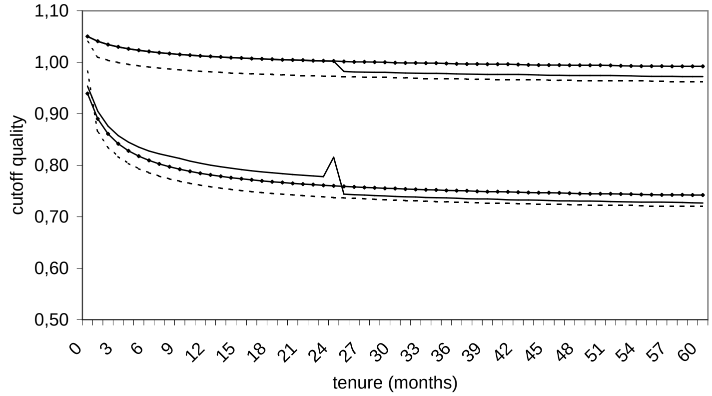
The value of δ is set to its estimated value in all three cases. In the case of only learning-by-doing the parameters are chosen the following way. To shut down learning about match quality, σ_μ and σ_x are set to zero. Note that, in contrast with the representative simulations for the case of only learning-by-doing in Section 3 of Nagypál (2001), there is no dispersion in match quality (σ_μ is set to zero, while it was set to a positive in value in Section 3 of Nagypál

Parameter	Only LBD	Only LMQ	At the estimated values
δ	0.00322	0.00322	0.00322
σ_μ	0.00	0.80	0.6261
σ_x	0.00	1.20	1.0283
σ_γ	0.50	0.00	0.6016
σ_y	0.50	0.00	0.3075
b	0.30	0.80	0.40
N	5.00	0.00	5.0901
c	0.08	1.50	1.00
$\bar{f}$	0.50	3.00	2.00

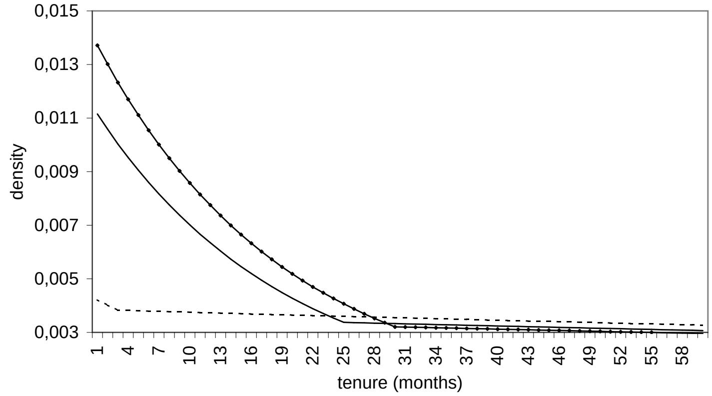
Table 3: Parameter values for which the policy scenarios are compared

(2001)). This is because I want to focus solely on learning-by-doing without considering the effect of the introduction of dismissal costs on the quality distribution of workers. σ_y, σ_γ, N, b and c are set to values such that there is substantial amount of learning-by-doing taking place and that the optimal policy differs sufficiently in the low- and high-price state. (With only one worker quality and two price states, it is common for the optimal policy not to differ across the two price states. This means that for several parameter values either the firm keeps all workers at all tenures, or it is not worth hiring any workers.) Finally, the dismissal cost, $\bar{f}$, is set to 0.5, which is equal to six weeks' worth of average revenue.

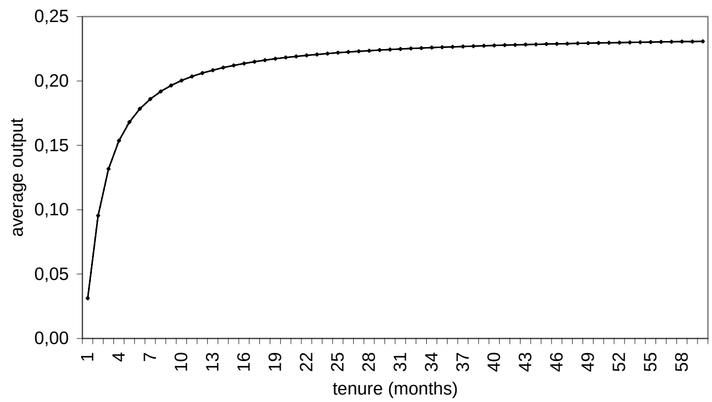
Figure 1 shows the results for the case of only learning-by-doing. Panel (a) shows the optimal cutoff quality in the three policy scenarios. With no dismissal costs (crossed line), the optimal cutoff quality is declining at all tenure levels, since as match-specific expertise increases with tenure, workers and firms are willing to continue less and less good matches. With constant dismissal costs at all tenure levels (dashed line), the optimal cutoff quality is also declining and is lower than without dismissal costs as workers and firms become less stringent as to what quality relationships they continue due to the presence of dismissal costs. There is a large decline in the cutoff quality between the time of meeting and one month of tenure because, while it is costly to end a relationship after one month of tenure, it is costless to not start it in the first place. This means that workers that would not be hired upon



