Fixed-Term Contracts in Europe: A Reassessment in Light of the Importance of Match-Specific Learning

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June, 2001

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Abstract

The use of fixed-term contracts has proliferated during the past decade in many European countries due to the relaxation of their regulation. Policymakers aimed to reduce labor-market rigidities by offering to firms these flexible contracts with little or no dismissal costs but with a finite contract length. The analysis of these contracts has thus far focused on their effect on the overall employment rate. This study highlights that in the evaluation of fixed-term contracts as policy instruments it is also important to look at their effect on productivity as a function of tenure and on the tenure distribution of employed workers. These two effects jointly determine the policy's overall productivity effect. I show that the liberalization of fixed-term contracts can have a significant effect on the productivity of employment relationships when match-specific learning is important. Moreover, the effect is different depending on the assumption about the nature of the learning process. I distinguish between two kinds of match-specific learning — learning-by-doing and learning about match quality — and show that under learning-by-doing the overall productivity effect is necessarily negative, while under learning about match quality the effect could be either negative or positive depending on how much experimentation improves in the presence of fixed-term contracts. I calibrate the model based on earlier empirical work and find that indeed the productivity effect is positive as output per worker increases by 0.6%.

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1 Introduction

This paper discusses the new insights that can be gained by explicitly incorporating match-specific learning into the evaluation of labor-market policies that alter the separation decisions of workers and firms. Match-specific learning leads to productivity gains with tenure, which means that it is crucial to consider match-specific learning in the evaluation of the productivity effect of a labor-market policy, in particular one that changes the average tenure structure in the economy. Moreover, productivity gains accumulate differently depending on the nature of the learning process. 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 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.

In recent years, there has been a proliferation of theoretical and empirical work trying to evaluate the effects of different labor-market policies. One key motivating factor behind this research has been the prevalence of labor-market restrictions in many European countries. Raising the cost of dismissals 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. As unemployment across Europe rose during the 1970s and 1980s, however, it was argued more and more that dismissal costs have a negative impact 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.

One important measure 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 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.

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

Due to differences in the institutional details, the use of fixed-term contracts is different across countries. Table 1 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. 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)).

There are several justifications for the use of fixed-term contracts in informal discussions (see, for example, Brewster, Mayne, and Tregaskis (1997)). First, some jobs are temporary in nature, which makes it natural to employ workers performing these jobs on fixed-term contracts. Second, fixed-term contracts provide more flexibility to firms in responding to idiosyncratic and aggregate shocks, since they provide firms with workers that are less costly to dismiss in case of an adverse shock. I call this the *flexibility* explanation. Third, fixed-term contracts allow firms to "experiment" with workers before offering them permanent contracts. I call this the *experimentation* explanation. The latter two justifications are, of course, more important in the analysis of the effects of the liberalization of the use of fixed-term contracts, since the interest there is in the use of fixed-term contracts for the more numerous workers not performing temporary jobs.

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 fixed-term contracts (for example, 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. 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 the liberalization of fixed-term contracts on aggregate employment, job turnover (as opposed to worker turnover), and job creation and destruction.

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 or that there are constant returns to labor at any particular firm with no interaction between different workers at the same firm (as in the model of Nagypál (2001)). The match-based approach is more suitable for evaluating the effect of the liberalization of fixed-term contracts on how well workers and firms are matched to each other and hence on the productivity of the average employed worker.

The difficulty in unifying the two 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. Since the analysis of this paper is concerned with learning that naturally leads to belief heterogeneity, I choose the match-based approach, and adopt the assumption of "one firm–one worker" matches that is standard in the matching literature.

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. 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.

