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EVALUATING LABOR MARKET REFORMS: A GENERAL EQUILIBRIUM APPROACH*

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Abstract

Job security provisions are commonly invoked to explain the high and persistent European unemployment rates. This belief has led several countries to reform their labor markets and liberalize the use of fixed-term contracts. Despite how common such contracts have become after deregulation, there is a lack of quantitative analysis of their impact on the economy. To fill this gap, we build a general equilibrium model with heterogeneous agents and firing costs in the tradition of Hopenhayn and Rogerson (1983). We calibrate our model to Spanish data, choosing in part parameters estimated with firm-level longitudinal data. Spain is particularly interesting, since its labor regulations are among the most protective in the OECD, and both its unemployment and its share of fixed-term employment are the highest. We find that fixed-term contracts increase unemployment, reduce output, and raise productivity. The welfare effects are ambiguous.

Keywords: Fixed-term contracts, Firing costs, General equilibrium, Heterogeneous agents.

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Evaluating Labor Market Reforms: A General Equilibrium Approach*

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Abstract

Job security provisions are commonly invoked to explain the high and persistent European unemployment rates. This belief has led several countries to reform their labor markets and liberalize the use of fixed-term contracts. Despite how common such contracts have become after deregulation, there is a lack of quantitative analysis of their impact on the economy. To fill this gap, we build a general equilibrium model with heterogeneous agents and firing costs in the tradition of Hopenhayn and Rogerson (1993). We calibrate our model to Spanish data, choosing in part parameters estimated with firm-level longitudinal data. Spain is particularly interesting, since its labor regulations are among the most protective in the OECD, and both its unemployment and its share of fixed-term employment are the highest. We find that fixed-term contracts increase unemployment, reduce output, and raise productivity. The welfare effects are ambiguous.

Key words: Fixed-term contracts, Firing costs, General equilibrium, Heterogeneous agents.

JEL classifications: E24, C68, J30.

1. Introduction

The consequences of job security provisions for employment, output, and welfare constitute an issue of great concern for economists and policymakers. Labor market rigidities, particularly those regarding workers' layoffs, are commonly blamed for the high European unemployment rates (see OECD, 1994a, for an example of this view). Following this belief and hastened by the worsening of unemployment rates during the 1980s, several European countries undertook institutional reforms aimed at deregulating labor markets.

A common feature of these reforms was the elimination of most restrictions on the use of non-causal fixed-term (also called temporary) contracts, which are characterized by much lower firing costs than those of permanent contracts. Since their introduction, fixed-term contracts have accounted for most new hirings in all sectors and occupations (OECD, 1993). Spain, with the highest unemployment rate among the industrialized countries, is a paradigmatic case. After the 1984 reform that allowed the widespread signing of non-causal fixed-term contracts, Spain has become the European country with the highest share of temporary employment: 32 percent in 2000. In addition, temporary contracts accounted for more than 98 percent of hires in the period right after the reform. Dolado *et al.* (2002) provide an informative survey of the Spanish experience with fixed-term jobs.

Until now, the literature evaluating the aggregate outcome of these institutional reforms has been sparse. While their impact on flows (both job creation and job destruction have increased) and on the variability of employment (also increased) seems clear, the effect of the reforms on unemployment level and welfare is less obvious. Although the existence of firing costs will reduce the level of hirings after a positive shock, firings after a negative shock will also be lower. Even more important, the research on layoff cost has shown how existing quantitative results depend crucially on different modelling choices (see Ljungqvist, 2002, for a thorough discussion).

To fill this gap, this paper quantitatively studies the effects of temporary contracts on quantities and prices. We develop a general equilibrium model with heterogeneous households, heterogeneous firms, and incomplete markets. In our economy, households work, search, and consume subject to a set of allowed labor contracts and a borrowing constraint, while firms maximize profits. The existence of firing costs transforms the firms' problem into a non-trivial intertemporal one.

We calibrate our model to Spanish data because the rate of temporality created by the reform of 1984 makes Spain a fascinating case study. An interesting point of our calibration is that some of the parameters are estimated with a dynamic partial equilibrium model and longitudinal data of Spanish firms.

The theory measures the consequences of fixed-term contracts for employment, labor turnover, productivity, and welfare. Our main finding is that eliminating temporary contracts *reduces* unemployment. In our model, unemployment is a function of the flows of job creation/destruction and the intensity of search undertaken by households. Since temporary contracts lower the adjustment costs created by severance payments, the elimination of these contracts decreases the flows into unemployment. Moreover, in the absence of temporary contracts, households search more intensively because the pool of jobs being offered improves. The combination of a higher search intensity and fewer layoffs reduces the equilibrium rate of unemployment. The fall in the matching probability induced by the lower number of vacancies posted is of second order and does not overcome the first two forces. Our result suggests that as a recipe to fight high unemployment rates, temporary contracts are a failure.

Fixed-term contracts, however, increase average labor productivity, since firms can respond more aggressively to productivity shocks. The wages of permanents workers rise because the firm fires them and pays the severance tax less often, as it takes advantage of the stock of temporaries to absorb negative shocks. The effect on welfare is ambiguous. Unemployed households and workers in high productivity firms win from the existence of temporary contracts while workers in low productivity firms lose.

This paper is not the first to assess temporary contracts. A number of previous studies have concentrated on the influence of fixed-term contracts on the dynamics of the labor market within a partial equilibrium perspective. The models conclude that fixed-term contracts boost the number of hirings and firings in the economy while the variation of aggregate employment remains unclear. Some examples are the labor demand models by Aguirregabiria and Alonso-Borrego (1999), Bentolila and Bertola (1990), Bentolila and Saint-Paul (1992), and Goux *et al.* (2001); the model of job creation and destruction by Cabrales and Hopenhayn (1997); or the matching economies by Blanchard and Landier (2002), Cahuc and Postel-Vinay (2002), and Wasmer (1999).

A second line of research is more empirical and addresses specific issues. The transition from fixed-term to permanent contracts has been analyzed by Booth *et al.* (2002) for the U.K.,

Güell and Petrongolo (2000) for Spain, and Holmlund and Storrie (2002) for Sweden. Nagypal (2001) probes the interaction between match-specific learning and fixed-term contracts. The changes on unemployment duration caused by temporary contracts is the focus of Boeri (1999) and Güell (2000b). Regarding the significance of fixed-term contracts on wages, Bentolila and Dolado (1994) and Saint-Paul (1996) show that a dualism in the labor market may imply a higher wage pressure if the unions protect the interests of permanent workers in the wage bargaining. Jimeno and Toharia (1993) and de la Rica (2003) document how employers frequently underrate workers with temporary contracts in order to pay them a lower wage than the one that corresponds to an equivalent permanent worker.

Finally, to the best of our knowledge, there have been only three other attempts to investigate these issues in a general equilibrium framework. Güell (2000a) looks at the qualitative implications of fixed-term contracts on unemployment with an efficiency wage model, in which the firm's choice of workers' types and the renewal rate of fixed-term positions into permanent ones are endogenous. She proves that the relationship between firing costs and fixed-term contracts is undetermined and that these contracts may not raise employment even in a world where firing costs would reduce employment. Álvarez and Veracierto (1999b) extend a Lucas-Prescott islands model with undirected search and complete markets to deal with severance taxes that depend on tenure. They interpret this dependence as a form of temporary contracts. Veracierto (2000) uses a similar environment to appraise the short-run consequences of introducing labor market flexibility. Both papers find that fixed-term contracts may increase unemployment.

The rest of the paper is organized as follows. Section 2 overviews the evolution of labor contract regulations in Europe since the 1980's, and lists some stylized facts. Section 3 presents our model and its equilibrium is defined in section 4. We discuss our calibration in section 5 and the results in section 6. Section 7 reinterprets the recent history of Spanish unemployment in the light of our findings. Section 8 summarizes and advances some ideas for future research. An appendix provides details about the computation.

2. Stylized Facts

The regulation of labor contracts differs among European countries (see European Commission, 1996 and 1997). For this reason, we need to define what we understand as permanent

and temporary workers in the data. Permanent workers are those with contracts of indefinite duration. Temporary workers are those with a fixed-term contract. The maximum duration of the latter is usually between one and three years. Also, the application of temporary contracts is often ruled by the principle of causality, i.e., aimed at jobs that are occasional or seasonal, jobs that fill temporary vacancies, apprenticeships, and jobs for carrying out a task or service predetermined in time. Another important difference between temporary and permanent contracts is the amount of severance payments and the degree of dismissal protection on each of them. Although regulations vary, a general feature of fixed-term contracts is that severance payments and dismissal protection are low.