(a) Optimal cutoff quality



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 1: Comparison of the policy scenario with no dismissal costs (crossed line), that with dismissal costs at all tenure levels (dashed line), and that with fixed-term contracts (solid line) for the case when only learning-by-doing is present

meeting in a particular price state nonetheless remain employed once inside the firm in the same price state. Insiders and outsiders are thus treated differently. With the introduction of fixed-term contracts (solid line), the optimal cutoff quality increases compared to the case of dismissal costs at all tenure levels, and workers and firms become more stringent as to what quality relationships they continue during the time while the worker is on a fixed-term contract. The cutoff quality increases right before the signing of the permanent contract, since promotion to a permanent contract means that the worker can subsequently be dismissed only at a substantial cost.

Of course, in the simple case when there is no dispersion of match quality, all workers enter at the same quality of $\bar{\mu} = 1$. The three policies then simply differ in that, with no dismissal costs, workers that were hired in a good price state are vulnerable to termination in a bad price state up to a tenure of 31 months, with dismissal costs they are vulnerable only up to a tenure of 3 months, while with fixed-term contracts they are vulnerable up to a tenure of 24 months (until they are promoted to permanent contracts). A similar optimal cutoff quality would arise if we allowed for dispersion in match quality. As I argued above, I do not allow for such dispersion, since if I did then the effect of the policy change on the quality distribution would confound the pure learning-by-doing effects.

Panel (b) shows the distribution of workers across different tenure levels. Clearly, the distribution after the introduction of dismissal costs shifts to the right, since workers are vulnerable to termination for a much shorter period of time under this policy. The distribution after the introduction of fixed-term contracts is in between the one for the policy of no dismissal costs and the one for the policy of dismissal costs at all tenure levels, reflecting the fact that fixed-term contracts represent a compromise between the two.

Panel (c) shows the average output of a worker at each tenure level under the three policies. As the learning-by-doing process is a passive learning process, the policy has no effect on the productivity as a function of tenure. The shift in the distribution towards higher tenure levels and the unchanged distribution of productivity across tenure together imply that average output per worker increases after the introduction of dismissal costs. As Table 4 reports, average output goes from 0.2235 to 0.2307, an increase of 3.24%. Such an increase in output per worker is necessary when there is only learning-by-doing, since the introduction of dismissal costs makes it harder to dismiss workers of lower tenure, thus shifting the distribution of workers towards higher tenure levels, where workers are more productive.

This positive productivity effect needs to be weighed against the relocation hindering aspect of dismissal costs, which in this setup means that, with dismissal costs, workers are more often employed by firms experiencing a bad price shock because the relocation of workers to high-price firms (which are all the newly created firms) is more costly. This means that despite the increase in productivity, average revenue actually drops after the introduction of dismissal costs, from 0.3558 to 0.3494, a decrease of 1.79%, as reported in Table 4.

Both the increase in average output and the decrease in average revenue are much attenuated with the introduction of fixed-term contracts. Compared to the case of no dismissal costs, with fixed-term contracts average output increases only by 0.96% and average revenue declines only by 0.42%, implying that the introduction of fixed-term contracts shifts back the economy most of the way towards the equilibrium with no dismissal costs.

Table 4 also reports the effect of the policy changes on unemployment. For the given parameters, unemployment declines from 10.67% to 3.43% when dismissal costs are introduced. The introduction of dismissal costs influences unemployment through two channels. First, unemployment decreases as the rate of job loss decreases, due to the increased cost of dismissing workers. Second, unemployment increases as the job-finding rate decreases due to the decline in job creation that takes place because of the decreased value of a new match (the equilibrium market tightness declines from 0.4464 to 0.4049). For the given parameters, the first effect dominates, hence unemployment declines. With the introduction of fixed-term contracts, unemployment rises to 8.80%, most of the way back to the unemployment rate with no dismissal costs. These results are very sensitive, however, to the choice of the parameters of the matching function, so the results regarding unemployment should be treated with more caution than those regarding average output and revenue per worker.

Finally, Table 4 reports total revenue per capita, which takes into account the average

Only learning-by-doing			
	No dismissal costs	Dismissal costs	Fixed-term contracts
Average output per worker	0.2235 (100)	0.2307 (103.24)	0.2256 (100.96)
Average revenue per worker	0.3558 (100)	0.3494 (98.21)	0.3543 (99.58)
Total revenue per capita	0.3498 (100)	0.3477 (99.40)	0.3495 (99.91)
Market tightness	0.4464	0.4049	0.4459
Unemployment rate	10.67%	3.43%	8.80%
Less than 2 years tenure	18.15%	7.80%	14.63%