Different authors evaluating the liberalization of fixed-term contracts, such as Bentolila and Saint-Paul (1992), Cabrales and Hopenhayn (1997) and Aguirregabiria and Alonso-Borrego (1999), have similar model structures. They assume that there are two types of workers. Permanent workers have productivity unity and can be dismissed at cost f, while temporary workers have productivity $\eta < 1$ and can be dismissed without cost. The trade-off then is between productivity and dismissal costs. It is this trade-off that determines the optimal employment structure of a firm in the face of shocks to the firm's productivity. There is no explicit modeling, however, of why temporary workers are less productive than permanent workers. 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 the liberalization of the use of fixed-term contracts on average worker productivity. The particular mechanisms that I study are the learning mechanisms studied in Nagypál (2001): learning-by-doing and learning about match quality. Additionally, most models (with the exception of Aguirregabiria and Alonso-Borrego (1999)) do not take into account the fact that there is a maximum duration after which a fixed-term contract needs to be transformed into a permanent contract, but rather treat workers on fixed-term contracts and those on permanent contracts as two separate classes of workers.

By incorporating learning about match quality, 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; this implies that there is a substantial amount of heterogeneity among workers on fixed-term contracts. Note that, in the setup of Bentolila and Saint-Paul (1992) and others, there is no possibility of such simultaneous hiring and separation of workers on fixed-term contracts. 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.

2 Dismissal costs

One of the most important features of fixed-term contracts is that they can be dissolved at a much lower cost than permanent ones. To understand the effect of the liberalization of the use of fixed-term contracts, then, one has to first understand where the costs of dissolving a permanent contract — generally referred to as dismissal costs — arise from. While there is considerable work on dismissal costs and their effects on the labor market, there is no real consensus in the literature as to what these dismissal costs actually are. Some researchers, 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. A separation takes place only if the joint surplus of the relationship falls below zero. It is assumed that, if the surplus is positive, the parties always find a way to split the surplus so that it is beneficial for both of them to continue the relationship. The worker and the firm can thus undo the effect of a severance payment by appropriately modifying the wage contract. 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.

Another way to think about dismissal costs is as the costs of terminating a worker 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. 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 more difficult to assess their size than that of severance payments, though the consensus view is that these costs are substantial and affect separation decisions substantially. Also, because of the difficulty of measurement, it is harder to assess how these costs differ across heterogeneous groups of workers, across tenure, and so on. In this work, I interpret dismissal costs in the latter way and model them as costs that are expended when a separation takes place.

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 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, q_τ, be

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

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. 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 $p_{\tau-1}$. In other words, the higher last period's price was, the less likely it is that this period's price is low. 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 $\pi(.)$.[2] 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 $\mathbf{x}_1^\tau$, and $\mathbf{p}_1^\tau$). 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 Evolution of beliefs

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 $N(\tilde{\mu}_\tau, \tilde{\sigma}^2_{\mu\tau})$.

3.1.3 Preferences and dismissal costs

The labor supply of workers is perfectly elastic at wage w, where w is the alternative value of a worker's time. This means that workers capture none of the surplus when in an employment relationship. Given that all separations are bilaterally efficient in the model, in the sense that separations only take place when the joint outside option of the parties exceeds the value of continuing the match, this assumption does not influence the decisions to separate,

[2] Of course, the caveats discussed in Judd (1985) apply here, too.

since that is independent of the surplus sharing rule. This assumption does mean, however, that, in the policy experiments, for the sake of simplicity, I do not consider the effect of policy changes on the outside option and hence on the bargaining position of workers.

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. This is equivalent to the firm making decisions unilaterally, since the worker is indifferent between being employed or not.

Finally, I introduce dismissal costs that are represented by the function $f(\tau), \tau = 1, 2, ..., \infty$, which gives the amount of dismissal costs as a function of tenure. I assume that f has a finite limit, i.e. $\lim_{t\to\infty} f(\tau) = \bar{f}$.

3.1.4 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 $\mathcal{F}_\tau = \sigma(\mathbf{x}_\mathbf{1}^\tau, \mathbf{p}_\mathbf{1}^\tau, \tilde{\mu}_0, \tilde{\sigma}_{\mu 0}^2)$.
- Agents have rational expectations: $\tilde{\mu_0} = \bar{\mu}$ and $\tilde{\sigma}_{\mu 0}^2 = \sigma_\mu^2$.
- Inactive firms open vacancies in each period in order to maximize the discounted sum of their revenues.
- The distribution of workers across price and belief states and the state of unemployment is constant.