The adverse economic conditions in the mid-1980's, together with the complaints of entrepreneurs about the rigidity of contract regulations, led several European countries to reform their labor markets. One of the main changes was to relax the limitations on the use of temporary contracts, in particular the restrictions regarding non-causal fixed-term contracts. Among the countries in the European Union, six liberalized temporary contracts over the 1980s (other six already had no limits on the use of temporary contracts). For instance, France deregulated temporary contracts in 1986, lifting the limitations on the purpose of these contracts and lengthening their maximum duration (previously between 6 to 12 months) up to 24 months. A counter-reform in 1990 reduced the applicability of these contracts, lowered their maximum duration to 18 months, and imposed a severance payment equivalent to 5 percent of gross salary. Germany moved in 1985 from a restrictive casuistic to a widespread allowance of temporary contracts for any new hiring and former apprentices. Also, the maximum length was extended from six months to up to two years. In Italy, fixed-term contracts were limited to seasonal and training jobs before 1987. Since then, temporary contracts are allowed through collective agreements and prior administrative authorization. Nowadays, only Finland, Greece, and Sweden keep tight restrictions on temporary contracts (see OECD, 1994a and European Commission, 1996 and 1997).

[Table 1 here]

The extent of these reforms can be appreciated in table 1, where we present the evolution in the temporality rate (share of temporary employment in total employment) in the countries of the European Union. A remarkable fact is the jump experienced by France, Portugal and Spain, which deregulated the use of temporary contracts in the mid-1980s.

Spain, where a third of employees have a fixed-term contract, is a shocking case. Labor market regulations before 1984 were among the most protective in the industrialized world. That year, many of the previous restrictions on temporary contracts were removed, leading to their nearly unlimited use. Temporary contracts could be cancelled at termination with a low severance payment (12 days per year of tenure),[1] and their extinction could not be appealed to labor courts. The maximum length of temporary contracts was set to three years. Thereafter, the firms would decide whether to offer the worker a permanent contract or to dismiss him. The reform did not introduce any change in the regulations of permanent contracts. In 1992, the minimum length of a non-causal temporary contract was set to one year, and in 1994, further restrictions on the scope of non-causal temporary contracts, related to the age and conditions of the employee, were established. In 1997, severance payments for permanent employees were reduced in order to promote the use of permanent contracts.[2] Regulation of temporary contracts is currently a controversial issue, and trade unions and the government are considering further legal regulations.

Three facts have emerged from the reforms across Europe. First, the introduction of temporary contracts does not correlate with a reduction of unemployment. Second, the entry and exit flows have substantially augmented. Finally, the elasticity of employment with respect to real GDP has risen.

[Table 2 here]

To illustrate the first assertion, in table 2, we report the correlation between the temporality and the unemployment rate using data for the EU countries from 1990 to 1996. We estimate such correlation controlling for country-specific effects and with time dummies to account for aggregate shocks. In the first column, we report the results for the EU-15 countries. In the second, we have excluded the three countries that were the last to join the EU (Austria, Finland, and Sweden). Whereas the correlation coefficient using the full sample is positive (although marginally significant), the coefficient with the restricted EU-12 sample

[1] Mandatory severance payments for permanent workers were 20 days of salary per year of tenure (up to one year wages) if the dismissal was considered "fair," and 45 days (up to 42 months of wages) if it were considered "unfair." The burden of proof for a fair dismissal fell on the firm. Labor courts tended to rule in favor of workers. See Galdón-Sánchez and Güell (2000).

[2] Severance payments for fair dismissals of permanent workers were maintained at 20 days of salary per year of tenure, but those for unfair dismissals were lowered to 33 days of salary.

turns out negative, yet very small and clearly non-significant. There are three reasons to concentrate on the EU-12 results. First, there are issues of data homogeneity, since these three countries joined the EU in 1995. As an extreme case, Austria reports observations only for the last two years. Second, Finland and Sweden have two of the most restrictive legislations on temporary contracts (see OECD, 1994a). Finally, these very same countries suffered from a severe recession in the 1990s, and in both cases, their unemployment rates were multiplied by a factor of five in six years. Our evidence agrees with the findings in Bertola (1990), among several others, who showed no straightforward relationship between low employment and job security provisions for the major industrialized countries.

Concerning temporary contracts and job flows, OECD data show the negative correlation between job turnover and different indices of employment protection, including those related to the regulation of permanent and temporary contracts. When the index is built considering only the legal treatment of fixed-term contracts, the correlations are significantly stronger. They are also robust when correlations are computed for establishments of different size. This finding is not at odds with the similarity found in the amounts of job creation and job destruction across Europe and North America (Bertola and Rogerson, 1997). Comparable job turnover rates are compatible with the very different rates at which workers enter and leave unemployment. Temporary contracts have lifted entry and exit rates, leaving constant the job turnover rate.

Changes in labor market regulations also have a huge impact on how workers leave unemployment. OECD data document that the percentage of previously unemployed people who get a permanent contract has plummeted in countries that have implemented thorough reforms of temporary contracts (i.e., France and Spain). For example, in Spain, over 90 percent of workers that leave unemployment do so through a temporary contract. Countries that opted for mild reforms have suffered modest reductions in that percentage (i.e., Germany and Italy), whereas in those countries in which these contracts were already deregulated, the percentage has been constant (U.K., Denmark and the Netherlands).

Regarding the third fact- a stronger procyclical behavior of employment- Bertola (1990) and Bentolila and Dolado (1994), among others, report how temporary contracts increase labor demand in booms and decrease it in slumps, relative to the situation in which only permanent contracts are allowed.

3. The Economy

To explore the impact of temporary contracts on the economy, we build a dynamic general equilibrium model with heterogeneous households, firms subject to idiosyncratic shocks, and incomplete markets. Our model is in the tradition of Hopenhayn and Rogerson (1993) and Álvarez and Veracierto (2001).

We briefly motivate the elements in the theory. First, since this is the phenomenon we want to explore, we allow for two types of labor contracts: fixed-duration and permanent.

Second, we have heterogeneous households that can save in a one-period uncontingent bond. Previous contributions have focused on models with complete markets (see Álvarez and Veracierto, 2001, and Bertola, 2004, for two exceptions). However, full risk-sharing conceals the role of employment protection as a substitute for complete markets. Empirically, unemployment spells are long (over 20 months in Spain), repeated over time, and associated with substantial consumption and future wage reductions. These observations suggest that labor risks are difficult to insure. As a consequence, we believe that our framework delivers a more accurate weighting of labor market reforms. More important, in our model, households make non-trivial search decisions. Those decisions are optimally determined given the labor institutions. Our quantitative results show that households respond very differently to variations in the regulation depending on their asset levels. A version of our economy with a representative agent would not capture this margin and would imply a wrong assessment of changes in labor market policies.

Third, we introduce a simple labor market friction that provides an additional justification for job security provisions and that generates a positive unemployment rate. Households need to search to find a new job. The probability of finding a job depends on the search intensity that the household exerts and on the number of open positions. Both the effort and the number of vacancies are endogenously determined in the model. This friction emphasizes the matching problems of the labor market.

Fourth, we generate an endogenous cross-sectional distribution of firms subject to idiosyncratic shocks. Firms decide the division of their labor input between permanent and temporary workers as the optimal intertemporal response to shocks. In this way we capture the large volume of job creation and destruction at the individual firm level and learn how the firm's dynamics and productivity are affected by labor market regulations.

Finally, we use a general equilibrium approach. We keep track of the aggregate movements induced by the reforms because we want to use the model as a measurement tool to quantitatively appraise counterfactual policies. Our findings show that introducing fixed-term contracts has implications on the aggregate distribution of workers, capital accumulation, labor supply, and prices. Those general equilibrium effects would be missed by a partial equilibrium analysis. We checked that if we did not let prices adjust after the introduction of a labor market reform, we would reach opposite but misleading conclusions about the impact of that policy.

To keep the model tractable and computationally feasible, we abstract from several important features of the data. First, we exclude any interaction between fixed-duration contracts and the business cycle. Intuition suggests that aggregate fluctuations can be magnified if firms have an additional margin to respond to a common shock. Second, we do not explore how temporary contracts affect the wage-bargaining process. It has been argued that the presence of fixed-duration workers strengthens the bargaining power of permanent workers, since the firm will prefer to lay off the temporary workers first when a bad shock hits. However, in a dynamic framework, the presence of fixed-duration contracts will shift the average composition of employment. This shift may reduce the bargaining power of permanent workers. Third, we do not model the feedback between fixed-term contracts and private information. Fourth, we do not introduce ex-ante heterogeneity among households. Differences in productivity across workers or a life-cycle component may make the importance of temporary contracts vary. Finally, we omit any political-economic considerations that can explain why these contracts appeared in Europe during the 1980's. All these issues are worth exploring in future research.

3.1. Household's Problem

The economy is populated by a continuum of households of measure one which work and consume.

Households experience stochastic lifetimes: in every period they face a death probability σ. When a household dies, it is immediately replaced by a new household. The assets of the dead household are taxed away by the government. The new household is born unemployed and with zero assets. Assuming that an appropriate law of large numbers holds in this economy, the mortality rate of the population is also equal to σ.

During their lives, households can be employed or unemployed. Employment can be in a permanent or in a temporary position, but both labor contracts imply working the whole unit of time.[3] If unemployed, the household searches for a new job with effort $e_t \in [0,1]$. If employed, the household cannot search for a new job, i.e., e_t is equal to zero. We will discuss below how search operates and how the search effort affects the probability of finding a job. At this moment, it suffices to say that households enjoy consumption, dislike search effort, and are indifferent about the fate of future generations.

