A Dynamic General Equilibrium Model of Temporary Contracts*

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Abstract

Job security provisions, particularly those regarding workers' layoffs, are commonly invoked to explain the large and persistent differences between European and U.S. unemployment rates. This fact has led European countries to undertake reforms in the last two decades aimed at reducing firing costs. However, this reduction has typically been applied to fixed-term or temporary contracts, while firing costs for permanent or indefinite-term contracts have been maintained unchanged. Despite the widespread promotion of such contracts, there is a lack of quantitative analysis of their impact over the aggregate economy. To address this question, we build and calibrate a dynamic general equilibrium model with heterogeneous agents in a firing-cost economy. An important feature of our calibration is that our parameters are estimated using a dynamic partial equilibrium model with a panel of firm-level Spanish data. Spain is a particularly interesting case since its labor regulations are among the most protective in the OECD and its unemployment rates among the highest. We find that the the introduction of temporary contracts have small quantitative effects on aggregate output and employment.

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

JEL classifications:

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1 Introduction

The consequences of job security provisions on employment and output constitute an issue of great concern for the economists and policymakers. As a matter of fact, labor market rigidities, particularly those regarding workers' layoffs, are commonly blamed as the major cause of the large and persistent differences between European and US unemployment rates. There is a vast literature, both at the empirical and the theoretical levels, about firing costs and their implications for the labor market. The view that labor market restrictions can account for an important part of those high unemployment rates is now widely held (see OECD, 1994a). Nevertheless, the theoretical effect of firing costs on aggregate employment is ambiguous, since it depends on different factors, from which we should emphasize the size of hiring and firing costs and the persistence of shocks. Although the existence of firing costs will reduce the level of hirings after a positive shock is realized, the levels of firings after a negative shock will also be lower. Indeed, the calibrated models of Bentolila and Bertola (1990) and Hopenhayn and Rogerson (1993) present opposite predictions about the effects of firing costs in net employment.

The worsening of economic prospects during the eighties and the consequent rise in unemployment led several European countries to undertake institutional reforms in their labor markets aimed at increasing flexibility. A common feature of these reforms was the elimination of most legal restrictions in the application of non-causal fixed-term or temporary contracts, which were characterized by much lower firing costs than those for the existing workers, with indefinite-term contracts (also called permanent workers). According to the OECD (1993), since their introduction, fixed-term contracts have accounted for most new hirings in all sectors and occupations. Spain, with the highest unemployment rate among the OECD countries, appears as a paradigmatic case. After the 1984 reform which allowed the widespread use of non-causal fixed-term contracts, Spain has become by far the European country with the highest share of temporary employment (33.6 percent in 1996), with temporary contracts representing above 98 percent of hires in the period 1986-1992 (see Bentolila and Saint-Paul, 1992).[1]

Until now, and despite some worthy attempts, there has not been any proper evaluation of the global outcome of these sort of reforms. On the one hand, their impact on labor market flows seems unambiguous: both job creation and job destruction have increased. On the other hand, the variability of aggregate employment also seems to have

[1] Also in France, according to Goux et al. (2001), 80 percent of all entries were hirings made on fixed-term contracts in 1992.

risen. In particular, it seems interesting to quantitatively study the effects of temporary contracts using the tools of standard neoclassical theory.

The purpose of this paper is to evaluate, in a dynamic general equilibrium framework, the impact of the introduction of temporary contracts in a firing-cost economy, as an instrument to increase aggregate employment levels. In order to analyze this problem, we use a dynamic general equilibrium model with heterogeneous agents. In our model, households offer labor and consume subject to a set of allowed labor contracts and a bound on net asset positions, while firms maximize profits. The existence of firing costs transforms firms' problem into an non-trivial intertemporal one. We evaluate the effects of the introduction of fixed-term contracts on aggregate employment, labor turnover and productivity calibrating our model for the Spanish economy. A particular feature of our model is that some of the parameters used for calibration are estimated using a dynamic partial equilibrium model with a panel of firm level Spanish data (see Aguirregabiria and Alonso-Borrego, 1999).

Although Cabrales and Hopenhayn (1997) calibrate a firing-cost economy with temporary contracts for the Spanish economy, their model considers wages as constant. To our knowledge, the contribution of Güell (2000a) is the only one that seeks to evaluate, in a general equilibrium framework, the theoretical effects of fixed-term contracts on unemployment. Our contribution takes a different approach, concentrating on the consequences of the introduction of fixed-term contracts on aggregate employment, labor turnover and productivity in a dynamic general equilibrium framework.

Our main finding is that eliminating temporary contracts will slightly reduce unemployment. In our model unemployment depends on the flows of job creation/destruction in the economy. Since temporary contracts reduce the adjustment cost induced by firing cost, they increase these flows, and consequently unemployment, while their positive effect through higher labor supply induced by higher productivity is of second order. Our results strongly suggest that, as a recipe to reduce European high unemployment rates, temporary contracts are a failure.

The rest of the paper is organized as follows. In section 2 we give an overview of the labor contract regulations in Europe, distinguishing between indefinite-term or permanent contracts and fixed-term or temporary contracts, and summarize the major institutional changes occurred in the European countries. In section 3 we construct a dynamic general equilibrium model with heterogeneous agents for a firing-cost economy with fixed-term contracts, and its equilibrium is derived in section 4. The calibration of the model is

detailed in section 5. The results are discussed in section 6, and section 7 concludes with the summary of the main findings.