As I show below, the optimal policies are unique, which implies that this equilibrium exists and is unique.

3.2.1 Separation decisions

Given Bayesian updating,

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

Note that the posterior variance, $\tilde{\sigma}_{\mu\tau}^2$, is a deterministic functions of τ.[3] Hence, τ is a sufficient statistic.

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 (prices prior to the last period are not part of the state space due to the first-order Markovian nature of the price process). Hence, the state space at the beginning of the τ^{th} period of employment includes $p_{\tau-1}, \tilde{\mu}_{\tau-1}$, and $\tau - 1$.

[3] This is not the case for other distributional assumptions.

Given the option of quitting and taking a known unemployment value U and vacancy value F (to be derived below), the Bellman equation describing the decision of agents at the time of meeting whether to form a match is

$$V_0(\bar{\mu}) = \max\left\{U + F\ ,\ p_M\bar{\mu}h(1) + \beta\left(\delta(U+F) + (1-\delta)EV(p_M, \tilde{\mu}_1, 1)\right)\right\}. \tag{3}$$

In periods $\tau \geq 2$ the Bellman equation describing the sequential decision problem of the agents is

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

The first term in the parentheses represents the value of separating taking into account dismissal costs (or the value of continued search at the time of meeting), 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,

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

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 $d(p_{\tau-1}, \tilde{\mu}_{\tau-1}, \tau-1)$ 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:

$$F = -c + \beta \left[g(\xi)/\xi \left(V_0(\bar{\mu}) - U - F \right) + F \right]. \tag{6}$$

Given that inactive firms are free to enter and open new vacancies, the value of a vacancy is bid down to 0, hence $F = 0$. This then means that

$$V_0(\bar{\mu}) - U = \frac{c\xi}{\beta g(\xi)}. \tag{7}$$

The value of unemployment is simply

$$U = \frac{w}{1-\beta}. \tag{8}$$

4 Policy experiment

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 $\tau = 1, 2, ...\infty$. In the baseline case that I study, there are dismissal costs at all tenure levels, which corresponds to the policy environment prior to the introduction of fixed-term contracts. I then alter this setup by introducing fixed-term contracts, which means 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 $\tau = T+1, T+2, ...\infty$.

I solve the above model numerically. I approximate the value function as in Nagypál (2001) taking into account dismissal costs. I then calculate the equilibrium value of market tightness from Equations (7) and (8). For the matching function, I use the commonly used Cobb-Douglas specification, $g(\xi) = \eta\xi^{\omega}$.

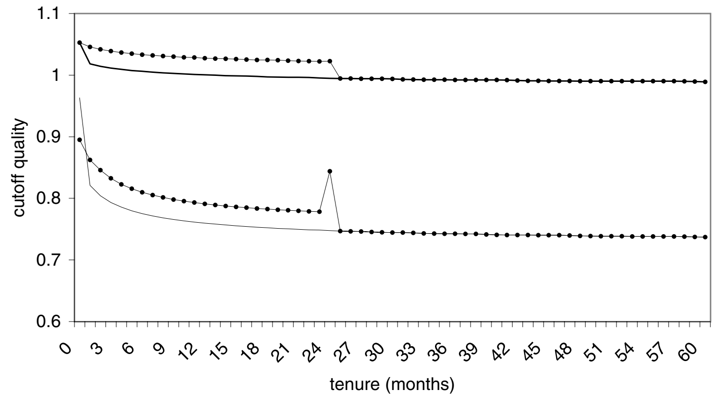
To see how the different learning processes lead to different policy evaluations, I first consider two polar cases: that of only learning-by-doing ('Only LBD') and that of only learning about match quality ('Only LMQ'). Then I evaluate the two policy scenarios given the estimated parameters from Nagypál (2001). Table 2 gives the value of the parameters used in each of the three cases.