Only learning about match quality			
	No dismissal costs	Dismissal costs	Fixed-term contracts
Average output per worker	2.1097 (100)	2.0333 (96.38)	2.1027 (99.67)
Average revenue per worker	3.1916 (100)	3.0734 (96.30)	3.1792 (99.61)
Total revenue per capita	3.0447 (100)	2.9478 (96.82)	3.0350 (99.68)
Market tightness	1.0715	1.0067	1.0685
Unemployment rate	6.14%	5.43%	6.05%
Less than 2 years tenure	15.45%	14.85%	15.07%

At the estimated parameters			
	No dismissal costs	Dismissal costs	Fixed-term contracts
Average output per worker	1.0309 (100)	0.9977 (96.78)	1.0264 (99.56)
Average revenue per worker	1.5580 (100)	1.5053 (96.62)	1,5498 (99.48)
Total revenue per capita	1.4972 (100)	1.4380 (96.05)	1.4906 (99.56)
Market tightness	0.7765	0.7323	0.7736
Unemployment rate	5.24%	4.47%	5.14%
Less than 2 years tenure	14.20%	13.43%	13.77%

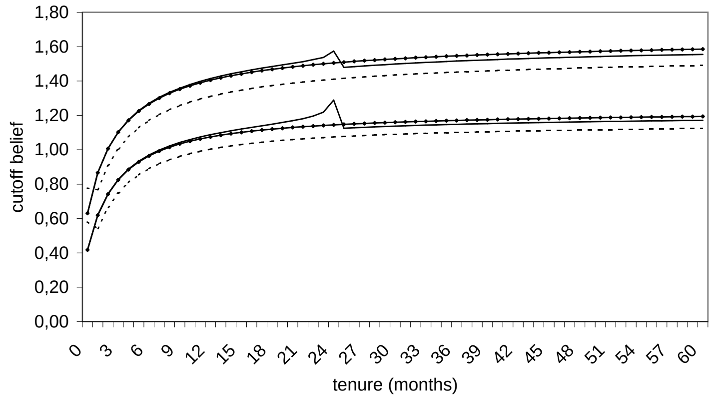
Table 4: Average output and revenue per worker, total revenue per capita, unemployment rate, market tightness and the fraction of workers with less than two years of tenure under the three policy scenarios for the three cases considered

revenue per worker, the level of employment, and the expended dismissal costs. Due to the decrease in average revenue per worker, total revenue per capita declines despite the decrease in unemployment when dismissal costs are introduced. Once again, the introduction of fixed-term contracts pushes the economy back towards the case with no dismissal costs.

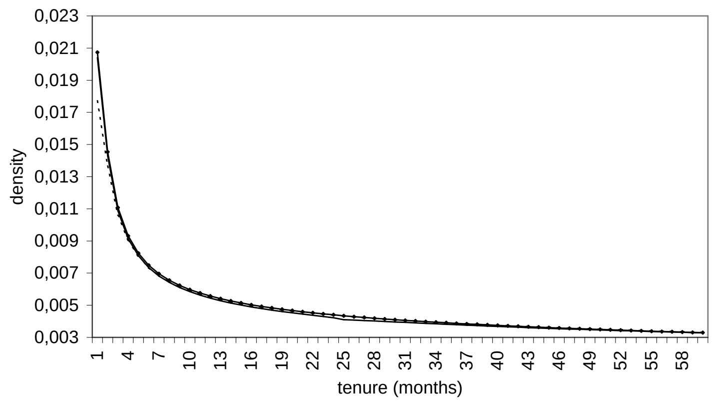
4.2 Only learning about match quality

In the case of only learning about match quality, σ_μ and σ_x are set to 0.8 and 1.2, respectively, implying a substantial amount of heterogeneity in match quality (σ_μ) and slow learning due to the noisiness of the signals (σ_x). σ_y, σ_γ and N are set to zero, which shuts down the learning-by-doing process. b is set to 0.8, which is approximately a week's worth of average revenue. Setting the value of leisure at a relatively high level compared to the average quality of a match makes experimentation a very important aspect of an employment relationship, since it means that the quality of a match has to be well above average to justify continued employment. The cost of keeping a vacancy open is set to 1.5, which is approximately two weeks' worth of average revenue, while the dismissal cost, $\bar{f}$, is set to be equal to a months' worth of average revenue.

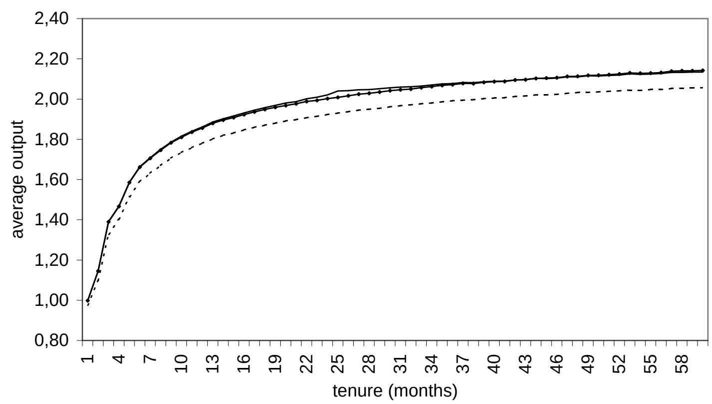
Figure 2 shows the results for the case of only learning about match quality. Panel (a) shows the optimal cutoff belief in the three policy scenarios. With no dismissal costs (crossed line), the optimal cutoff belief is increasing at all tenure levels which is due to the fact that, as the option value of employment declines with tenure due to decreased uncertainty about match quality, the worker-firm pair becomes more and more stringent regarding the belief about match quality required to continue employment. The same pattern arises when dismissal costs are introduced (dashed line), but now cutoff beliefs are lower, since workers and firms become less choosy and more willing to continue matches even if they are not very good quality in order to avoid paying the dismissal costs. This is exactly the experimentation hindering aspect of dismissal costs that becomes important when there is substantial amount of learning about match quality. Here, too, there is a decline between the time of meeting and one month of tenure and it occurs for the same reason as in the case of only learning-by-