2 Institutional background and related literature

2.1 Evolution of labor market regulations in Europe

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

Permanent workers are those with indefinite duration contracts, and temporary workers are those with a fixed-term contract. The maximum length of the latter contracts is usually limited between two and three years in most countries. The application of temporary contracts in most countries of continental Europe has been ruled by the principle of causality, i.e., aimed at jobs that are occasional or seasonal, jobs for absent post, apprenticeships, and jobs for carrying out a specific 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 across countries, a general feature of temporary contracts is that both severance payments and dismissal protection are substantially lower.[2]

The adverse economic conditions in the mid-80's, together with the complaints of entrepreneurs about the rigidity of contract regulations, led several European countries to introduce significant reforms in their labor markets. One of the main reforms were aimed to relax the restrictions on the use of temporary contracts in order to introduce higher flexibility in the labor market. The common feature of the reforms occurred in the different countries is the elimination of many restrictions on non-causal fixed-term contracts. These contracts have been also extensively used by firms as a cheap screening device. Among the 15 countries in the European Union, seven had no limitations on the use of temporary contracts, and another five liberalized their use over the eighties. Only Finland, Greece, and Sweden keep high restrictions on temporary contracts.[3]

France substantially deregulated temporary contracts in 1986, relaxing the limitations on the purpose of these contracts and increasing their maximum length (previously between 6 to 12 months) up to 24 months. However, a counter-reform in 1990 reduced again

[2]Among the main mechanisms of dismissal protection, we can mention the right of the employee to litigate for an indemnity payment if he considers that the dismissal is 'unfair'.

[3]For more information regarding all EU countries see OECD (1994a) and European Commission (1996b and 1997b).

the legal purpose of these contracts, the maximum duration fell to 18 months, and severance payments equivalent to 5 percent of gross salary were imposed. Germany changed its legislation in 1985, moving from a very restrictive casuistic to a widespread allowance of temporary contracts for any new hiring and former apprentices. In the same line, the maximum duration 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 official authorization. Finally, in the case of the United Kingdom, whose legislation is essentially the most flexible among the European countries, there is no specific regulation.

The case of Spain is paradigmatic. Labor market regulations before 1984 were among the most protective in the industrialized world. Afterwards, many of the previous restrictions on temporary contracts were removed, leading to an unlimited use of these contracts (well beyond the original purpose of the law) with official acquiescence. In contrast to permanent contracts, temporary contracts could be cancelled at termination with a much lower severance payment (12 days per year of tenure versus a minimum of 20 days per year of tenure)[4] and their extinction could not be appealed to labor courts. The maximum length of temporary contracts was set to three years; thereafter, the firms should decide whether to offer the worker a permanent contract or to dismiss him. Nevertheless, the reform did not introduce any change in the regulations of permanent contracts.

In fact, as it has been mentioned in the Introduction, Spain has become, by far, the European country with the highest percentage of temporary employment (33.6 percent in 1996), with fixed-term contracts representing above 98 percent on average of newly registered contracts during the period 1986-1992 (see Bentolila and Saint-Paul, 1992). Moreover, according to Güell and Petrongolo (2000), on average, between 1987 and 1996 only 11 percent of fixed-term contracts were converted into permanent ones.

In 1992, the minimum length of a non causal temporary contract was set to one year, and in 1994 some restrictions on the use of non causal temporary contracts, related to the age and conditions of the employee, were established. This abusive use of temporary contracts led in 1997 to negotiate a reduction of severance payments for permanent employees in order to promote the use of permanent contracts as a hiring instrument.[5]

[4]Mandatory severance payments for permanent workers were 20 days of salary per year of tenure (up to 1 year wages) if the dismissal is considered 'fair', and 45 days (up to 42 months wages) if it is considered 'unfair'. The burden of the proof for a fair dismissal must be assumed by the firm, and if the worker does not agree -as it is usually the case- the worker must undertake a legal process that may end up in the labor court, which is favorable to the worker in many cases.

[5]More specifically, 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 up to 33 days of salary.

Regulation of temporary contracts is currently a controversial issue, and trade unions are claiming for new legal limitations.

Table 1
Distribution of the share of temporary employment
in total employment

	1985	1990	1991	1992	1993	1994	1995	1996
EU-15*	9.0	10.2	10.4	10.9	10.6	11.0	11.5	11.8
Belgium	6.9	5.3	5.1	4.9	5.1	5.1	5.3	5.9
Denmark	12.3	10.8	11.9	11.0	10.7	12.0	12.1	11.2
Germany*	10.0	10.5	10.1	10.5	10.3	10.3	10.4	11.1
Greece	21.1	16.5	14.7	10.2	10.4	10.3	10.2	11.0
Spain	15.6	29.8	32.2	33.5	32.2	33.7	35.0	33.6
France	4.7	10.5	10.2	10.5	10.9	11.0	12.3	12.6
Ireland	7.3	8.5	8.3	8.7	9.4	9.5	10.2	9.2
Italy	4.8	5.2	5.4	7.5	6.0	7.3	7.2	7.5
Luxembourg	4.7	3.4	3.3	2.9	3.0	2.9	..	2.6
Netherlands	7.5	7.6	7.7	9.7	10.0	10.9	10.9	12.0
Austria	..	..	..	..	..	..	6.0	8.0
Portugal	14.4	18.3	16.4	11.0	9.8	9.4	10.0	10.6
Finland	10.5	11.5	12.0	13.1	12.7	12.9	16.5	17.3
Sweden	11.9	10.0	9.8	10.5	11.5	11.5	12.5	11.8
UK	7.0	5.2	5.3	5.5	5.9	6.5	7.0	7.1

Source: European Commission. Employment in Europe
*Since 1991, data on Germany and EU-15 include the new German Länder

In Table 1, 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 significant jump experienced by this variable in France, Portugal and Spain, which had deregulated the use of temporary contracts in the mid-eighties. In the cases of France and Spain, the temporality rate in 1990 doubles the one in 1985.

There are three main ideas we would like to remark regarding the introduction of temporary contracts. First, it does not mean by itself a reduction of the unemployment rate. Second, the entry and exit flows have substantially increased after their introduction. Finally, the elasticity of employment with respect to real GDP has increased as well.