Parameter	Only LBD	Only LMQ	For the estimated values
δ	0.00322	0.00322	0.00322
σ_μ	0.00	0.40	0.6261
σ_x	0.00	1.00	1.0283
σ_γ	0.40	0.00	0.6016
σ_y	0.40	0.00	0.3075
w	0.61	1.85	0.5189
N	5.00	0.00	5.0901
β	0.99	0.99	0.99
ρ	0.95	0.95	0.95
c	0.15	0.46	0.52
η	0.20	0.20	0.10
ω	0.50	0.50	0.10
T	24	24	24
$\bar{f}$	1.22	7.40	2.08

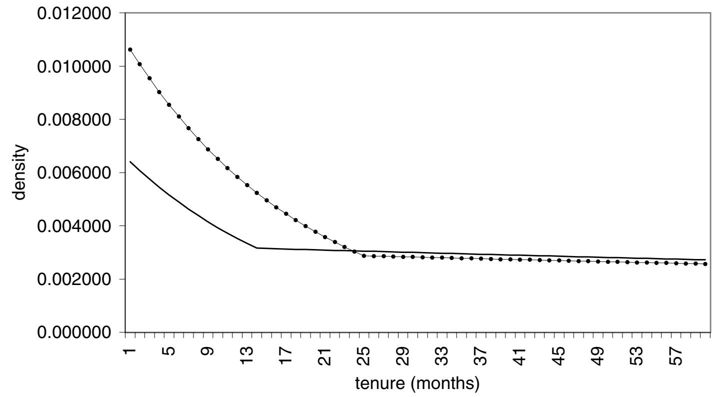
Table 2: Parameter values for which the two policy scenarios are compared

In the case of only learning-by-doing the parameters are chosen the following way. δ is set to its estimated value, while β and ρ are set to the same values that they were set to in the estimation procedure. σ_μ and σ_x are set to zero, since these are the parameters driving learning about match quality, which is not present in this polar case. 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 (2001)). I want to focus solely on learning-by-doing without considering the effect of the introduction of fixed-term contracts on the quality distribution of workers. σ_y, σ_γ, N and w 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. I.e., either the firm keeps all workers at all tenures, or it is not worth hiring any workers.) The cost of keeping a vacancy open is set to $w/4$, which means that it costs approximately a week's worth of the reservation wage to keep a vacancy open for a month. 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, and the job-finding rate when there are equal number of vacancies and unemployed workers, η, is 20% on a monthly basis. The parameters of the matching function determine how sensitive the job-finding rate is to changes in the value of employing a worker. T is chosen to be 24, which implies that the maximum duration of a fixed-term contract is two years, while the dismissal cost, $\bar{f}$, is set to be equal to two months' worth of the reservation wage.

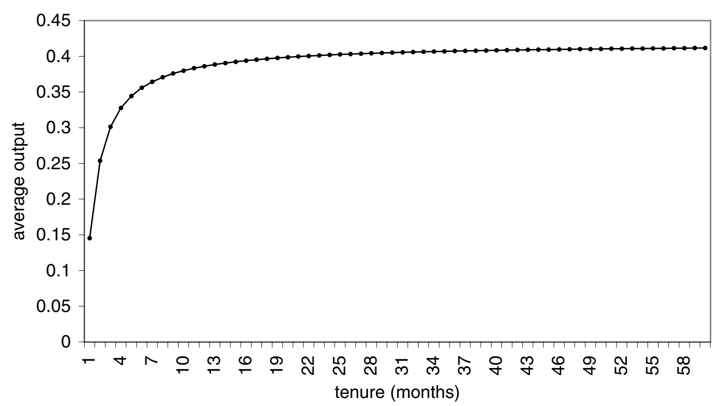
Figure 1 shows the results for the case of only learning-by-doing. Panel (a) shows the optimal cutoff quality in the two policy scenarios. With constant dismissal costs at all tenure levels, the optimal cutoff quality is declining at all tenure levels. There is a large decline between the time of meeting 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 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, the optimal cutoff quality changes, and worker and firm 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 two policies then simply differ in that, under the policy with dismissal costs at all tenure levels, workers that were hired in a good price state are vulnerable to termination in a bad price state up to a tenure of 14 months, while under the policy 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, so that I can abstract from the effect of the policy change on the quality