(a) Optimal cutoff belief



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 2: Comparison of the policy scenario with no dismissal costs (crossed line), that with dismissal costs at all tenure levels (dashed line), and that with fixed-term contracts (solid line) for the case when only learning about match quality is present

doing. With the introduction of fixed-term contracts (solid line), the optimal cutoff belief increases for tenure levels less than two years. As it is costless to dismiss a worker at these tenure levels, the cutoff belief becomes higher. Once again, the cutoff belief increases right before the signing of the permanent contract, since promotion to a permanent contract means that the worker can subsequently be dismissed only at a substantial cost. This means that, with the introduction of fixed-term contracts, the average quality required to be promoted to a permanent contract is higher than when there are dismissal costs at all tenure levels, and is even higher than when there are no dismissal costs.

Panel (b) shows the distribution of workers across different tenure levels. The distribution after the introduction of dismissal costs shifts to the right, since under this policy workers are less vulnerable to termination due to the lower optimal cutoff belief. As before, the distribution after the introduction of fixed-term contracts is in between the one for the policy of no dismissal costs and the one for the policy of dismissal costs at all tenure levels.

Panel (c) shows the average output of a worker at each tenure level under the three policies. There is a substantial decrease in average output at each tenure level when dismissal costs are introduced, since there is much less scope for experimentation, which means that the average quality of a worker at each tenure level declines. With the introduction of fixed-term contracts most of this decline is eliminated and the productivity distribution is very similar to the one with no dismissal costs. In fact, average productivity at the time of promotion is even higher than with no dismissal costs, since this is the last time dismissal is costless with fixed-term contracts, implying a stringent promotion policy and a high average quality of those promoted.

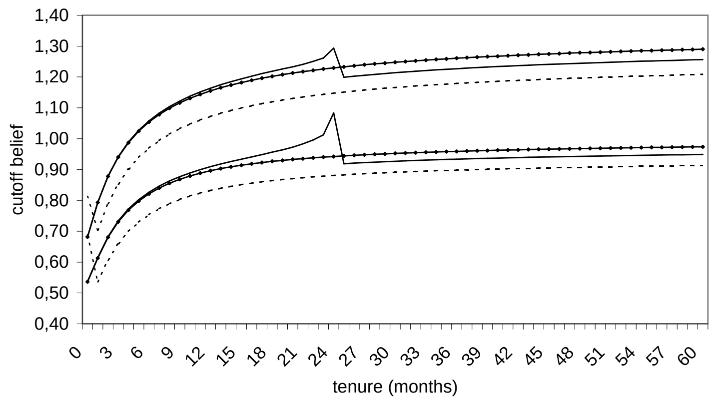
The shift in the distribution towards higher tenure levels where workers on average are more productive has to be weighed against the decrease in average output at each tenure level in order to determine the change in average output per worker. For the given parameters, the second effect far outweighs the first one. As Table 4 reports, average output goes from 2.1097 to 2.0333, a decrease of 3.62%. (Note that these average output numbers are not directly comparable with the case of only learning-by-doing.) The additional loss of revenue due to the relocation hindering effect is not very large in this case, average revenue drops by 3.70%, just a bit more than average product. These losses are once again much attenuated with the introduction of fixed-term contracts. Compared to the case of no dismissal costs, with fixed-term contracts average output decreases only by 0.33% and average revenue declines only by 0.39%, implying again that the introduction of fixed-term contracts shifts back the economy most of the way towards the equilibrium with no dismissal costs.

For the given parameters, unemployment declines from 6.14% to 5.43% when dismissal costs are introduced and is 6.05% with fixed-term contracts. With regards to unemployment, the same two effects are at work as in the case of only learning-by-doing. As for total revenue per capita, given the small change in unemployment, the magnitude of its change is similar to that of average revenue, it drops by 3.18% when dismissal costs are introduced, and only by 0.32% when fixed-term contracts are allowed.