To illustrate the first assertion, in Table 2 we report the correlation between the temporality rate and the unemployment rate using data for the EU countries from 1990 to 1996. We have estimated such correlation controlling for country-specific effects and for time dummies to control for aggregate shocks. In the first column we report the results for the EU-15 countries, and in the second we have excluded the three countries

that were 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 turns out negative, although very small and clearly nonsignificant. There are three reasons why we think that we should concentrate on the EU-12 results. The first one has to do with data homogeneity, since they joined the EU in 1995. As an extreme case, Austria only reports observations 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 nineties, and in both cases their unemployment rates were multiplied by a factor of five in six years. Indeed, our evidence agrees with the findings in Bertola (1990), who showed no straight forward relationship between low employment on average and job security provisions for the major OECD countries.

Table 2
Within-group regression of the share of temporary employment over the unemployment rate

	EU-15	EU-12
Coefficient	0.182	−0.008
	(0.103)	(0.165)
p-value	0.08	0.96
F test	61.2	67.7
p-value	0.00	0.00

The F-test is a statistic for the null hypothesis of no country effects.

Regarding the second fact, the similarity in the amounts of job creation and job destruction across Europe and North American labor markets (see Bertola and Rogerson, 1997) seems to be at odds with the intuition that the introduction of temporary contracts would facilitate firms' adjustment when confronting economic shocks. However, as Bertola and Rogerson point out, similar job turnover rates are compatible with the very different rates at which workers enter and leave unemployment. In fact, this is the case since those rates are significantly greater in the US as compared to Europe. Our idea is that the introduction of temporary contracts will reduce this difference between the average European country and the US, keeping constant the job turnover rate.

Concerning the effects of temporary contracts in job flows, we use OECD data on the type of contract that a person unemployed in the previous period has in the present one

(see Table 3). Countries that have implemented thorough temporary contracts reforms (i.e., France and Spain) show after them a dramatic decrease in the percentage of previously unemployed people who get a permanent contract. Countries that opted for mild reforms only show modest reductions in that percentage (i.e. Germany and Italy), whereas in those countries in which these contracts were already deregulated that percentage is almost constant (United Kingdom, Denmark or Netherlands).

Table 3
Probability of getting a permanent (P)
or a temporary (T) contract
(conditional on entering from unemployment)

	1983		1989		1994	
	P	T	P	T	P	T
Denmark	57.6	42.4	59.6	40.4	54.8	45.2
Germany	68.5	31.5	66.1	33.9	62.1	37.9
Spain	39.0	61.0	22.7	77.3	9.8	90.2
France	81.5	18.5	57.3	42.7	45.1	54.9
Italy	65.3	34.7	..	..	61.2	38.8
Netherlands	59.4	40.6	56.1	43.9	61.9	38.1
United Kingdom	76.6	23.4	83.9	16.1	77.6	22.4

Source: OECD Employment Outlook (1996)

The evidence presented in the former study also shows the negative relation between job turnover and different indices of employment protection, including those related with the regulation of permanent and temporary contracts. It is worth noticing that when the index is built considering only the effects of temporary contracts, the correlations are significantly stronger. They are also robust when correlations are computed for establishments of different size. These results are consistent across countries.

Regarding the third fact, available empirical evidence (see Bertola, 1990, and Bentolila and Dolado, 1994, among others) resembles the theoretical prediction that temporary contracts increase labor demand in booms and decrease it in slumps, relative to the situation in which only permanent contracts are allowed.

2.2 Previous literature

There is a broad and growing literature on fixed-term contracts and their implications for the labor market. The subject has been an object of debate not only for European-based economists but also for their American counterparts, which shows its international

relevance. The vast majority of this literature is essentially empirical, even though there is also a fair amount of theoretical contributions to the subject.

A first line of research studies the impact of fixed-term contracts on labor market performance by means of different partial equilibrium models. Most papers along this line of research concentrate on the effects of fixed-term contracts on the dynamics of the labor market. These models feature that fixed-term contracts increase the number of hirings and firings in the economy; however, the effects on aggregate employment remain ambiguous. Some examples are the labor demand models by Bentolila and Saint-Paul (1992), Aguirregabiria and Alonso-Borrego (1999), and Goux et al. (2001); the model of job creation and destruction by Cabrales and Hopenhayn (1997); or the matching models by Wasmer (1999), Cahuc and Postel-Vinay (2000), and Blanchard and Landier (2001).[6]

A second line of research is mostly empirical and addresses several more specific issues such as the transition from fixed-term to permanent contracts, the consequences of introducing fixed-term contracts on unemployment duration or the effects of fixed-term contracts on wages. The transition from fixed-term to permanent contracts has been recently analyzed by Booth et al. (2001) for the UK, Güell and Petrongolo (2000) for Spain, and Holmlund and Storrie (2001) for Sweden. Also related to this issue is the paper by Nagypal (2001), in which a matching model with permanent and fixed-term contracts is build to show that the liberalization of fixed-term contracts can have a significant effect on the productivity of the employment relationships when match-specific learning is important. The effects on unemployment duration of introducing fixed-term contracts has been studied by Boeri (1999) and Güell (2000). Boeri concludes that higher worker's turnover implies a decrease of unemployment duration and therefore reduces long-term unemployment. Güell shows that whereas fixed-term contracts reduce the share of long term unemployment, they can increase the duration dependence of unemployment. Regarding the effects of fixed-term contracts on wages, Bentolila and Dolado (1994) show that an increased dualism in the labor market may imply a higher wage pressure if the unions protect the interests of permanent workers in the wage bargaining. Saint-Paul (1996) generalizes this model by endogenizing the wage of permanent contracts in an efficiency wage framework. Jimeno and Toharia (1993) and de la Rica and Felgueroso (2000) show that employers tend to underclassify workers with temporary contracts, so

[6]In this paper, they consider the removal of firing costs across the board as an alternative policy to the introduction of fixed-term contracts using French data. Hunt (2000) also compares, in an empirical contribution, alternative policies to fixed-term contracts in Germany, such as the introduction of flexible hours of work.

that they actually get paid less than an equivalent with a permanent contract.