(a) Optimal cutoff quality



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 1: Comparison of the policy scenario with dismissal costs at all tenure levels (solid line) and that with fixed-term contracts (dotted line) for the case when only learning-by-doing is present

distribution.

Panel (b) shows the distribution of workers across different tenure levels. Clearly, the distribution after the introduction of fixed-term contracts shifts to the left, since workers are vulnerable to termination for a longer period of time under this policy, and the probability of reaching at least two years of tenure declines. Panel (c) shows the average output of a worker at each tenure level under the two policies. As the learning-by-doing process is a passive learning process, the policy has no effect on the productivity distribution. The shift in the distribution towards lower tenure levels and the unchanged distribution of productivity across tenure together imply that average output per worker declines. As Table 3 reports, average output goes from 0.4091 to 0.4053, a decline of almost 1%. Such a decline in output per worker is necessary when there is only learning-by-doing, since the introduction of fixed-term contracts makes it easier to dismiss workers of lower tenure, thus shifting the distribution of workers towards lower tenure levels, where workers are less productive.

Table 3 also reports the effect of the policy change on unemployment. For the given parameters, unemployment declines from 9.65% to 6.58% when fixed-term contracts are introduced. The introduction of these contracts influences unemployment through two channels. First, unemployment increases as the rate of job loss increases, due to the relative ease with which workers on fixed-term contracts can be dismissed. Second, unemployment declines as the job-finding rate increases. This increase is due to the job creation that takes place because of the increased value of a new match that results from the lower average cost of dismissal. For the given parameters, the second effect dominates, hence unemployment declines. This result is 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 per worker. Finally, Table 3 reports total product per capita, which takes into account the average output per worker, the level of employment, and the expended dismissal costs. Due to the decline in the unemployment rate, total product per capita increases despite the decline in average output per worker.

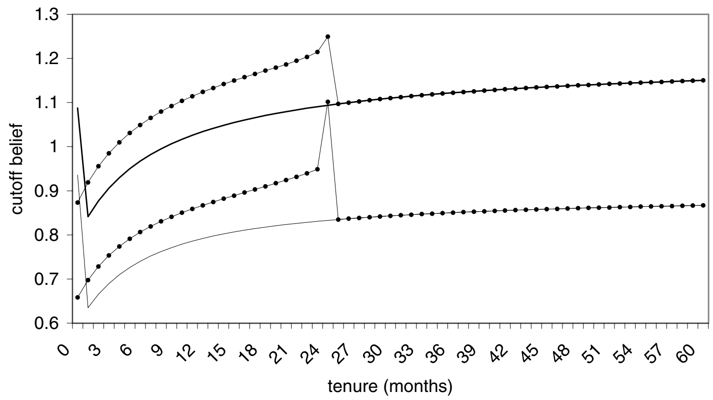
In the case of only learning about match quality δ, β, ρ, η, ω and T are chosen the same way as in the case of only learning-by-doing. σ_μ and σ_x are set to 0.4 and 1.0, respectively,

		Unemployment rate	Average output per worker	Total product per capita
Only LBD	Dismissal costs	9.65%	0.4091	0.3663
	Fixed-term	6.58%	0.4053	0.3786
Only LMQ	Dismissal costs	10.80%	1.3885	1.1710
	Fixed-term	2.83%	1.4618	1.4154
At estimates	Dismissal costs	3.53%	0.7497	0.7209
	Fixed-term	3.58%	0.7545	0.7270