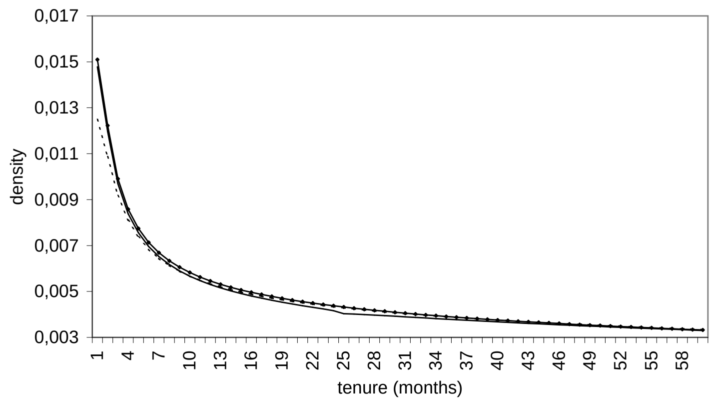
4.3 Both learning processes given the estimated parameters

Of course, the above polar cases tell two extreme stories, which is useful to highlight the different effects at work and their potential size. In order to get a sense of the actual size of these effects, I evaluate the two policies at the values of learning parameters estimated in Nagypál (2001). $\bar{f}$ is set to six weeks' worth of average revenue, which is in the plausible range, though probably on the low end. (Recall that there are no easy ways to measure dismissal costs, since they are non-monetary in nature.) The monthly cost of keeping a vacancy open (c) is set to 1.0, which is approximately three weeks's worth of average revenue, and is in line with empirical estimates. The monthly value of leisure (b) is set to 0.4, which is a little more than a weeks' worth of average revenue.

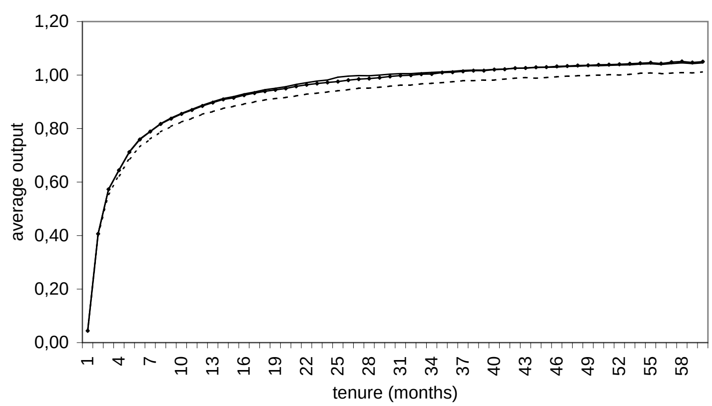
Figure 3 shows the results when the estimated parameter values are used. Panel (a) shows the optimal cutoff belief in the three policy scenarios. We see very similar patterns as in the case of only learning about match quality, which is to be expected, since that is the dominant learning process at the estimated parameters. Here, too, with the introduction of dismissal costs (dashed line), the optimal cutoff belief decreases compared to the case of no dismissal costs (crossed line), while with the introduction of fixed-term contracts (solid line),



(a) Optimal cutoff belief



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 3: Comparison of the policy scenario with no dismissal costs (crossed line), that with dismissal costs at all tenure levels (dashed line), and that with fixed-term contracts (solid line) when using the estimated values for the learning parameters

the optimal cutoff belief increases for tenure levels less than two years.

Panel (b) shows the distribution of workers across different tenure levels. Once again, the distribution after the introduction of dismissal costs shifts to the right and the distribution after the introduction of fixed-term contracts is in between the one for the policy of no dismissal costs and the one for the policy of dismissal costs at all tenure levels. The fraction of workers with less than two years of tenure drops from 14.20% to 13.43% after the introduction of dismissal costs and rises to 13.77%, less than half way back, with the introduction of fixed-term contracts.

Panel (c) shows the average output of a worker at each tenure level under the three policies. There is a decrease in average output at each tenure level when dismissal costs are introduced, though the extent of this is not as large as in the previously considered polar case. With the introduction of fixed-term contracts most of this decline is once again eliminated and the productivity distribution is very similar to the one with no dismissal costs.

In terms of the overall productivity effect, for the estimated parameters, the effect of decreased productivity at each tenure level outweighs the effect of the shift distribution towards higher tenure and thus more productive workers. As Table 4 reports, average output goes from 1.0309 to 0.9977, a decrease of 3.22%. The additional loss of revenue due to the relocation hindering effect of dismissal costs is not very large, average revenue drops by 3.38%, only slightly more than average product. Compared to the case of no dismissal costs, with fixed-term contracts average output decreases only by 0.44% and average revenue declines only by 0.52%, implying again that the introduction of fixed-term contracts shifts back the economy most of the way towards the equilibrium with no dismissal costs. In particular, the introduction of fixed-term contracts with a maximum length of two years eliminates 86% of the productivity loss due to dismissal costs.

For the estimated parameters, unemployment declines from 5.24% to 4.47% when dismissal costs are introduced and rises to 5.14% with fixed-term contracts, meaning that with dismissal costs the effect of lower job destruction outweighs the effect of lower job creation (the presence of which is apparent from the lower market tightness). As for total revenue per capita, given the small change in unemployment, the magnitude of its change is similar to that of average revenue, it drops by 3.95% when dismissal costs are introduced, and only by 0.44% when fixed-term contracts are allowed.