Those preferences can be represented by:

$$E_0 \sum_{t=0}^{\infty} (1-\sigma)^t \beta^t \left[\log\left(c_t^i\right) - \varphi e_t^i\right] \tag{1}$$

where E_0 is the expectation operator conditional on information available at time 0, β is the discount factor, c_t^i is consumption, and e_t^i is the search effort of household i at time t.

If we denote input prices by r_t and w_t^i, where r_t is the interest rate for assets and w_t^i is the wage received by the household, the household's budget constraint for period t is:

$$a_{t+1}^i + c_t^i \leq (1+r_t)\, a_t^i + w_t^i I_t^i + \Pi_t \text{ with } a_t^i \geq 0,\ \forall t \tag{2}$$

where I_t^i is an indicator function that tracks whether the household works in the period, Π_t is the household's share in the aggregate profits of the economy, and a_t^i is the household's holding of an uncontingent bond at the beginning of the period.

The budget constraint reveals how we are closing all securities markets, except the one in which the households trade an uncontingent bond subject to a no-short-selling restriction $a_t^i \geq 0$. This market structure generates the lack of perfect insurance reported by the literature. Arguments such as moral hazard or lack of commitment explain why households cannot insure labor risks and why a_t^i must be non negative. Also, as explained above, our market structure captures the ideas that labor market regulations may be a remedy for incomplete markets and that households' responses to labor market regulations differ depending on their asset level.

[3] In this paper we concentrate on full-time contracts. Interestingly enough, in most European countries in which fixed-term contracts have been introduced, part-time contracts are rare (see OECD, 1994a). Non-convexities due to commuting time or coordination problems may explain this observation if lotteries are not available.

3.2. Labor Contracts

We now describe the two labor contracts that we allow in the economy. First, we have the permanent contract. Under this arrangement, firms pay a wage for each period and a tax to the government in the case of dismissal. Two points deserve elaboration. First, firms cannot insure against the productivity shocks that lead to layoffs and severance payments. Consequently, Lazear's argument (1990) that if markets are complete, severance taxes are neutral, does not hold. Second, contrary to the practice in most countries, we do not condition the severance tax on seniority. If we did so, we would have a state space too large for practical computation. For simplicity, we assume that the tax revenue from this source and from bequests is wasted in unproductive purposes.

The second contract is the fixed-term one. Under this contract, firms pay a wage for one period and may offer a permanent contract at the beginning of the next. The households will come back next period to the firm and accept a permanent position if one is offered to them. We abstract from the fact that some temporary contracts can be renewed (for instance, in Spain up to three years in certain cases). Little content is lost because the possibility of renewals of temporary workers is equivalent to changes in the period length.

It is important to distinguish the fixed-term contract from the probationary period: those initial months in the employment relationship during which a firm can terminate a contract without a severance payment because the quality of a worker is inferior to what was expected. Even before the liberalization of fixed-term contracts, European countries had probationary periods with durations between two and six months that could be used by firms for screening purposes. Owing to the existence of a probationary period, it can be dangerous to overemphasize the role of fixed-term contracts as a screening device. Since we do not have private information, such a probation time is useless in our model. Also, a theory of temporary contracts constructed around screening has the problematic implication that, for example, one-third of Spanish workers are being tested at any moment in time.

The wages for permanent and temporary workers are given by w_{nt} and w_{mt}, respectively. This wage is common across firms. This is broadly consistent with the case of Spain, where firms are subject to a national, binding agreement between the unions and the industry's association that set the wage level for all workers, fixed-term and permanent. Firms cannot opt out of the agreement even if they experience a negative productivity shock. This assump-

tion is important because it transforms the level of employment in the main adjustment tool of firms. Other market structures, in which both wages and employment can adjust at firm level, will imply a different impact of the labor market reforms. See Álvarez and Veracierto (1999c and 2001) for a thorough discussion.

Permanent workers can quit at any period, although, in equilibrium, we will not observe voluntary quits. We do not include the proof of this result because it is tedious and uninteresting. The intuition, however, is simple. Since wages are common across firms, a permanent worker cannot search for a higher wage. At the same time, the worker risks an unemployment spell of positive duration and faces the cost of search. Even if the household leaves the firm to avoid a future firing, it is only to accelerate the negative outcome of unemployment. A similar argument shows that temporary workers will return to the firm where they worked during the last period and accept a permanent position if they are offered one.[4]

3.3. Search

There are two labor markets for unemployed households: the market for permanent jobs and the market for temporary jobs. Effort is required to find these markets, and households can search for only one of these markets at a time. A Walrasian auctioneer sets the wage in each market to equalize the number of households that found the market with the number of positions available and assigns the households randomly to one of the jobs offered in that market. In the case of temporary contracts, the available jobs are equal to the total temporary positions open. In the case of permanent jobs, the positions are equal to the net demand of new permanent jobs by firms, i.e., the total demand of new permanent positions less the temporary workers in the firm that are promoted. We will see below how firms decide how many workers to hire and why the firm gives priority in filling new permanent positions to workers within the firm.

Unemployed households decide which market they search for and how much effort e_t to exert. The probability of finding the labor market is:

$$p_j = e_t^{\xi} x_{jt}^{1-\xi} \qquad \text{for } j = n, m, \tag{3}$$

[4]The theory does not account for voluntary quitting. Data suggest that voluntary quitting is mostly related to transfers from one firm to another (keeping a permanent contract) or with life-cycle issues such as retirement or maternity. Differences in the quality of the match and life-cycle events are absent in our model.

where $0 \leq \xi \leq 1$, and x_{jt} is the amount of new jobs being offered in that market. This parametric form captures the idea that more effort increases the probability of finding a position but that this probability grows at a decreasing rate and that more jobs being offered makes it easier for households to find one. Constant returns to scale is a natural assumption. Since we have a Walrasian auctioneer in each labor market, the number of workers searching does not decrease the probability of each of them of finding a job. However, since wages are such that firms hire exactly the number of workers that show up in each market, more workers searching will lower the equilibrium wage and endogenously, through less search effort, will also lower the probability of finding a job.

3.4. Firm's Problem

There is a measure one of firms in the economy. Each firm has access to a production function $y_t = \exp(s_t) k_t^{\alpha} N_t^{\gamma}$ where k_t is the capital rented by the firm, N_t is an index of efficiency units of labor defined below, and s_t is a productivity shock. The output y_t can be consumed, used to pay the costs of hiring and firing workers, or invested in physical capital, which depreciates at a rate δ each period.

The index of efficiency units of labor is equal to $N_t = n_t^1 + \lambda (n_t^0 + m_t)$, a weighted sum of the workers n_t with a permanent contract and the workers m_t with a temporary contract. We use the notation n_t^1 to denote those permanent workers that have already worked one period for the firm (either as permanents or as temporaries) and n_t^0 for those permanents currently working for the first time in the firm. The parameter $\lambda < 1$ accounts for the lower productivity of the new workers in the firm as observed in micro data. We interpret this lower productivity as due to some form of firm-specific human capital that requires time to be acquired, regardless of the labor contract of the worker.[5]

The productivity shock s_t follows a first-order Markov process $F(s_t, s_{t+1})$. We can also think of s_t as the reduced form of other shocks, such changes to demand or taxes. To ensure that an appropriate law of large numbers holds, we do not require independence of shocks across firms.

[5]Since ours is a model with perfect information, we do not study the possibility of temporary workers exerting high effort to get a promotion to permanent. The empirical evidence clearly points out that the productivity of temporary workers is lower than the productivity of permanent workers after controlling for observables (de la Rica, 2003).

Firms face hiring and firing costs. For the permanent worker, the hiring cost is given by $\theta_n^H > 0$ and the firing cost by $\theta_n^F > 0$. The firing cost represents the severance tax paid by the firm and the hiring cost captures the cost of filling a vacancy, for instance, the time and money involved in a screening process. A special case is the promotion of workers from temporary to permanent. In this situation, the firm does not have to pay the hiring cost again, as the vacancy is already filled. As a consequence, the firm will always give temporary workers the priority to be hired as permanents (empirically, nearly all the firms do so). Only if the firm solicits more new permanent workers than the amount of temporaries it had left from the previous period, it will hire new permanents from the market. For the temporary worker, the hiring cost is given by $\theta_m^H > 0$ and the firing cost by $\theta_n^F = 0$. This last assumption embodies the nature of temporary contracts: their extinction is free for the firm.