Finally, the most recent line of research analyzes, in a general equilibrium framework, the effects of fixed-term contracts on aggregate employment. This is the line in which our model inserts. To our knowledge, there is only one other attempt to analyze these issues in a general equilibrium framework. Güell (2001) analyses theoretically the effects of fixed-term contracts on unemployment using an efficiency wage model in which the firm's choice of contracts and the renewal rate of fixed-term contracts into permanent ones are endogenous. She shows that the relationship between firing costs and fixed-term contracts is not as straightforward as it has typically been assumed, and concludes that fixed-term contracts may not increase employment even in a world where firing costs would reduce employment.

Our paper takes a different approach. It analyses the effects of fixed-term contracts on aggregate employment, labor turnover and productivity in a dynamic general equilibrium framework with heterogeneous agents. The fact that we can calibrate and simulate the model for the Spanish economy allows us to use it as a measurement tool to quantitatively asses the impact of counterfactual policies.

3 The Model

We build a dynamic general equilibrium model with heterogeneous agents, in the tradition of Hopenhayn and Rogerson (1993). In our model, households offer labor and consume subject to a set of allowed labor contracts and a bound on net asset positions, while firms maximize profits. The existence of firing costs transforms firms' problem into a non-trivial intertemporal one.

As we mentioned in the introduction, a general equilibrium approach is needed to study this issue for two reasons. First, to be able to fully evaluate the impact of such policy in the aggregate economy. Second, since introducing fixed-term contracts could be considered equivalent to reducing firing costs, specially in the partial equilibrium literature, in order to fully understand the implications of the introduction of fixed-term contracts over aggregate employment we need a model in which the reduction of firing costs reduces unemployment. In that sense, the dynamic general equilibrium model by Hopenhayn and Rogerson (1993) provides an excellent framework. In their model, a tax on job destruction equal to one year's wages reduces employment by roughly 2.5 percent and the cost in terms of consumption of this same tax is greater than 2 percent. Diaz-Moreno and Galdón-Sánchez (1999) apply and calibrate that model economy to Spanish

data finding that a reduction of the dismissal tax from the equivalent of one year of wages to zero would increase employment by 8.13 percent and productivity by 2.28 percent.

It would also be interesting to analyze the behavior of this model economy introducing business cycles. However, Krusell and Smith (1998) showed that the elimination of business cycles do not affect significantly the welfare of different consumer groups in a model with substantial heterogeneity. This is the reason why we concentrate here in a stationary analysis.

3.1 Household's Problem

There is a continuum of households of measure η that offer labor and consume. All labor contracts establish a fixed duration δ of the working day. We assume a time endowment of one, so that $\delta \in (0,1)$.[7] Each household owns a share τ of all firms in the economy. A way to rationalize this is to think of the economy as a huge investment fund whose participations are equally distributed among all agents.[8]

Households maximize the following problem:

$$\max_{\{c_t, l_t\}} E_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, 1-l_t\right) \tag{1}$$

subject to

$$a_{t+1} + c_t \leq (1+r_t)\, a_t + w_t l_t + \tau \Pi_t \tag{2}$$

$$l_t \in \{0, \delta\} \ , \forall t \tag{3}$$

$$a_t \geq -A \ , \forall t \tag{4}$$

where $u(\cdot,\cdot) : R_+ \times \{1, 1-\delta\} \rightarrow R$ is a C^2 utility function with the usual properties (increasing in both arguments, strictly concave, and $\lim_{c \to 0} u'_c\left(1-l_t\right) = \lim_{(1-l)\to 0} u'_{1-l}\left(1-l_t\right) = \infty$), c_t is consumption and $(1-l_t)$ stands for leisure. Moreover, E_0 is the expectation operator at time 0, β is the discount factor, where $0 \leq \beta \leq 1$, and a_t is the level of assets

[7] This parameter corresponds to the duration of a full-time contract. In this paper, we only concentrate on full-time contracts, which can be fixed-term contracts or permanent contracts (see the definitions in the next subsection). Interestingly enough, in most European countries in which fixed-term contracts have been introduced, the share of part-time contracts is generally small (see OECD, 1994a). Reasons such as non convexities due to commuting time (Hansen, 1985) or other coordination problems justify the value of this parameter.

[8] This greatly simplifies the problem because the absence of an explicit entrepreneur allows us to avoid two issues. The first one is the entry-exit problem. The second one is the relationship between the entrepreneurs' savings in bonds, a, and savings in firm assets that generate an implicit return. Since the focus of this paper is not to do a detailed explanation of corporate finance with adjustment cost, but in labor market issues, we believe the result would be robust with respect to this assumption.

at the beginning of the period, which must be always higher than some value $(-A)$, where $A > 0$. There is an additional term, $\tau\Pi_t$, that represents the participation share, τ, on aggregate profits, Π_t. Finally, r_t and w_t are the interest rate for assets and the wage received by the household, respectively.

3.2 Firm's Problem

There is a continuum of firms of measure μ. Each firm has access to a technology represented by a C^2 production function $f(\cdot,\cdot,\cdot) : R_+ \times R_+ \times \Omega \to R_+$, such that the output y_t is given by:

$$y_t = f(k_t, N_t, \varepsilon_t) \tag{5}$$

where the function $f(\cdot,\cdot)$ is increasing in all arguments, concave in N_t and k_t, and presents decreasing returns to scale. Moreover usual inada conditions apply.