4.4 Sensitivity analysis

The above result of a 3.2% decline in average productivity when dismissal costs are introduced and only of a 0.44% loss when fixed-term contracts are allowed hinges crucially on the extent of experimentation in the economy. If there is substantial experimentation, then, by hindering this process, dismissal costs can lead to large productivity losses. On the contrary, the extent of this productivity loss is much lower when experimentation is less important.

The extent of experimentation depends on the value of the outside option of the agents in an employment relationship. If this is low, then the agents are willing to continue even low quality relationships to avoid being separated. If it is higher, agents become more choosy and experiment more. Given free entry, the value of a vacancy is zero, and thus this outside option is simply the value of unemployment. By Equation (9), this in turn depends on the value of leisure, the cost of a vacancy (since this affects the wage bargaining), and the bargaining share of the worker (and implicitly on the parameters of the matching function since these influence the equilibrium value of the market tightness). This section presents some results as to the extent of the productivity loss due to the introduction of dismissal costs when the above parameters of the model are changed.

First, Figure 4 presents results for the case when the value of leisure is allowed to vary. Negative values for the value of leisure are allowed, since what matters in terms of the separation decision is the difference between expected revenue and the value of leisure, and not their absolute value. (Adding a constant revenue when unemployed and employed would not change separation decisions, but would make the value of leisure positive.) The solid line is the average product when dismissal costs are introduced (with average product with no dismissal costs being normalized to 100). The dashed line is the implied value of unemployment (right scale), which of course rises with the value of leisure. We can see that as the value of leisure increases, the average productivity loss also increases, since experimentation becomes

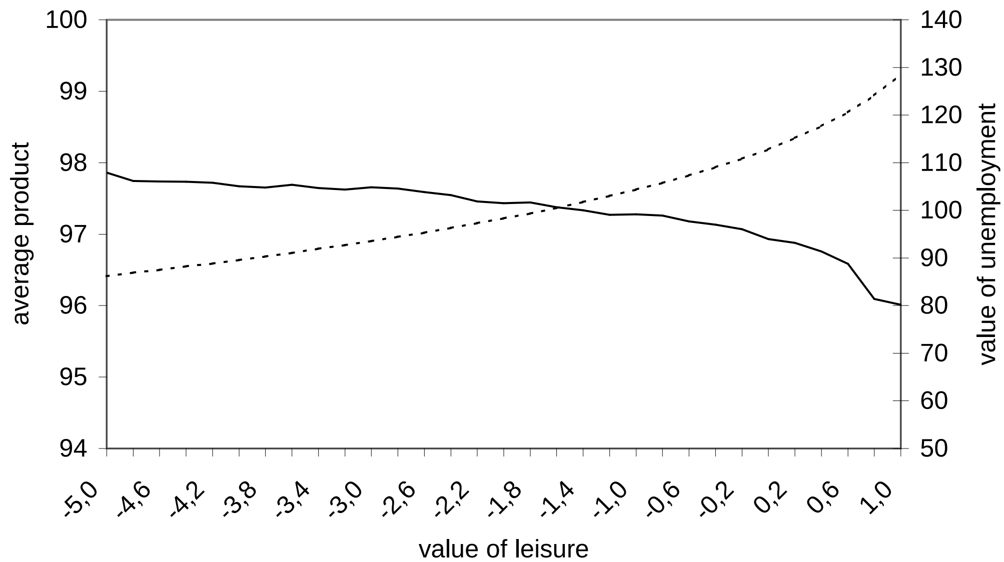


Figure 4: Average product (solid line, left scale) and the value of unemployment (dashed line, right scale) as a function of the value of leisure

more important. It is interesting to observe that the value of unemployment estimated in Nagypál (2001) is 51.89, which is lower than any value in the graph. Such a low value of unemployment was due to the fact that the workers for whom the estimation was carried out were highly attached to their jobs and had a low hazard rate of separation, which was possible to reconcile only by a low value of unemployment. That paper also showed, however, that the average worker in the French Labor Force Survey had a hazard rate that was almost twice as high as that of the workers in the sample used, therefore it is reasonable to use a higher value of unemployment than the one estimated in Nagypál (2001).