The presence of hiring and firing costs makes the problem of the firm dynamic, since hiring and firing decisions in the current period will modify the profit function in the future. If the firm had n_{t-1} permanent workers in the past period, it has $(1-\sigma)n_{t-1}$ at hand at the beginning of the period (remember that a fraction σ of households dies every period). Then, if the firms wants to hire n_t permanent workers this period, the total demand will be equal to $d_t = n_t - (1-\sigma)n_{t-1}$. If the firm had m_{t-1} temporaries, the net demand of permanents will be $netd_t = \max\left\{n_t - (1-\sigma)\left(n_{t-1} + m_{t-1}\right), 0\right\}$. Thus, if the productivity shock of the firm is s_t, the number of permanent workers in the last period was n_{t-1} and the number of temporaries m_{t-1}, the profit in period t for given levels of n_t, m_t, and k_t is given by:

$$\pi\left(s_t, n_{t-1}, m_{t-1}\right) = \left\{ \begin{array}{c} \exp(s_t) k_t^{\alpha} N_t^{\gamma} - \left(r_t + \delta\right) k_t - w_{nt} n_t - w_{mt} m_t - \theta_m^H m_t \\ - \theta_n^H netd_t - \theta_n^F \max\left\{-d_t, 0\right\} \end{array} \right\} \tag{4}$$

where N_t is the labor productivity index defined as above.

The intertemporal problem of the firm is given by:

$$\max_{\{n_t, m_t, k_t\}} E_0 \sum_{t=0}^{\infty} \frac{1}{\left(1+r\right)^t} \pi\left(s_t, n_{t-1}, m_{t-1}\right) \tag{5}$$

where we use the interest rate as the firm's discount factor. In the absence of complete markets, it is not obvious that the interest rate is the right discount factor to use. However, we follow the most common practice in the literature. The profits of the firm are distributed

as a lump sum to all households in the economy.

We depart from Hopenhayn and Rogerson (1993) and Álvarez and Veracierto (2001) in that we do not consider entry and exit of firms. Since in our calibration the expected present-value profit of a new firm is very low, we closed down that margin to simplify the description of the model. Also, the presence of aggregate profits ensures that consumption will also be positive (but rather small) even for unemployed households with zero assets. Picking an appropriate initial distribution of entry cost will make our model equivalent to one with entry and exit of firms. We checked that the results of the model are robust to the size of the measure of firms.

3.5. Timing

Since a clear grasp of timing in this model is key to understand its behavior, we will spend a few lines describing it in detail.

3.5.1. Households

At the end of period $t-1$, each household is either unemployed, employed under a temporary contract that expires in that period, or employed under a permanent contract. At the beginning of period t, if the household survives, it observes all the information about the economy: the wages, the states of the firm where it works, and the distributions of agents. If the household dies, its wealth is taxed away by the government and a new unemployed household is created with zero initial assets.

If the household is a permanent worker in period t, it goes to the firm to work, and either stays as a permanent worker or is fired and becomes unemployed. If it is not dismissed, it stays as a permanent worker. If the household was a temporary worker in period $t-1$, it goes to the firm at the beginning of period t. Once there, the household is either promoted to permanent worker or is fired and becomes unemployed. Remember, there is no possibility of a renewal as temporary worker.

If the household is unemployed at the beginning of period t, either because it was unemployed at the end of the last period or because it was dismissed right at the beginning of the period, it decides for which job market to search and the intensity of the search effort e_t. Given this effort, the household will find the labor market with a probability given by (3). If so, the household is assigned randomly to one of the jobs posted by firms and produce in the

same period. Otherwise, it ends the period unemployed. This timing convention incorporates our modelling of the search friction in the job market: it takes time and effort to find a new job. We let the workers laid off at the beginning of the period to immediately find, with some probability, a new job to allow durations of unemployment spells lower than the period length (one year in our calibration).

3.5.2. Firms

At the end of period $t-1$, firms know the number of permanent and temporary workers they hired and, because of mortality, that only a fraction $1-\sigma$ will come to work in the next period. At the beginning of period t, firms observe wages, distributions, and their own idiosyncratic shock and decide about their new hirings or layoffs.

If the number of optimal permanent workers is equal to the number of present permanent workers, there are no hirings or firings. If the number of optimal permanent workers is larger, the firm promotes to permanent some workers who were under fixed-term contracts in the previous period and, if still there is not enough of them, it hires new workers. Finally, if the number of optimal permanent workers is smaller, the firm dismisses redundant permanent workers. Who is fired and who is promoted is a random choice (conditioning this decision on tenure or some other state would make the model intractable). Regarding temporary workers, at the beginning of each period, the firm recruits as many as it needs. Finally, firms produce, pay wages and interest, and distribute profits.

4. Equilibrium

We concentrate on studying stationary equilibria. Our concept of equilibrium will track the fact that the individual states of households must be consistent with the states of the firms, i.e., there should be as many households employed in firms with certain characteristics as the labor hired by firms with those states. We will call the joint stationary distribution of firms μ and households η in the economy $P = (\eta, \mu)$.

In this section we write the problems of the households and firms with a recursive formulation and define a stationary recursive competitive equilibrium.

4.1. Recursive Problems of the Households and Firms

The vector of state variables for the firm is given by $(s_t, n_{t-1}, m_{t-1}; P)$, i.e., the productivity shock, the amount of permanent workers and temporary workers, and the stationary distribution of agents in the economy. To emphasize that we deal with the stationary case, we use a semi-colon to separate P from the other states.

The vector $(a_t, s_t, n_{t-1}, m_{t-1}; P_t)$ records the state variables for the employed household i (we drop the superscript when no confusion occurs). Households are indexed not only by their assets and the stationary distribution of agents but also by the states of the firm in which they are employed at the beginning of the period. These firm states are relevant to computing the conditional probability of transition from permanent employment into unemployment or from temporary into permanent employment or unemployment. Our choice of state variables is equivalent to using as state variables n_t and m_t, since, conditional on a_t, they are a deterministic function of n_{t-1} and m_{t-1}. For an unemployed household the states are given by $(a_t; P)$.

The value function $W(\cdot)$ for the firm is defined by:

$$W(s_t, n_{t-1}, m_{t-1}; P) = \max_{\{m_t, n_t, k_t\}} \left\{ \pi(s_t, n_{t-1}, m_{t-1}) + \frac{1}{(1+r)} \int W(s_{t+1}, n_t, m_t; P)\, dF \right\} \quad (6)$$

where the profit function was defined in section 3.

The value function of a permanent worker before hiring/firing decisions in its firm, $V^n(\cdot)$, can be written as:

$$\begin{aligned} V^n(a_t, s_t, n_{t-1}, m_{t-1}; P) &= p_1(s_t, n_{t-1}, m_{t-1}; P)\, \widehat{V^n}(a_t, s_t, n_t, m_t; P) \\ &\quad + (1 - p_1(s_t, n_{t-1}, m_{t-1}; P))\, V^u(a_t; P) \end{aligned} \quad (7)$$

where $p_1(s_t, n_{t-1}, m_{t-1}; P)$ is the probability of staying employed as a permanent worker given the states of the firm s_t, n_{t-1} and m_{t-1}, $1 - p_1(s_t, n_{t-1}, m_{t-1}; P)$ is the probability of being laid off given the same states, $\widehat{V^n}(a_t, s_t, n_t, m_t; P)$ is the value function of the worker that stays employed as a permanent worker, and $V^u(a_t; P)$ is the value function of an unemployed household.

In an analogous way, the value function of a temporary worker before hiring/firing deci-

sions $V^m(\cdot)$ is

$$\begin{aligned} V^m(a_t, s_t, n_{t-1}, m_{t-1}; P) &= p_2(s_t, n_{t-1}, m_{t-1}; P)\,\widehat{V^n}(a_t, s_t, n_t, m_t; P) \\ &\quad + (1 - p_2(s_t, n_{t-1}, m_{t-1}; P))\,V^u(a_t; P) \end{aligned} \tag{8}$$

where now $p_2(s_t, n_{t-1}, m_{t-1}; P)$ is the probability of being promoted to permanent and the complement $1 - p_2(s_t, n_{t-1}, m_{t-1}; P)$ is the probability of being dismissed.

The problem of the employed household's that stays employed can be written as:

$$\widehat{V^n}(a_t, s_t, n_t, m_t; P) = \max_{\{c_t, a_{t+1}\}} \left\{ u(c_t) + (1-\sigma)\beta \int V^n(a_{t+1}, s_{t+1}, n_t, m_t; P)\, dF \right\} \tag{9}$$

subject to:

$$\begin{aligned} a_{t+1} + c_t &\leq (1 + r_t)\, a_t + w_{nt} + \Pi_t \\ a_{t+1} &\geq -A\ ,\ \forall t \end{aligned}$$

This equation reflects how the household, after being retained as or promoted to a permanent position chooses optimally current consumption, c_t, and the next period assets, a_{t+1}, given its budget constraint and the new states of the firm. Since the search effort of this household is zero, we forget the linear term from the utility function. The integral in the second term of the right-hand side is taken with respect to the conditional probability of the productivity shock of the firm in which the household works.