The variable k_t is the capital rented by the firm.[9] The random variable ε_t with support Ω follows a first order Markov process F_t and represents an idiosyncratic productivity shock. The variable N_t is an index of efficiency units of labor, defined as

$$N_t = n_t + \lambda m_t \tag{6}$$

This index is a weighted sum of the measure n_t of permanent contracts and the measure m_t of temporary contracts. The weighting parameter $\lambda < 1$, accounts for the lower productivity of those temporary workers. This lower productivity could be due to several factors such as lower firm-specific human capital related to shorter contract duration. Therefore, in this economy we assume the existence of only two different full-time labor contracts:

- Permanent contract. Under this contract, firms will pay a wage for each working period and a fixed indemnization in the case of dismissal. Households commit themselves to not to quit voluntarily. In that sense, this contract insures both parts: firms against unexpected shortages of labor, and households against arbitrary dismissals.[10]

[9] Note that Hopenhayn and Rogerson (1993) do not include capital in their production function.

[10] It can be argued that empirically, we observe voluntary quits. However, most of them are related to the transfer from one firm to another (keeping a permanent contract) or with life cycle issues such as retirement or maternity. Both reasons are absent in our model because, on the one hand, human capital is homogeneous and therefore transfers among firms will not increase marginal productivity. On the other, because our agents are infinitely lived. As a consequence, we do not think that the design of this contract is too far away from real life.

- **Fixed-term contract.** Under this contract, firms will pay a wage for one working period and may offer a permanent contract at the beginning of the next. Households commit themselves to come back next period to the firm and accept a permanent contract if they are offered one.[11]

The rental price of labor for permanent and temporary workers is given by w_t^j, where $j = n, m$, respectively. Firms also face hiring and firing costs for permanent and temporary contracts which are represented by θ_j^H and θ_j^F respectively. Assume that $\theta_m^F = 0$ and that $\theta_n^F > 0$, while $\theta_m^H < \theta_n^H$. This first assumption represents the very nature of temporary contracts: their dismissal cost is negligible. The hiring cost takes account of some kind of fixed cost related with writing a new contract or having a screening device. In addition, the cost of hiring can be assumed to be greater for the case of permanent workers because of the intertemporal consequences of those hirings. The two most clear examples are tougher screening processes and the required on-the-job training investment. Regarding the first example, it seems clear that the presence of dismissal costs creates an incentive for the firm to be more careful when deciding hirings. In relation with our second example, even if some on-the-job training is simply learning-by-doing, much of it takes place either in formal or informal training programs. All those programs are a conscious choice on the part of the employer and are costly. These costs are both explicit, as expenditures on training material, or implicit, as the commitment of time by trainers or supervisors to the teaching process.

A special case is the promotion of temporary to permanent workers when their contracts expire. In this case, the firm does not have to pay the hiring cost again, as the screening process has been already done. As a consequence, the firm will always give temporary workers the priority to be hired as permanents. Only if the firm needs more permanent workers than the amount of temporary it had in the previous period, it will hire them from the market. Then, the flow of permanent contracts, d_t, will be given by:

$$d_t = n_t - n_{t-1} \tag{7}$$

The firm also pays an interest rate r_t plus the depreciation ζ for the capital it rents.

[11] Again, this is not exactly what happens in real life. Some temporary contracts can be renewed (for instance, in Spain, up to three periods) and workers are not usually obliged to accept a promotion to permanent. However, not too much is lost. In our model, the wage in another firm is not going to be higher, and the only difference among firms is the actual realization of the shock (and hence the probabilities of not being fired in the next period). Therefore, the incentive to move to another job is rather small and we can ignore it.

Firm's profit function will have the following form:

$$\pi\left(\varepsilon_{t}, n_{t-1}, m_{t-1}\right) = \max \quad \left\{ \begin{array}{l} f\left(k_{t}, N_{t}, \varepsilon_{t}\right) - \left(r_{t}+\zeta\right) k_{t} - w_{t}^{n} n_{t} - w_{t}^{m} m_{t} - \theta_{m}^{H} m_{t} \\ - \ \theta_{n}^{H} \max\left\{d_{t} - m_{t-1}, 0\right\} - \theta_{n}^{F} \max\left\{-d_{t}, 0\right\} \end{array} \right\} \tag{8}$$

3.3 Timing

3.3.1 Households

At the end of period $t-1$, the 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, the household observes all the information about the economy: the wages, the shock to the firm where she works, and the distributions.

If the household is a permanent worker in period t, she has to go to the firm to work, and either stays as a permanent worker, or is fired. If she is not fired, at the end of period t she stays as a permanent worker. If the household is fired, she becomes unemployed at the end of period t and, in period $t+1$, she goes to the employment office. Note that the household cannot quit because of the type of contract she has signed with her firm.

If the household is a temporary worker that finishes her contract in period $t-1$, at the beginning of period t she has to go to the firm. Once there, either she is promoted to permanent worker or is not renewed. In the second case, at the end period t she is unemployed and in period $t+1$ she has to go to the employment office. Remember there is no possibility of a renewal as temporary worker.

If the household is unemployed at the end of period $t-1$, she has two options at the beginning of period t:

a) she goes to the employment office and finds a job with probability ρ (any job). Recall that she cannot refuse the offer she receives. If she does not find a job, she finishes period t again as an unemployed,[12]

b) she does not go to the employment office in period t and ends the period as an unemployed.

At the employment office, the household either gets a job offer (as permanent or temporary), or does not get a job offer.[13] The assignment of employment offers is done with the help of a random device. If the household is offered a job, she has to accept it, even if it is not the kind of contract she prefers; work in that period; and end the period as a temporary worker with a contract that expires in that period, or as permanent worker.

[12] Although in equilibrium this is not going to happen, since markets clear.

[13] Again, this is not going to happen in equilibrium.

If she does not get a job, she finishes the period as an unemployed. At the end of any period, households receive wages and profits, and consume.

3.3.2 Firms

At the end of period $t-1$, firms know the number of permanent and temporary workers they have. At the beginning of period t, firms observe wages, distributions and their own idiosyncratic shock, and decide about their new hirings or firings.