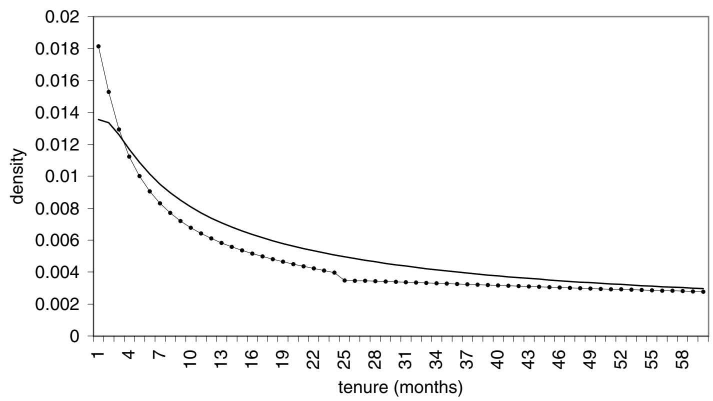
Table 3: Unemployment rate, average output per worker and total product per capita under the two policy scenarios for the three cases considered
(The numbers are not directly comparable across the three different cases, only across the two policy scenarios for each case.)

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. w is set to 1.85, which is somewhat higher that the average revenue generated by the average-quality worker. Setting the value of leisure at such a high level 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 once again set to $w/4$, while the dismissal cost, $\bar{f}$, is set to be equal to four months' worth of the reservation wage.

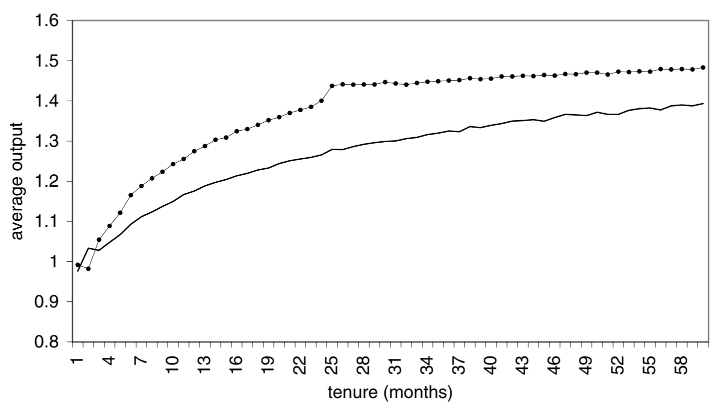
Figure 2 shows the results for the case of only learning about match quality. Panel (a) shows the optimal cutoff belief in the two policy scenarios. With constant dismissal costs at all tenure levels, the optimal cutoff belief is increasing at all tenure levels, except between the time of meeting and one month of tenure. This increase is due to the fact that, as the option value of employment declines, the worker-firm pair becomes more and more stringent regarding the belief about match quality required to continue employment. The decline between the time of meeting and one month of tenure occurs for the same reason as in the case of only learning-by-doing. With the introduction of fixed-term contracts, 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



(a) Optimal cutoff belief



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 2: Comparison of the policy scenario with dismissal costs at all tenure levels (solid line) and that with fixed-term contracts (dotted line) for the case when only learning about match quality is present

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. This is exactly the experimentation aspect of fixed-term contracts that becomes important when there is substantial amount of learning about match quality.

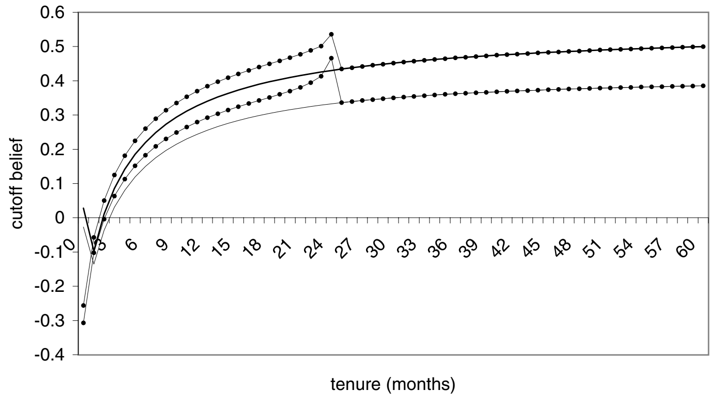
Panel (b) shows the distribution of workers across different tenure levels. Once again, the distribution after the introduction of fixed-term contracts shifts to the left, since under this policy workers are more vulnerable to termination due to the higher optimal cutoff belief. Panel (c) shows the average output of a worker at each tenure level under the two policies. There is a substantial increase in average output at each tenure level when fixed-term contracts are introduced, since there is much more scope for experimentation with such contracts, which means that the average quality of a worker at each tenure level increases.