The value function of a temporary worker after being hired in that position is:

$$\widehat{V^m}(a_t, s_t, n_t, m_t; P) = \max_{\{c_t, a_{t+1}\}} \left\{ u(c_t) + (1-\sigma)\beta \int V^m(a_{t+1}, s_{t+1}, n_t, m_t; P)\, dF \right\} \tag{10}$$

subject to:

$$\begin{aligned} a_{t+1} + c_t &\leq (1 + r_t)\, a_t + w_{mt} + \Pi_t \\ a_{t+1} &\geq -A\ ,\ \forall t \end{aligned}$$

The value function of an unemployed household is defined by:

$$V^u(a_t;P) = \max \left\{ \begin{array}{c} \max_{e_t} \left\{ -\varphi e_t + e_t^{\xi} x_{nt}^{1-\xi} \widehat{V_n^{NEW}}(a_t;P) + (1 - e_t^{\xi} x_{nt}^{1-\xi}) \widehat{V^u}(a_t;P) \right\}, \\ \max_{e_t} \left\{ -\varphi e_t + e_t^{\xi} x_{mt}^{1-\xi} \widehat{V_m^{NEW}}(a_t;P) + (1 - e_t^{\xi} x_{mt}^{1-\xi}) \widehat{V^u}(a_t;P) \right\} \end{array} \right\}$$

where the unemployed household chooses in which market to search and the optimal level of search effort. Conditional on that effort, it finds a job with probability $e_t^{\xi} x_{jt}^{1-\xi}$ and stays unemployed with probability $1 - e_t^{\xi} x_{jt}^{1-\xi}$.

Three new objects appear in our definition of the value function of the unemployed. The first is the expected value of a new permanent job $\widehat{V_n^{NEW}}(\cdot)$ given assets a_t:

$$\widehat{V_n^{NEW}}(a_t;P) = \int p_3(s_t, n_t, m_t; P) \widehat{V^n}(a_t, s_t, n_t, m_t; P) \, dP \tag{11}$$

where $p_3(s_t, n_t, m_t; P)$ is the conditional probability of being offered a permanent job in a firm with states s_t, n_t and m_t. The second object is the expected value of a new temporary job $\widehat{V_m^{NEW}}(\cdot)$ given assets a_t:

$$\widehat{V_m^{NEW}}(a_t;P) = \int p_4(s_t, n_t, m_t; P) \widehat{V^m}(a_t, s_t, n_t, m_t; P) \, dP \tag{12}$$

where $p_4(s_t, n_t, m_t; P)$ is the conditional probability of getting a temporary job in a firm with states s_t, n_t, and m_t. Finally, the value function of an unemployed household after search is:

$$\widehat{V^u}(a_t;P) = \max_{\{c_t, a_{t+1}\}} \{ u(c_t) + (1-\sigma)\beta V^u(a_{t+1}) \} \tag{13}$$

subject to:

$$\begin{aligned} a_{t+1} + c_t &\leq (1 + r_t) a_t + \Pi_t \\ a_{t+1} &\geq -A \ , \forall t \end{aligned}$$

4.2. A Stationary Recursive Competitive Equilibrium

Now we are ready to define an equilibrium for our economy. A *recursive stationary competitive equilibrium* is a set of value functions $V^n(\cdot), V^m(\cdot), V^u(\cdot), \widehat{V^n}(\cdot), \widehat{V^m}(\cdot), \widehat{V^u}(\cdot)$ and a set of

associated decision rules $c(\cdot)$, $a(\cdot)$, $e(\cdot)$ for the household, and a value function $W(\cdot)$, and a set of decision rules $y(\cdot), k(\cdot), m(\cdot)$, $n(\cdot)$, for the firm, factor price functions $w^n(\eta(\cdot), \mu(\cdot))$, $w^m(\eta_t(\cdot), \mu(\cdot))$, $r(\eta(\cdot), \mu(\cdot))$, and aggregate laws of motion for the distribution of agents in the economy $\eta = h(\eta(\cdot), \mu(\cdot))$ and $\mu = q(\eta(\cdot), \mu(\cdot))$, such that these functions satisfy:

- the household's problem;
- the firm's problem;
- the consistency of individual and aggregate decisions:

$$\eta(S_o) = h(\eta(\cdot), \mu(\cdot))(S) = \int_{S_o} \left\{ \int_S \eta(\cdot)\, d\eta \right\} d\eta \tag{14}$$

$$\mu(R_o) = q(\eta(\cdot), \mu(\cdot))(R) = \int_{R_o} \left\{ \int_R \mu(\cdot)\, d\mu \right\} d\mu \tag{15}$$

  for all $S_o, S \in \sigma(\Upsilon)$ and $R_o, R \in \sigma(\Gamma)$ where $\sigma(\cdot)$ is the appropriate borel algebra;

- market clearing; and
- the aggregate resource constraints.

Proving the existence of an equilibrium follows standard arguments like those in Aiyagari (1994). In fact, the problem is not existence but multiplicity of equilibria. Those non-unique equilibria are of concern because they may entail contradictory statements about observables and welfare. Unfortunately, we are not able to prove uniqueness. Heuristically, and despite some effort, we failed to find alternative equilibria to the ones reported below.

Our intuition for the result relies on two arguments. First, we have two labor markets to clear. If we move away from the wages computed in our equilibrium, one market tends to have excess demand and the other one excess supply. The second argument is the presence of capital. In our computational experiments, we observe that different wages induce substantial variations in the distribution of workers in the firms. These distributional movements affect the probabilities of unemployment spells. Since, in our model, savings are basically driven by a precautionary motive, changes in those probabilities translate into changes in capital accumulation. Consequently, the capital market does not clear even if we propose equilibrium interest rates well outside reasonable bounds.

5. Calibration

The benchmark economy is calibrated to reproduce characteristics of the Spanish economy during the 1990's.

Some parameters for the firm and the hiring/firing costs parameters come from Aguirregabiria and Alonso-Borrego (1999), who posit and estimate a dynamic programming model in a partial equilibrium framework. They use a longitudinal panel of 2356 Spanish manufacturing companies between 1982 and 1993, taken from the database of the Bank of Spain Central Balance Sheets Office. The database contains annual information at the firm level about the number of employees by type of contract (permanent and fixed-term), the total wage bill, and other complementary information. Since, as is usual with firm-level data, there is no information on employment flows, all the estimates are based on net employment changes. Nevertheless, the information on voluntary quitting can be exploited in order to distinguish between negative employment changes due to voluntary reasons and those due to costly dismissals.

Evidence from the firm-level data reflects the existence of large adjustment costs for permanent workers. The job turnover rates are very high for temporary employees, but very small for permanent ones. When the information on severance payments was exploited, it could be observed that under the definitions of firings and quits, half of the destruction of permanent jobs during 1986-1990 was due to voluntary quitting. This fact implies that most firms prefer to wait until redundant workers decide voluntarily to leave the firm rather than incur in costly dismissals. Our model captures this attrition of workers through the mortality rate σ.

An important issue is the wage differential between temporary and permanent workers. This concern appears because it is expected that firms with higher proportions of temporary employees will pay lower wages. Ignoring this effect could introduce serious biases in the estimates. Since wages by type of contract are not observed at the firm level, the use of industry level information is needed. With these industry level data, it is observed that the relative wage has remained fairly constant over the estimation period.

The estimates were obtained by means of a two-stage approach. In the first stage, the technological parameters were estimated using a first-differences GMM estimator. In the estimation, an AR(1) process for technological idiosyncratic shocks was assumed to allow for

shock persistence. The autoregressive process for shocks implies a relatively high degree of persistence (0.691). Computationally, productivity is approximated in our model by a five-states Markov Chain. To get more precise estimates, we can exploit the marginal condition for temporary workers and estimate the relative productivity of new workers using within-firms non-linear least squares.

In the second stage, the dynamic discrete decision for the sign of adjustment in permanent employment was exploited. The problem generates a Markov discrete choice model, whose log-likelihood resembles the one for a standard ordered probit, except for the fact that the thresholds depend on the firm's expected marginal value function. The estimation method is a partial maximum likelihood estimator, developed by Aguirregabiria and Mira (2002), which consists of an algorithm that builds a sequence of pseudo-maximum likelihood estimators based on approximations to the marginal value function.

The hiring and firing parameters take account of voluntary quitting and the heterogeneity of costs between firms. To allow for additional unobservable labor costs for permanent workers, the estimation introduced a wage idiosyncratic cost, which was assumed to be *iid* with mean μ_ε and variance σ_ε^2.

The main results indicate unit firing costs that amount to 51 percent of the gross annual wage of a permanent worker, as well as unit hiring costs between 10 percent and 16 percent of gross annual wages. These estimated values are similar to those found for other European countries as in Abowd and Kramarz (2003) and Kramarz and Michaud (2002) for France.

The other parameters were chosen as follows. The survival probability generates an average working life of 45 years. The depreciation rate δ was chosen to match the capital/output ratio of the Spanish economy and the discount factor was selected to generate an interest rate of 4 percent in equilibrium. The utility cost of search effort φ of 0.93 and the elasticity of the probability of finding a job 0.66 match an average duration of unemployment spells of 20.5 months and as well as a unemployment rate of 19.5 (the mean values for Spain during the 1990's). We calibrate the production function to have a share of income going to capital of one-third and a degree of decreasing returns to scale of 10 percent to reproduce the income attributable to entrepreneurs. We summarize our parametrization in table 3.

[Table 3 here]

6. Findings

This section analyzes the effects of labor market regulations on quantities, prices, and welfare. First, we compare the equilibrium in our benchmark economy with the consequences of implementing two commonly discussed reforms: the elimination of temporary contracts and the reduction of firing costs. We comment on the robustness of the results and we relate our findings to the literature. Second, we explore an alternative policy: the introduction of a subsidy to the conversion of temporary contracts into permanent positions.