Next, Figure 5 presents results for the case when the vacancy cost is allowed to vary. Again, the solid line is the average product when dismissal costs are introduced (with average product with no dismissal costs being normalized to 100) and the dashed line is the implied value of unemployment (right scale). Unlike for the the value of leisure, the general sign of the change in the value of unemployment is ambiguous as the vacancy costs is varied, though for the given range and parameter values we see that the value of unemployment declines as the vacancy cost is increased. With the decline in the value of unemployment, the average

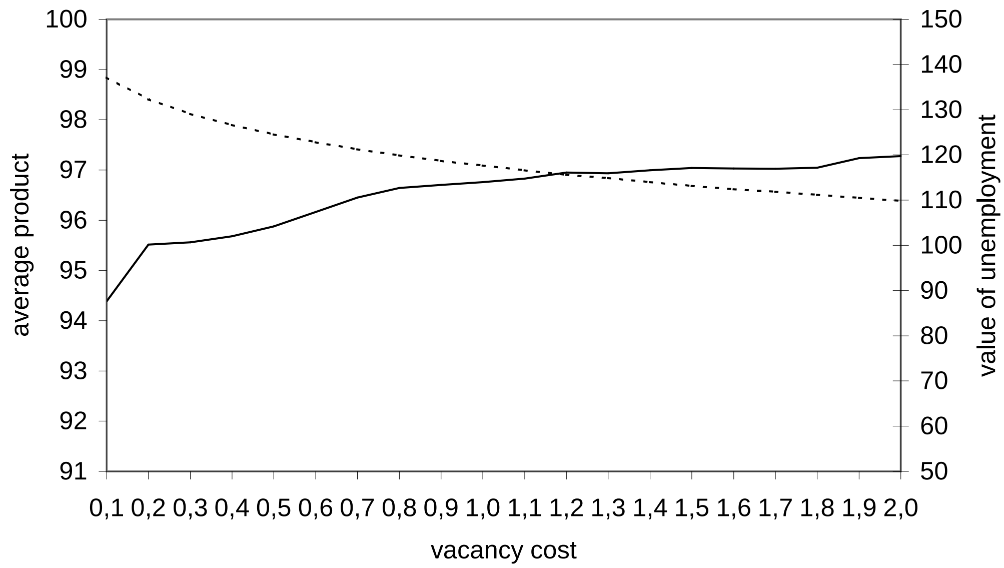


Figure 5: Average product (solid line, left scale) and the value of unemployment (dashed line, right scale) as a function of the vacancy cost

productivity loss also declines as the vacancy cost increases.

Figure 6 presents results for the case when the worker's bargaining share is allowed to vary. Again, the worker's bargaining share influences the size of the productivity loss through its effect on the value of unemployment. This effect is non-monotonic. There are two effects of an increase in the worker's bargaining share. On the one hand, it leads to higher wages, since the worker captures a larger share of the surplus. On the other hand, it stifles job creation and thus leads to a reduction in the job finding rate. For low values of the worker's bargaining share, the first effect dominates, while for higher values the second effect dominates.

In the policy experiments above I set the dismissal costs to be equal to 2. Figure 7 shows how the size of the productivity loss changes as the dismissal costs vary between 0 and 10. To put these numbers in perspective, recall that average monthly revenue without any dismissal costs is 1.56, thus 10 represents roughly six months' of average revenue. We can see that there is an almost linear relationship between the size of dismissal costs and the productivity loss, with the later amounting to 13% when dismissal costs are equal to six

Figure 6: Average product (solid line, left scale) and the value of unemployment (dashed line, right scale) as a function of the worker's bargaining share

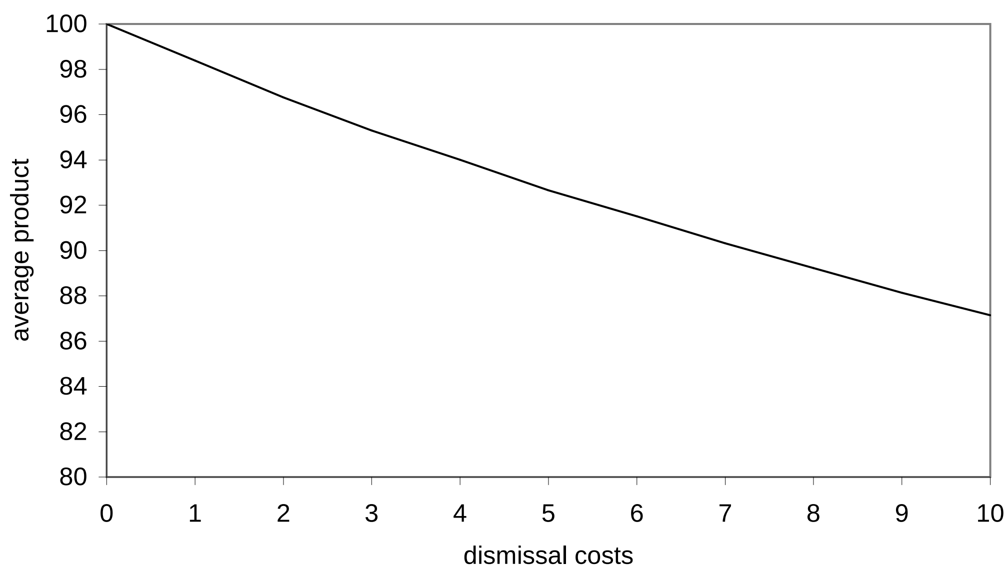


Figure 7: Average product as a function of the size of dismissal costs

months' of average revenue.