The shift in the distribution towards lower tenure levels where workers on average are less productive has to be weighed against the increase 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 3 reports, average output goes from 1.3885 to 1.4618, an increase of over 5%. (Note that these numbers are not directly comparable with the case of only learning-by-doing.) Of course, as I mentioned above, the parameters, in particular the value of leisure, were chosen so that experimentation would be an important aspect, which should be kept in mind when interpreting these numbers.

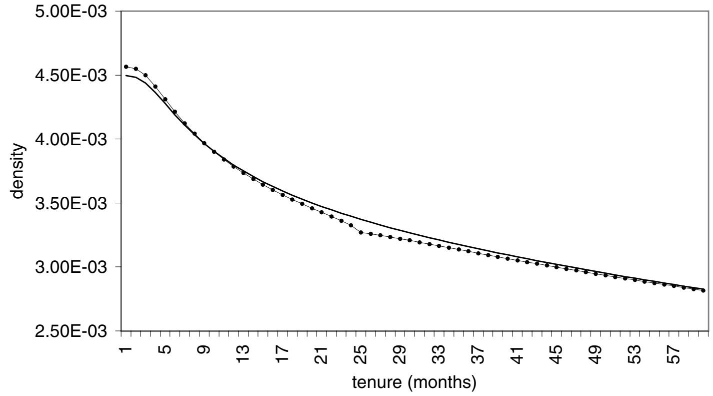
For the given parameters, unemployment declines from 10.80% to 2.83% when fixed-term contracts are introduced. With regards to unemployment, the same two effects are at work as in the case of only learning-by-doing. The large decline in unemployment implies that the effect of increased job creation far outweighs that of the increased job loss. Once again, this result is sensitive to the choice of the parameters of the matching function, so these unemployment results should be treated with caution. With regards to total product per capita, we see that there is a very large increase (over 20%) due to the fact that all three factors (increased average output per worker, declining unemployment, and lower average dismissal cost) favor the increase in total product per capita.

Of course, these two 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). β and ρ are once again set to the same values that they were set to in the estimation procedure. T is still set to 24, implying that fixed-term contracts may last for a maximum of two years, while $\bar{f}$ is set to four months' worth of the reservation wage, which is plausible. (Recall that there are no easy ways to measure dismissal costs, since they are non-monetary in nature.) The choice of the cost of a vacancy, c, and of the parameters of the matching function, η and ω, affects only the job-finding rate and not the optimal continuation decision of worker-firm pairs. In choosing their values, one has to consider the fact that, given that all the surplus from a relationship accrues to the firm, any increase in this surplus gives larger incentives for new firms to create vacancies than in the case where some fraction of the surplus accrues to the worker. This means that in order to get a reasonable evaluation of the job creation effect of the policy change, one needs to choose these parameters so that the they counter this large incentive to create new vacancies. This is why the cost of a vacancy is set to a large value (one month's worth of the reservation wage) and η and ω are set to relatively low values. Once again, it is important to note that the unemployment numbers should be interpreted with caution, since they depend heavily on the choice of the parameters that influence job creation. Also note, however, that the choice of these numbers does not influence changes in the average output per worker, which is the main focus of this exercise.