6.1. Benchmark Economy and Two Basic Experiments

Our main findings come from the comparison between the performance of the benchmark economy and the new stationary equilibria associated with two alternative labor market reforms: the elimination of temporary contracts and the reduction of firing costs.

A review of the public discussion in continental Europe explains why we find these two experiments crucial. Workers' unions forcefully lobby for limitations on the use of temporary contracts to stop job insecurity (what is famously called the "précarité": the constant rotation of workers between low-paid, low-quality temporary jobs with intermediate unemployment spells). In contrast, representatives of the industry are often on the record defending reductions in firing costs to improve the competitiveness of the European economy. Consequently, our two experiments represent movements in two opposite directions relevant to policy analysis: toward more regulation and toward increased liberalization.

We study two extreme counterfactuals, one where the temporary contracts are prohibited and one where the firing costs are reduced to zero.[6] These two polar cases provide bounds to gauge the impact of intermediate, and politically more feasible, reforms. Sensitivity analysis reveals that the economy is monotonic: intermediate reforms produce outcomes that are in the middle of the results for the benchmark economy and a radical reform.

[Table 4 here]

[6] An alternative exercise could be to calibrate our benchmark model to match an economy without temporary contracts and explore the effects of introducing them or of reducing firing costs. However, that experiment would imply matching data from the 1970s and early 1980, when the Spanish economy had a very different structure and when the effects of the oil shocks were acute.

Table 4 reports selected aggregate quantities for the benchmark economy and the two experiments. We have normalized the benchmark economy's values to 100. The first row compares output. A striking finding is that output goes up 1.7 percent when we eliminate temporary contracts. The higher output comes from an increased level of employment and not from a better use of inputs, since average labor productivity falls 4 percent. The result proves that when fixed-term contracts are prohibited, the reductions in productivity due to the misallocation of resources overtake the benefits of less rotation and the smaller loss of firm-specific human capital. The finding contradicts the common complaint of workers' unions that temporary contracts create so many low-quality jobs that they end up decreasing productivity. If firing costs disappear, output increases a 1.37 percent: slightly higher productivity (1.75 percent) is compensated by lower labor input.

The impact on hiring and firing costs is straightforward: they go down in both experiments-in the case were temporary contracts are eliminated, because of reduced rotation; in the economy with no firing restrictions, because the only costs left are those that come from hiring.

The capital-output ratio falls under both reforms but for opposite reasons. Without temporary contracts, capital is relatively more attractive because firms can vary their capital stock freely, while labor is more expensive to adjust. In the case without firing costs, additional capital is accumulated to take advantage of the higher mean productivity. Profits go up under both reforms: 6 percent without temporary contracts, and 16 percent without firing costs. This last observation, together with the increase in the interest rate, explains why firms strongly oppose firing costs.

Although we find that firms' profits slightly increase with the elimination of temporary contracts, our number is biased upward. Since we do not consider aggregate uncertainty, the cost of rigidities is undervalued. By the opposite argument, the increase in profits with the elimination of firing costs is biased downward, since ignoring aggregate uncertainty makes flexibility less valuable.

[Table 5 here]

Table 5 reports prices where all wages are expressed in relation to the wage of permanents in the benchmark economy. When temporary contracts are eliminated, the wage of

permanents goes down 7 percent. The wage falls in order to compensate firms for the higher average adjustment cost of labor. The drop in wages rationalizes why even if unions have been vocal opponents of temporary contracts, they have not marshalled all their might to eliminate them. In the case of no firing costs, the permanent wage goes up 3.42 percent but workers have to face unemployment spells more often. In the no-firing-costs economy, all the workers can be thought of as to be permanent: there is no time limit on the labor relation even though it may be terminated at will.

In the benchmark economy, a temporary contract implies a wage disadvantage of 11.86 percent plus the risk of not being promoted: only 42 percent of temporary workers become permanents in the same firm. The wage disadvantage is roughly equivalent to the difference observed in Spain (de la Rica, 2003). The promotion rate implies between two and three unemployment spells, on average, before a household achieves a permanent position. The result shows how the theory accounts for two observations. First, the repeated cycles of temporary employment/unemployment of the same worker. Second, the reduction in future wages after the layoff of a permanent worker. Since nearly all new contracts are temporary, the expected wage of the worker is lower than the one before being fired.

[Table 6 here]

The outcomes for the job market are summarized in table 6. The benchmark economy matches the unemployment rate (19.49 percent) of Spain during the 1990s. This is not surprising, since we calibrated the economy to reproduce this observation. More interesting is the fact that the model delivers a temporality rate, 34.89 percent, basically equal to the observed mean during the same period. Since we did not calibrate the model to achieve this goal, we interpret the result as a confirmation that the model is a good laboratory for policy analysis. As mentioned above, we also match the fact that nearly all new contracts are temporary: less than 1 percent of new hirings are permanent.

Firms use temporary workers to increase production when productivity shocks are high. As a firm grows in size, it first prefers to augment the number of temporary workers, which have no firing costs, as a hedge against a reversion to lower productivity levels. Only as the firm keeps enjoying a high productivity level does it moves toward a mix with a higher proportion of permanents. However, even after the end of the adjustment, a firm keeps a percentage of fixed-term contracts to escape from future severance payments.

Households accumulate bonds for self-insurance. They increase their bond holdings when they are temporary workers since they will face, with certain probability, an unemployment spell in the next period. With respect to search, figure 1 plots the optimal effort as a function of assets. The negative slope is a direct consequence of a desire for utility smoothing over time: when assets are high, the marginal utility of a wage is lower than the cost of additional effort.

What happens when we reform the labor market? First and most important, unemployment goes in the opposite direction than commonly argued. The elimination of temporary contracts reduces unemployment from 19.49 percent to 14.23 percent while phasing out firing costs increases it to 19.77 percent.

Why is that? Unemployment is a function of how many households become unemployed in one period and how long they stay unemployed. The first component depends on how many jobs are destroyed during a period plus mortality. When we eliminate temporary contracts, the destruction rate falls from 33.71 percent to 18.69 percent because of the higher marginal cost of firing workers. How long do households stay unemployed? This is a function of the effort exerted by households and the number of jobs created. The number of jobs offered decreases (since in a stationary equilibrium they must be equal to the number of jobs destroyed), but the optimal effort substantially increases. The reason for the higher effort is that the probability of finding a permanent job is higher and consequently, the return to searching is also higher. In figure 1 we see how for all asset levels the optimal effort is higher for the case of no temporary contracts.[7] The combination of the first and third forces dominates the second, resulting in the 5-point fall in the unemployment rate. In the case where we eliminate firing costs, search intensity is nearly unchanged, and since job destruction goes up slightly, we find a small rise in unemployment.

[Figure 1 here]

Figure 1 also proves our previous assertion that households respond in an asymmetric way to changes in labor market regulations, depending on their asset levels. The optimal effort

[7] We compare the effort in the market for a permanent job in the case where there are no fixed-term contracts with the effort in the market for temporary jobs when fixed-term contracts are allowed because nearly all households search in this market. The differences are even bigger if we drew the effort in the market for permanent jobs in the benchmark economy.

function moves to the right and rotates north when temporary contracts are eliminated. That shift would be missed in a model with complete markets, since, in that economy, the effort will increase at a uniform rate.

Our results may explain why it has been difficult to find a negative correlation between job market flexibility and unemployment rates (see Lazear, 1990 or Nickell, 1997): higher flexibility in the job market is good for productivity, but it has ambiguous, if not negative, implications for aggregate employment.

What about welfare? Undertaking welfare comparisons in the model is complicated because the transitions from one stationary equilibrium to the other after a policy change are too difficult to compute. As a consequence, we can only compare the welfare in the two steady states. Subject to this caveat, we discuss two findings. The great winners of the elimination of temporary contracts are unemployed households, especially those with low assets. Thanks to the reform, they can escape the cycle of temporary jobs/unemployment spells in which they are trapped. In the new equilibrium, they will need a bit longer to find a job, but, when they do, they find a permanent one. The great losers are the households that are permanent workers in a firm with a good technology shock. In a world with temporary contracts, these households suffer a low probability of being fired, since there is a cushion of temporary workers that will be dismissed before the cuts hit the permanents. In an environment without temporary workers that buffer shocks, permanent workers are more exposed to layoffs.

6.2. Robustness of Results and Comparison with the Literature

How robust are our results? Based on our (non-reported) explorations of variations of the model, we know that issues such as changing the specifications of the search mechanisms, the matching function, or the introduction of an explicit unemployment insurance do not modify the main results. For example, we did not include an unemployment insurance system in the interest of simplicity. The Spanish unemployment coverage is limited, especially for those workers with temporary contracts. More important, the main effect of unemployment payments is to decrease the exit rate from unemployment. Consequently, to calibrate the economy to match the observed average duration of unemployment, we would need to lower the search cost. But once this has been taken care of, the economy behaves nearly in the same way as in the case without unemployment insurance.