Let's first consider permanent workers. If the number of desired permanent workers is equal to the number of permanent workers in the previous period, there is no hirings or firings. If the number of desired permanent workers is larger than the number of permanent workers in the previous period, they promote to permanent those workers that were under fixed-term contracts in the previous period and, if there is not enough of them, firms go to the employment office to hire new workers. Finally, if the number of desired permanent workers is smaller than the number of permanent workers in the previous period, firms fire the number of workers corresponding to such difference. We assume that firms do not follow a LIFO (last-in, first out) system because firing costs are constant and labor is homogeneous in our model. Therefore the workers who are fired are randomly chosen.[14]

Regarding temporary workers, at the beginning of each period, if firms need a positive amount of temporary workers, they go to the employment office and hire as many workers as they need.

Along any period, firms produce, and at the end of each period, they pay wages and distribute profits.

4 Equilibrium

We will use the recursive competitive equilibrium concept. For the household, we define a quasi-indicator function I_t equal to 0 if the household is unemployed, (-1) if it has a fixed-term contract, and 1 if it has a permanent contract. The function is always evaluated at the end of period $t-1$. The state variables for the employed household in this economy is given by the vector $(a_t, \varepsilon_t, n_{t-1}, m_{t-1}, I_t; P_t)$ where P_t is the joint distribution of firms and households in the economy. For the rest of the paper we will concentrate only in the case

[14] In most countries, firing costs are proportional to tenure within a firm up to a certain point in time. From that point in time, there is a maximum severance pay that applies regardless of tenure. We assume that workers under permanent contracts stay in a firm for a long enough period such that their firing cost is the same (i.e. the maximum indemnity).

where the economy is an stationary equilibrium where P is not indexed by time. Note that households are indexed by the states of the firm in which they are employed since these states are relevant to compute the probability of transition from employment into unemployment (permanent) or from temporary into permanent or unemployment. For an unemployed household the states are just given by $(a_t, I_t; P)$. For convenience, we define also separate measures for households η and firms μ.

The optimality equation for the employed household's problem can be written, remembering that the working day has a fixed duration δ, as:[15]

$$\begin{array}{lll} V^{e}(a_t, \varepsilon_t, n_{t-1}, m_{t-1}, I_t; P) = & \max_{\{c_t, a_t\}} & \{\, u(c_t, 1-l_t) \\ & & \quad + \beta \int V((a_t, \varepsilon_t, n_{t-1}, m_{t-1}, I_t; P_t))\, dF_t \,\} \\ \text{subject to} & & a_{t+1} + c_t \leq (1+r_t)\, a_t + w_t^{n}\delta + \tau\Pi_t, \text{ if } I_{t+1} = 1 \\ & & a_{t+1} + c_t \leq (1+r_t)\, a_t + w_t^{m}\delta + \tau\Pi_t, \text{ if } I_{t+1} = -1 \\ & & a_t \geq -A\ ,\ \forall t \end{array} \tag{9}$$

while the problem for the unemployed household is:

$$\begin{array}{lll} V^{u}(a_t, I_t; P_t) = & \max_{\{c_t, a_t, l_t\}} & \left\{ \begin{array}{c} u(c_t, 1) + \beta V^{u}(a_t, I_t; P_t), \\ \int V^{e}(a_t, \varepsilon_t, n_{t-1}, m_{t-1}, I_t; P_t)\, dP \end{array} \right\} \\ \text{subject to} & & a_{t+1} + c_t \leq (1+r_t)\, a_t + w_t^{n}\delta + \tau\Pi_t, \text{ if } I_{t+1} = 1 \\ & & a_{t+1} + c_t \leq (1+r_t)\, a_t + w_t^{m}\delta + \tau\Pi_t, \text{ if } I_{t+1} = -1 \\ & & a_{t+1} + c_t \leq (1+r_t)\, a_t + \tau\Pi_t, \text{ if } I_{t+1} = 0 \\ & & a_t \geq -A\ ,\ \forall t \end{array} \tag{10}$$

Note that, following our description of the household problem, this can choose between entering or not the labor force, and if it does, then the value function is integrated with respect to the distribution of firms and households that determines the probability of which firm and under which contract the households will find employment.

The vector of state variables for the firm is $(\varepsilon_t, n_{t-1}, m_{t-1})$. The optimality equation for the firm's problem becomes then:

$$\begin{array}{lll} W(\varepsilon_t, n_{t-1}, m_{t-1}) = & \max_{\{m_t, n_t\}} & \{\, \pi(\varepsilon_t, n_{t-1}, m_{t-1}) \\ & & \quad + \beta \int_{\Gamma} W(\varepsilon_{t+1}, n_t, m_t)\, dG_t \,\} \\ \text{subject to} & & d_t = n_t - n_{t-1} \end{array} \tag{11}$$

.

4.1 Definition

A recursive stationary competitive equilibrium for this economy consists of value functions $V^{e}(\cdot), V^{u}(\cdot)$ and a set of associated decision rules $c(\cdot)$, $a(\cdot)$, $l(\cdot)$, for the household, and

[15] Note that the optimality equation for the employed household's problem is defined after the realization of the firm's shock and after the firm has made its hiring and firing decisions. This implies that the expectation of tomorrow's value function has to be taken with respect to the stochastic shock, and the hiring and firing decisions of the firm.

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 $w^{\mathsf{n}}(\eta_{\mathsf{t}}(\cdot), \mu_{\mathsf{t}}(\cdot))$, $w^{\mathsf{m}}(\eta_{\mathsf{t}}(\cdot), \mu_{\mathsf{t}}(\cdot))$, $r(\eta_{\mathsf{t}}(\cdot), \mu_{\mathsf{t}}(\cdot))$, 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,

$$\eta(S_{\mathsf{o}}) = h(\eta(\cdot), \mu(\cdot))(S) = \int_{\mathsf{S_o}} \left\{ \int_{\mathsf{S}} \eta(\cdot)\, d\eta \right\} d\eta \tag{12}$$

$$\mu(R_{\mathsf{o}}) = q(\eta(\cdot), \mu(\cdot))(R) = \int_{\mathsf{R_o}} \left\{ \int_{\mathsf{R}} \mu(\cdot)\, d\mu \right\} d\mu \tag{13}$$

  for all $S_{\mathsf{o}}, S \in \sigma(\Upsilon)$ and $R_{\mathsf{o}}, R \in \sigma(\Gamma)$ where $\sigma(\cdot)$ is the appropriate borel algebra.