Another interesting question is how the maximum allowed length of fixed-term contracts affects the results regarding the extent to which the introduction of fixed-term contracts can eliminate the negative effects of dismissal costs. Figure 8 plots the average product (with average product with no dismissal costs being normalized to 100) for different maximum lengths (T) of the fixed-term contract. Clearly, $T = 0$ corresponds to the case of dismissal costs at all tenure levels, while $T = \infty$ corresponds to the case of no dismissal costs.

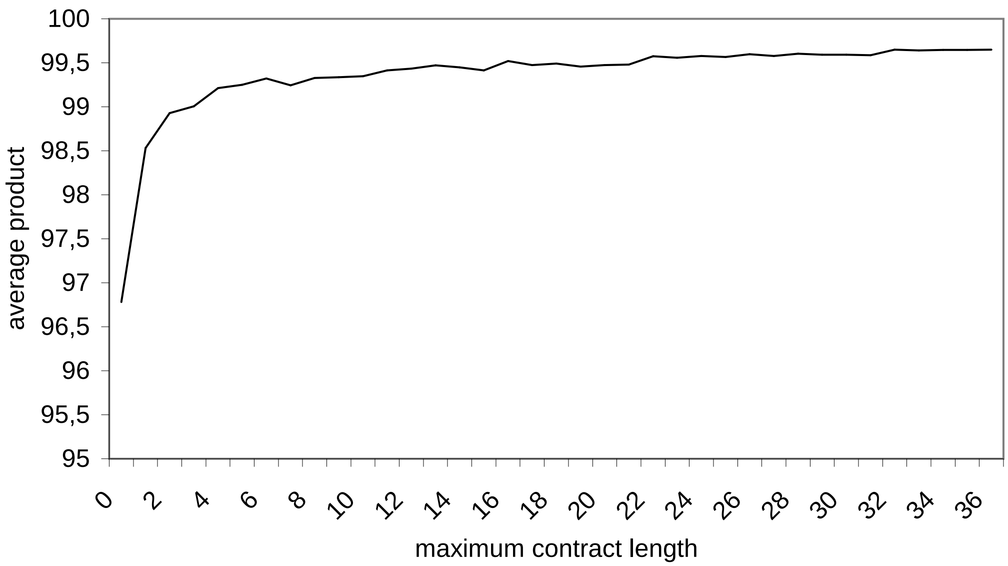


Figure 8: Average product in the presence of fixed-term contracts as a function of the maximum allowed contract length for fixed-term contracts

As we can see, much of the increase in average product comes from allowing for costless experimentation during the first few months of tenure, even though non-trivial further gains can be achieved by extending the contract length further. This plot also allows us to address the issue of trial periods. Trial periods are generally between 1 and 3 months in European countries (see, OECD (1999), with notable exceptions being UK, Ireland and Sweden), and are generally periods during which employment protection regulations do not apply to the same degree as for permanent employees. Trial periods can be thought of as fixed-term contracts with a very short maximum length. We can see from Figure 8 that the existence of trial periods even of a few months' length can be beneficial in terms of average productivity, but, even in the presence of trial periods, the introduction of dismissal costs leads to substantial productivity losses.

5 Conclusion

This paper emphasized the importance of considering match-specific learning when evaluating dismissal cost policies. It showed that it is crucial to consider the exact nature of the learning process to get an accurate evaluation of the productivity effect of such policies. Using estimates from Nagypál (2001), it demonstrated that the introduction of dismissal costs even on a small scale (equal to six weeks' worth of average revenue) reduces average product by 3.22%. This is due to the fact that dismissal costs hinder experimentation and thereby prohibit the optimal allocation of workers to matches. The removal of dismissal costs for workers with less than two years' of tenure via the introduction of fixed-term contracts removes more than 80% of this productivity loss.

On the one hand, to the extent that actual dismissal costs are probably higher, this study understates the productivity loss due to dismissal costs. On the other hand, even without fixed-term contracts, firms have some scope to costlessly experiment with workers for a few months (primarily through the use of trial periods), and thus this study overstates the productivity loss due to dismissal costs. In any event, the experimentation-hindering effect of dismissal costs and the experimentation-inducing effect of fixed-term contracts are important factors to consider when evaluating these policies. This is especially true since this productivity effect is sizable but is more subtle than the ambiguous employment effect that most previous work focuses on (for example, OECD (1999)) as it affects employed workers and the dynamics of experimentation.

The policy experiments above focused on comparisons of steady states. Transitional dynamics were not considered due to the complexity of keeping track of the distribution of workers over time and the time varying nature of the value of unemployment and the joint value of employment out of steady state. I believe that the insights that can be gained by considering the transitional dynamics are not of sufficient interest to take up this complex issue.

A more interesting issue that was side-stepped is why these dismissal costs exist in the first place. In the model of this paper, they simply lead to departures from the first-best outcome (given that the Hosios condition holds). Given the efficient separations framework used in this paper, one can show that it is not possible to construct a political economy argument for the opposition to the removal of dismissal costs. Studying the issue of why such a policy exists in the first place and how it relates to match-specific learning is an important question left for future research.

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