More problematic is the absence of technological change. Our environment is stationary:

firms get better or worse producing a uniform good under a constant technology. In an environment with technological advances, firing restrictions may decrease the expected value of an innovation because of the lack of flexibility in exiting the market if the new idea is not profitable (see Saint-Paul, 2002, for a similar argument). A reduced innovation may lead to seizable welfare losses and may be a more important reason behind the so-called Eurosclerosis than the disadvantages of firing restrictions for established firms. We see this area as a field for further research.

We can compare our results with previous findings in the literature. Hopenhayn and Rogerson (1993) compute that a tax on job destruction equal to one year's wages reduces employment roughly 2.5 percent, and the cost in terms of consumption of this same tax is greater than 2 percent. Díaz-Moreno and Galdón-Sánchez (1999) calibrate that model economy to Spanish data. They report that a reduction of the dismissal tax from the equivalent of one year of wages to zero would increase employment 8.13 percent and productivity 2.28 percent. Our model is different from these papers because we do not have an efficient allocation in the absence of labor regulation. In Hopenhayn and Rogerson the firing costs cannot be a positive policy: they reduce productivity and through this effect, labor supply. We are closer to Álvarez and Veracierto (2001), who document severance taxes' large and positive effects on employment and welfare because of the same mechanism that we emphasize: the reduction in frictional unemployment induced by the reduced flexibility of the labor market.

Another paper related to ours is that of Blanchard and Landier (2002). These authors also find that fixed-term contracts may lead to higher unemployment, lower output, and lower welfare. Their model, however, emphasizes the uncertainty regarding the quality of the match. The introduction of temporary contracts makes firms more selective: even relatively good matches are dissolved at the end of the fixed term, since trying out a new worker is cheap. The mechanism in our paper stresses more on firms' response to productivity shocks and on households' search effort. We argued before that this channel might be more important than screening, since, even before the arrival of fixed-term contracts, firms had access to probationary periods during which the quality of the match could be appraised without incurring a severance cost. Moreover, the magnitude of temporary contracts in Spain is difficult to reconcile with a history centered on screening.

6.3. An Alternative Experiment: Subsidizing the Conversion of Fixed-Term Contracts into Permanent Contracts

Our model provides a flexible framework to assess alternative labor market reforms. Because of space considerations, we present results from one further experiment. In particular, we evaluate a subsidy to convert fixed-term contracts into permanent ones. The government pays out the subsidy to firms from revenue raised by the severance taxes. The experiment is motivated by the introduction of such a measure in Spain during the period 1997-1999 and by different proposals presented by economists and political parties to reduce the impact of temporary contracts.

The reform of 1997 in Spain lowered the payroll tax paid by employers 50 percent to 60 percent (depending on the circumstances) during 24 months and 20 percent for another 12 months if the firm converted temporary contracts into permanent contracts. Given that the regular payroll tax rate paid by the employer was 31 percent, the reduction amounted to around a third of the yearly wage. However, the subsidies were greater for some workers, and additional payments were made through other programs. To round up all those transfers, in our experiment, we subsidize the conversion of temporary contracts to permanents by 50 percent of the yearly wage.

A transitory subsidy, like the one implemented in Spain, does not have any long-run impact in our model: after a few periods, firms return to their original employment mix. More revealing is the new steady state if we keep the subsidy over time. Our main finding is that unemployment rises to 20.27 percent. The reason is that, with the subsidy, firms have a bigger incentive to rotate workers: in the case of a future expansion of the firm's size, the loss in productivity associated with new hires is more than compensated by the subsidy. Another way to think about this result is that since matching is costly, a subsidy that increases the amount of workers searching without raising productivity will reduce welfare. We conclude from our experiment that the policy of subsidizing the conversion of fixed-term contracts into permanent contracts is unlikely to have a long-run positive effect.[8]

[8] A limitation of our analysis is that we do not consider the possibility of the subsidy eliminating one bad equilibrium in an economy that presented a multiplicity of equilibria or the interaction of the subsidy with other reforms along a fully specified transition path.

7. A "Crazy" History of Spanish Unemployment

Our quantitative results point out that temporary contracts increase unemployment. This statement is controversial. Do we observe other evidence in the data to convince us that this finding is plausible? We offer in this section a different view of the evolution of unemployment in Spain that offers some support for our conclusions. For obvious reasons, we call this interpretation a "crazy" history of Spanish unemployment.

[Figure 2 here]

Unemployment in Spain skyrocketed from 1973 until 1986 (see figure 2). Unemployment moved from 2 percent to over 20 percent in little more than a decade. The oil shocks and the big increase in real wages during the transition from the dictatorship to democracy have been singled out as possible reasons for that jump.

In 1984, in an attempt to slow down the rise in unemployment, temporary contracts were liberalized. Unemployment kept rising for two more years but then, it fell 5 points from 1986 until 1990. This could be interpreted as evidence in favor of temporary contracts. However, those were also years of strong economic growth, with rates above 5 percent. It is not implausible to reckon that the vigorous expansion hid the negative effects of temporary contracts on unemployment. In fact, we could have expected a better performance in terms of unemployment, given the length and strength of recovery of the late 1980s. The Spanish government was disappointed with the performance of the labor market and attempted further, largely unsuccessful, reforms in 1988 and 1992.

In 1991, the expansion ended and unemployment went up nearly 8 points in four years. The recession of the early 1990s was relatively severe but not terrible. Growth was only negative one year (1993: -1 percent), and in the other years, it was 2.5, 0.9, 2.4, and 2.8 percent, not a stellar performance but certainly not abysmal either. Why did unemployment increase so much? We conjecture that after the expansion ended, the drawbacks of temporary contracts began to be felt and pushed unemployment levels to nearly 24 percent (in addition, of course, to a pure cyclical component).

In 1992, 1994, and 1997 several restrictions on the use of temporary contracts were introduced. Firms were not longer allowed to employ temporary workers to cover a permanent position on a rolling basis. Although it is unclear how binding those restrictions have been

in practice, the percentage of workers with temporary contracts has fallen 5 points. The importance of the cycle to that reduction is open to discussion, but it is not unreasonable to attribute at least part of the fall to the reforms. After 1995, Spain experienced an authentic revolution in terms of unemployment, with current figures around 11 percent, a reduction of over 50 percent.

Again, we face the problem of how to control for the cyclical component. However, even if the late 1990s were years of steady expansion, they were not roaring. Growth rates fluctuated between 3 percent and 4 percent, with a peak of 4.3 percent in 1998. The contrast with the expansion of the second half of the 1980s could not be more streaking: lower growth rates delivered a 55 percent reduction of total unemployment. We can restate our claim in the form of an Okun's Law for the Spanish economy. Following this approach, Schnabel (2002) estimates that the level of output growth that leaves the unemployment rate constant in Spain fell from 3.3 in the 1980s to 2.2 in the second half of the 1990s. We interpret this finding as further favorable evidence for our results.

The theory also has predictions regarding productivity. Again, the evidence is consistent with the experimental results. The expansion of the 1980s was associated with rapid growth in the value added per worker, a measure of average productivity, exactly as the model implies when temporary contracts are introduced. In comparison, during the late 1990s, Spain saw falling productivity, a puzzling observation for standard models of the business cycle. The theory suggests that part of the reduction in productivity is the product of the reintroduction of limits on the use of temporary contracts.

Summarizing our view of the history of Spanish unemployment: the data are compatible with the effects that our model predicts after a liberalization and posterior partial reversal of the applicability of temporary contracts. Furthermore, our model helps to understand the evolution of productivity that is otherwise difficult to account for.

8. Conclusion

What are the quantitative effects of temporary contracts on the economy? Our exercise shows that they increase unemployment. Armed with a flexible instrument to raise or lower output, firms increase job flows. Since searching for a new job takes time, these higher flows generate a higher unemployment rate in equilibrium. The counterbalancing force of higher productivity allowed by the quicker adaptation to productivity shocks is not strong enough to turn the result around. This is an example of second-best reasoning: in a world where markets are characterized by frictions, introducing flexibility at the margin does not necessarily deliver an improvement in welfare.

Two main questions remain open for future research. First, introducing aggregate uncertainty. The interaction between labor market flexibility and incomplete markets is an important channel to inquire. Some evidence suggests that the European economies display a higher elasticity of employment to output after the introduction of temporary contracts. Can the theory account for this observation? Second, why did European countries introduce these partial reforms instead of reducing severance payments all across the market? Exploring this social choice may deliver important clues about the political economy of labor market regulation in Europe and casts further light on why Europe ended up with the high and persistent unemployment rates it suffers nowadays.

9. Appendix

This appendix describes an algorithm to compute the stationary equilibrium of our benchmark economy. This procedure is interesting because it ensures that the two different measures, the distribution of firms and the distribution of households, are consistent with each other. Adapting our algorithm to the various experiments in the paper is straightforward.

The basic structure of the algorithm is as follows:

1. Guess some equilibrium prices w_n, w_m, r. A good initial guess implies a ratio of permanent/temporary wages close to, but below, the ratio of productivities.