- the aggregate resource constraints.

4.2 Characterization

[To be added]

5 Model Solution

5.1 Calibration parameters

The benchmark economy is calibrated to reproduce some basic characteristics of the Spanish economy during the 1985-2000 period.

Some parameters for the firm and the policy parameters have been taken from Aguirregabiria and Alonso-Borrego (1999), who posit and estimate a dynamic programming model in a partial equilibrium framework using an unbalanced panel on 2,356 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 it is usual with firm-level data, there is no information on employment flows, all the estimates are based on net employment changes.[16] Evidence from the firm-level data clearly reflects the existence

[16] Nevertheless, the information on voluntary quits was exploited in order to distinguish between negative employment changes due to voluntary quits and those due to costly dismissals.

of fairly large adjustment costs for permanent workers. It is worth noticing that 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 quits. This fact implies that most firms have preferred to wait until redundant workers decide voluntarily to leave the firm rather than incur in costly dismissals.

An important issue which affects the estimation of the model in Aguirregabiria and Alonso-Borrego (1999) is the wage differential between temporary and permanent workers. This concern appears because it is expected that firms with higher proportions of temporary employees tend to pay lower wages, so that ignoring this fact 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. From the 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 are estimated using a first-differences GMM estimator. In the estimation, an AR(1) process for technological idiosyncratic shocks was assumed in order to allow for shock persistence. In order to get more precise estimates, they exploit the marginal condition for temporary workers and estimate the relative productivity of temporary workers using within-firms nonlinear least squares. In the second stage, the dynamic discrete decision for the sign of adjustment in permanent employment is exploited. The problem generates a Markov discrete choice model, whose log-likelihood resembles the one for an 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, due to Aguirregabiria and Mira (2001), which consists of an algorithm that exploits a sequence of pseudo maximum likelihood estimators based on approximations to the marginal value function.

The calibration parameters are reported in Table 4. In the top panel, we report the technological parameters. The most remarkable feature is that the relative productivity of temporary workers λ is very close to the relative wage between temporary and permanent workers.

Table 4
Benchmark Economy Parameterization

Technology parameters		
Relative productivity of temporary workers	λ	0.795
Technological coefficient of labor	α_{L}	0.682
Technological coefficient of capital	α_{K}	0.272
Depreciation	ζ	0.11
Productivity Shocks	e_{t}	$[0.75, 1, 1.25]$
Markov Matrix	a	$\begin{pmatrix} 0.7 & 0.2 & 0.1 \\ 0.1 & 0.8 & 0.1 \\ 0.1 & 0.2 & 0.7 \end{pmatrix}$
Preference Parameters		
Discount Factor	β	0.96
Leisure preference	φ	0.3
Policy Parameters		
Firing costs	$\phi^{\mathsf{F}} = \frac{\theta^{\mathsf{F}}}{w^{\mathsf{n}}}$	0.511
Promotion costs	$\phi^{\mathsf{P}} = \frac{\theta^{\mathsf{P}}}{w^{\mathsf{n}}}$	0.098
Hiring costs	$\phi^{\mathsf{H}} = \frac{\theta^{\mathsf{H}}}{w^{\mathsf{m}}}$	0.159

The other technology parameters were chosen as follows. The depretiation rate ζ was chosen to match the capital/output ratio of the Spanish economy. The productivity and Markov matrix were chosen to reflect a difference between the best and worst outcome of 66 percent and high persistence.

With respect to preference parameters, the discount factor was chosen to generate an interest rate of 4 percent in equilibrium.[17] As a utility function a log-log parametrization was assumed with leisure parameter φ of 0.3, a common choice in the literature.

Finally, the chosen policy parameters take account of voluntary quits and costs' heterogeneity between firms.[18] 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 promotion costs and hiring costs about 10 and 16 percent of the gross annual wages of permanent and temporary workers, respectively. When voluntary quits of permanent workers were ignored, results were remarkably different, with firing costs about 33 percent of the gross annual wage. Sensitivity analysis is conducted under this alternative parametrization

[17]Note that in this model the result of Aiyagari (1994) holds, and the gross interest rate should be lower in equilibrium than the inverse of the discount factor.

[18]In order to allow for additional unobservable labor costs for permanent workers, the authors introduced a wage idiosyncratic cost, which was assumed to be iid with mean μ_ε and variance σ_ε^2. Ignoring this additional labor cost would induce biased estimators if $\mu_\varepsilon \neq 0$.

5.2 Algorithm

We will concentrate in the computation of the stationary equilibrium of our benchmark economy. Computational limitations preclude us to carry the quantitative analysis under aggregate uncertainty.[19] Since the solution of this model is relatively challenging, and to the best of our knowledge, the first that solves for a joint, nontrivial distribution of firms and households, it is worthy to spend some time describing it.

The basic structure of the algorithm is:

1. Guess some equilibrium prices w^{n}, w^{m}, r.
2. Given prices, solve the problem of the firm.
3. Find the stationary distribution of firms implied by the problem of the firm.
4. Get the transition probabilities from the households in the job market and in the firms consistent with the stationary distribution of firms.
5. Given these transition probabilities and the vector of prices, solve the household's problem.
6. Find the stationary distribution of households implied by the problem of the household and the transition probabilities found in step (4). Note that using these model-consistent probabilities will assure that the stationary distribution of households will only assign mass to those points that have a positive mass of firms and ensures that we only need to clear the aggregate markets and not set by set.
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.