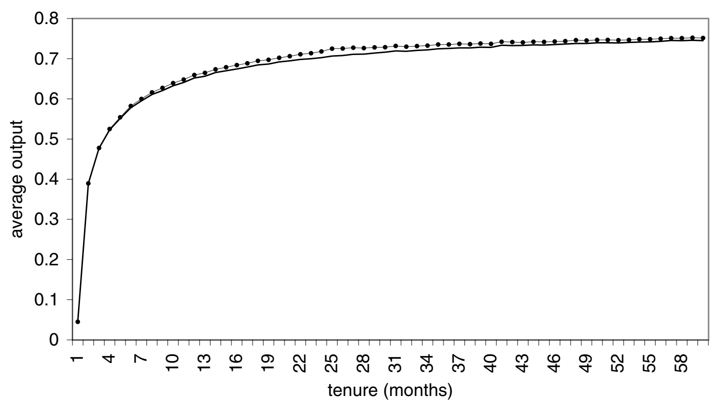
Figure 3 shows the results when the estimated parameter values are used. Panel (a) shows the optimal cutoff belief in the two policy scenarios. We see very similar patterns as in the case of only learning about match quality, which is to be expected, since that is the dominant learning process at the estimated parameters. Once again, with the introduction of fixed-term contracts, the optimal cutoff belief increases for tenure levels less than two years. This means that the average quality required to be promoted to a permanent contract is higher than when there are dismissal costs at all tenure levels. Note also, however, that the



(a) Optimal cutoff belief



(b) Distribution of workers across tenure



(c) Productivity across tenure

Figure 3: Comparison of the policy scenario with dismissal costs at all tenure levels (solid line) and that with fixed-term contracts (dotted line) when using the estimated values for the learning parameters

cutoff belief at all tenure levels is significantly below the average match quality, which means that experimentation is less significant than in the polar case of only learning about match quality.

Panel (b) shows the distribution of workers across different tenure levels. Once again, the distribution after the introduction of fixed-term contracts shifts to the left, though this effect is not as pronounced as in the polar cases. Panel (c) shows the average output of a worker at each tenure level under the two policies. There is an increase in average output at each tenure level when fixed-term contracts are introduced, though once again the extent of this is not as large as in the previously considered polar case. Just as in the case of only learning about match quality, the shift in the distribution towards lower tenure levels where workers on average are less productive has to be weighed against the increase in productivity at each tenure level in order to determine the change in average output per worker. For the estimated parameters, the second effect outweighs the first. As Table 3 reports, average output goes from 0.7497 to 0.7545, an increase of 0.6%. (These numbers are not directly comparable with the previous cases.)

For the given parameters, unemployment changes from 3.53% to 3.58% when fixed-term contracts are introduced. This means that the two effects of the introduction of fixed-term contracts on unemployment roughly cancel each other out. With regards to total product per capita, there is an increase of 1%. This increase is larger than the increase in average output per worker, since it takes into account the fact that fewer resources are expended when dismissals take place.

5 Conclusion

This paper emphasized the importance of considering match-specific learning when evaluating the policy of introducing fixed-term contracts. It showed that such a policy can have a potentially sizable productivity effect. This productivity effect is negative when there is only learning-by-doing present, but it is often positive when learning about match quality is present. While the introduction of fixed-term contracts shifts the distribution of workers towards lower tenure levels where they are less productive on average, it also can improve experimentation with different matches by allowing matches to be terminated at no cost during the early stages of employment. More experimentation leads to better quality matches on average, which results in increases in average output per worker at all tenure levels. Such experimentation is at the heart of learning about match quality.

I quantified this productivity effect using the estimates from Nagypál (2001). I found that there is a 0.6% increase in average output per worker when fixed-term contracts are introduced. Moreover, there is a 1% increase in total product per capita, where this increase takes into account, not only the increase in average output per worker, but also the declined average cost of dismissals. This increase of 1% in total product per capita is an important factor to consider when evaluating the effects of introducing fixed-term contracts. This is especially true since this productivity effect is more subtle than the employment effect that previous work focused on, as it affects employed workers and the dynamics of experimentation.

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