2. Given prices, solve the problem of the firm. Since the problem is not convex, we discretize the state space and the choices.

3. Find the stationary distribution of firms given the solution to the previous step.

4. Get the transition probabilities for the households implied by the stationary distribution of firms.

5. Given the transition probabilities in (4) and the prices, solve the household's problem.

6. Find the stationary distribution of households induced by (5) and the transition probabilities found in step (4). Note that using these model-consistent probabilities will imply that the stationary distribution of households will assign mass only to those points that have a positive mass of firms. Also, the mass of workers will be consistent, point by point, with the mass of firms.

7. Use the stationary distributions of firms and households to check for market clearing.

8. Update prices in step (1) and continue until all three markets clear.

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Table 1

Distribution of the share of temporary employment in total employment

	1985	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
*EU-15**	9.0	10.2	10.4	10.9	10.6	11.0	11.5	11.8	12.2	12.8	13.2	13.4
Belgium	6.9	5.3	5.1	4.9	5.1	5.1	5.3	5.9	6.3	7.8	10.3	9.0
Denmark	12.3	10.8	11.9	11.0	10.7	12.0	12.1	11.2	11.1	10.1	10.2	10.2
*Germany**	10.0	10.5	10.1	10.5	10.3	10.3	10.4	11.1	11.7	12.3	13.1	12.7
Greece	21.1	16.5	14.7	10.2	10.4	10.3	10.2	11.0	10.9	13.0	13.0(2)	13.1
Spain	15.6	29.8	32.2	33.5	32.2	33.7	35.0	33.6	33.6	32.9	32.7	32.1
France	4.7	10.5	10.2	10.5	10.9	11.0	12.3	12.6	13.1	13.9	14.0	15.0
Ireland	7.3	8.5	8.3	8.7	9.4	9.5	10.2	9.2	9.4	9.4(1)	9.4(1)	4.6
Italy	4.8	5.2	5.4	7.5	6.0	7.3	7.2	7.5	8.2	8.6	9.8	10.1
Luxembourg	4.7	3.4	3.3	2.9	3.0	2.9	..	2.6	2.1	2.9	3.4	3.4
Netherlands	7.5	7.6	7.7	9.7	10.0	10.9	10.9	12.0	11.4	12.7	12.0	14.0
Austria	..	..	..	..	..	..	6.0	8.0	7.8	7.8	7.5	7.9
Portugal	14.4	18.3	16.4	11.0	9.8	9.4	10.0	10.6	12.2	17.3	18.6	20.4
Finland	10.5	11.5	12.0	13.1	12.7	12.9	16.5	17.3	17.1	17.7	18.2	17.7
Sweden	11.9	10.0	9.8	10.5	11.5	11.5	12.5	11.8	12.1	12.9	13.9	14.7
UK	7.0	5.2	5.3	5.5	5.9	6.5	7.0	7.1	7.4	7.1	6.8	6.7

Source: European Commission. Employment in Europe (1985-1996) and Labour Force Survey (1997-2000).

*Since 1991, data on Germany and EU-15 include the new German Länder

(1) Ireland reports the 1997 value for 1998 and 1999.

(2) Greece reports the 1998 value for 1999.

Table 2

Within-group regression of the share of temporary employment over the unemployment rate

	EU-15	EU-12
Coefficient	0.182	−0.008
p-value	0.08	0.96
F test	61.2	67.7
p-value	0.00	0.00

Table 3: Benchmark Economy Parameterization

Technology parameters		
Relative productivity of new workers	λ	0.795
Technological coefficient of labor	α	0.6282
Technological coefficient of capital	γ	0.2718
Depreciation	δ	0.12
Productivity Shocks' Persistence	ρ	0.691
Productivity Shocks' S.D.	ω	0.196
Elasticity of probability of finding job	ξ	0.66
Death Probability	σ	0.022
Preference Parameters		
Discount Factor	β	0.976
Leisure preference	φ	0.93
Policy Parameters		
Firing costs	$\phi^F = \theta_n^F / w_n$	0.511
Hiring costs (permanents)	$\phi^P = \theta_n^H / w_n$	0.098
Hiring costs (fixed-term)	$\phi^H = \theta_m^H / w_m$	0.159

Table 4: Aggregate Quantities

	Benchmark Economy	*No Temporary Contracts*	*No Firing Costs*
Output	100	101.69	101.37
Capital/Output Ratio	100	97.44	99.94
Aggregate Firing/Hiring Costs	100	90.84	32.11
Average Labor Productivity	100	96.41	101.75
Profits	100	106.26	116.01

Table 5: Prices

	Benchmark Economy	*No Temporary Contracts*	*No Firing Costs*
Interest Rate	4%	4.42%	4.01%
Wage permanents	100	93.01	103.42
Wage temporaries	88.88	NA	NA

Table 6: Labor Market

	Benchmark Economy	*No Temporary Contracts*	*No Firing Costs*
Employment Rate	80.51%	85.76%	80.23%
Unemployment Rate	19.49%	14.24%	19.77%
Permanents	65.11%	100%	100%
Temporaries	34.89%	0%	0%
Job Creation/Destruction Rate	33.71%	18.69%	36.33%
Prob. of finding a permanent job	0.89%	100%	100%

Figure 1: Search Effort vs. Assets

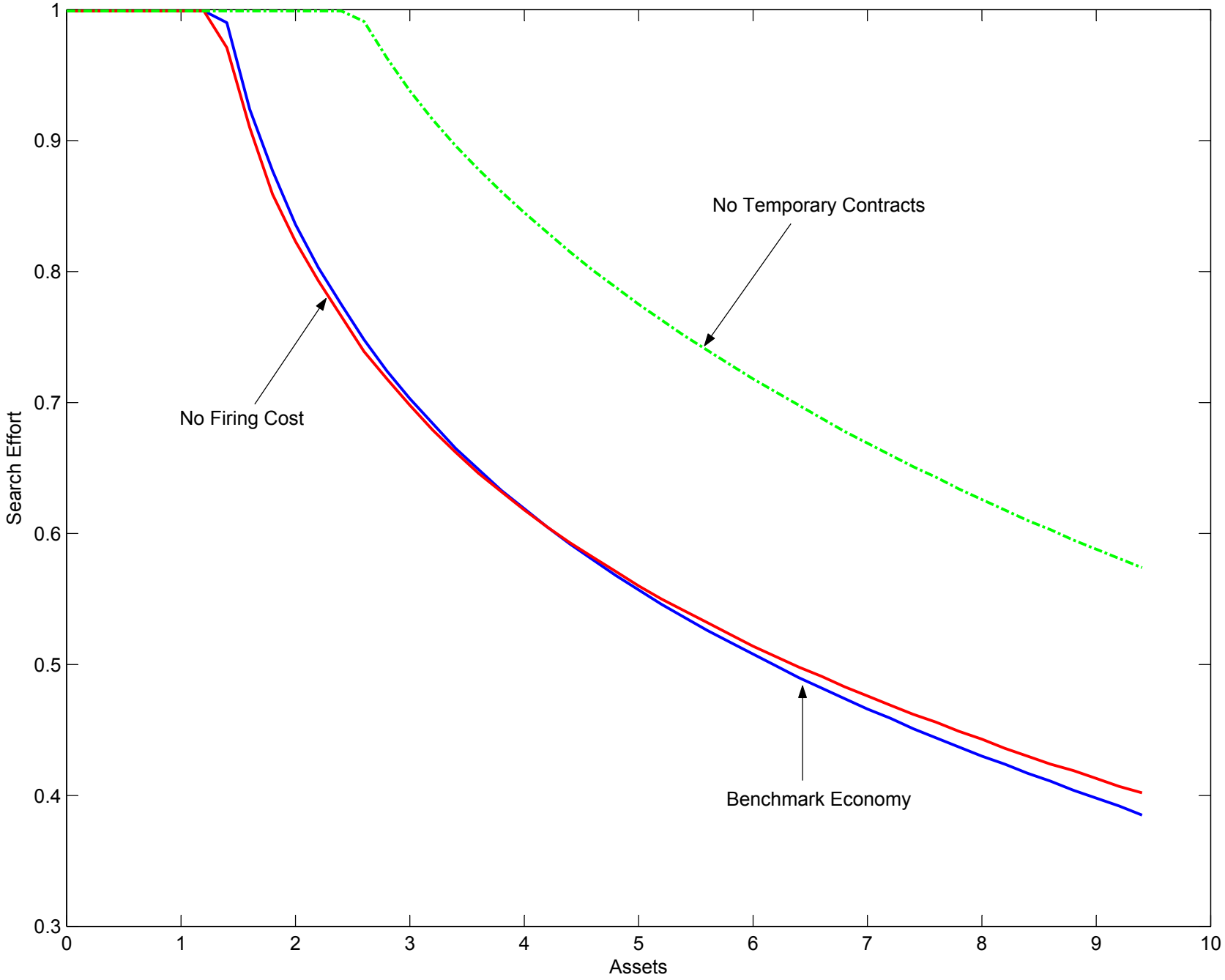

Figure 2: Unemployment Rate in Spain