6 Quantitative Results

6.1 Benchmark economy

Table 5 presents some of the main results of the benchmark economy.

[19] Approximation methods as Krusell-Smith (1998) seem inadecuate given the presence of binding corner solutions for an important share of the firms in the economy.

Table 5 Benchmark Economy, Aggregate Quantities	
Output	0.54
Capital/Output Ratio	1.81
Aggregrate Firing/Hiring Cost	0.02
Average Labor Productivity	1.60

The capital/output ratio is closed to the ratio of nonresidential capital/output ratio in the Spanish economy, that fluctuated around 1.7 during the nineties. The aggregate firing/hiring cost are around 1 percent with respect to the capital/output ratio and the average labor productivity is around 1.6. The main characteristics of the job market are presented in table 6:

Table 6 Benchmark Economy, Job Market	
Employment Rate	88.20%
Unemployment Rate	11.79%
Permanents	91.64%
Temporaries	8.36%
Job Creation/Destruction Rate	19.06%
Prob. of finding a permanent job	30.43%
Prob. of promotion	68.03%

The model is able to generate an unemployment rate (11.79 percent) close to the levels of unemployment is Spain around 2000-2001. The distribution of permanent/temporary workers is however, far away from the observed rates (30 percent versus 8 percent). Firms use temporary workers in this model to increase production during those periods in which they enjoy good productivity shocks. In particular, given our calibration, only firms with the high shock hire temporary workers. In the Spanish experience, however, a wide cross-section of firms use temporary workers (see Aguirregabiria and Alonso-Borrego, 1999). Also this is a model without aggregate uncertainty. The presence of a common aggregate technology shock may increase substantially the use of temporary workers, specially if it induces firms in the lower tail for the idiosyncratic shock to hire temporary to increase production as an answer to the aggregate shock.

The job creation and destruction rate in the model (remember that, since we study a stationary equilibrium both rates should be equal) is 19.06 percent (compare with Spain). The probability of moving from unemployment to a temporary contract is substantially

higher than the observed one (30 percent versus around 9 percent). However in the observed data we see quite a bit of rolling-over of temporary contracts, including firing and recalling from the same firm (to avoid exceeding the total amount of temporary work allow in the law) that are absent in the model. In our benchmark economy slightly less than 47 percent of new permanent jobs are filled with new hirings, while the remaining 53 percent are filled with internal promotions from temporary to permanents.

Finally, note that the ratio of the wage of permanent workers to the wage of temporary workers is 1.20.

6.2 Experiment 1: Eliminating Temporary Contracts

The first experiment we will perform is to eliminate temporary contracts in the economy.[20] Again, we present results for aggregate quantities (Table 7) and the job market (Table 8).

Table 7
Experiment 1, Aggregate Quantities

Output	0.53
Capital/Output Ratio	1.80
Aggregrate Firing/Hiring Cost	0.02
Average Labor Productivity	1.62

Only minor changes can be observed in aggregate quantities. Output falls by about 0.5 percent due to the lower ability of firms to reallocate labor services in the absence of temporary contracts. Although part of the losses in production are made up by a higher average labor productivity (due to the higher productivity of permanent workers that now make up hundred percent of the employees), there seem to be no evidence to substain the allegations that the lower quality of temporary contracts may reduce the production of the economy. Also, hiring and firing costs rise a 3 percent, reducing the total amount of output available for consumption. The Capital/Output ratio of the economy falls by less than 1 percent, while the interest rate increases nine basic points.

Table 8 reveals more interesting results though. In particular we see that the unemployment rate is lower without temporary contracts by nearly a 1 percent. The reason for that outcome is simple, and comes from the figures on job creation and destruction.

[20] We could have also calibrated our benchmark economy to match an economy without temporary contracts and then introduce them. However, that will imply matching data either from the sixties and early seventies, when the Spanish economy presented a very different structure, or from the early eighties when the effects of the oil shocks where very acute.

While in our benchmark economy this destruction rate is 19 percent, in the second economy it falls to 12 percent, due to the higher marginal cost of firing workers. Since the unemployment rate in our model has a frictional character, higher inflows and outflows from the job market translate into a higher unemployment rate in equilibrium. The effect on labor productivity of temporary contracts increases wages of permanent workers by 1 percent, not a trivial amount but clearly insufficient to induce more than a second order effect in labor supply.[21]

Table 8 Experiment 1, Job Market	
Employment Rate	89.13%
Unemployment Rate	10.87%
Permanents	100.00%
Temporaries	NA
Job Creation/Destruction Rate	12.20%
Prob. of finding a permanent job	100.00%
Prob. of promotion	NA

This results may explain why it has been difficult to find a negative correlation between job market flexibility and unemployment rates (Nickell (1997)): higher flexibility in the job market is good for productivity and total output but it has an ambiguous effect in aggregate employment when it is considered in general equilibrium.

6.3 Sensitivity Analysis

[To be completed]

7 Conclusion

What are the quantitative effects of temporary contracts in the economy? Our exercise suggest that small and maybe even in the opposite direction that suspected by a share of the conventional wisdom.

These paper suggest three future lines of research. First, modeling in more detail the job market. Following Hopenhayn and Rogerson (1993), we have shown that it is feasible to study rich aggregate models of the job market with endogenous prices. Further

[21] Also, if these effects were present, it would be difficult to reconcile that result with the observation that labor supply over the last decades does not have a clear trend and if any, this is negative, despite continuous increments in labor productivity.

details may include matching processes, richer learning-in-the-job environments or entry-exit decisions among others. The second line of research is the introduction of aggregate uncertainty. Unfortunately, since a number of firms will hit corners, methods as Krusell and Smith (1998) seem problematic. Finally it is important to study the politico-economic equilibrium implications of the introduction of temporary contracts.

[To be completed]

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