

# Temporary Contracts, Employment Protection and Skill: an Application to Spain<sup>1</sup>

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## Abstract

In this paper we explain the different conversion patterns of temporary contracts by the impact of employment protection in combination with differences in productivity between workers. In the theoretical part of the paper we propose a model that directly relates the dynamics of temporary contracts with the level of productivity of workers.

We use longitudinal survey data from individuals to estimate a competing risks model with multi-spells for Spain. The model includes correlated unobserved determinants in the transition rates to deal with selectivity. Our results suggest that workers' skills play an important role in all transitions. Temporary contracts serve as stepping stone for high educated workers. In contrast, workers with a low level of education seem to experience a penalty. Furthermore, we show the importance of employment protection in affecting the threshold level above which workers access to a permanent contract.

*Keywords:* temporary contracts, permanent contracts, duration models, unobserved heterogeneity.

*JEL classification:* J63, J64.

# 1 Introduction

This paper analyses the dynamics of temporary jobs in a labor market characterized by workers' skill heterogeneity and employment protection.

The motivation for this work is the following. In the literature that analyzes the dynamics of temporary contracts two contradictory hypotheses coexist. One view considers the bridging function of temporary contracts, suggesting that they can serve as an entry route to permanency, while the other suggests that temporary contracts can become dead-end jobs. On the other hand, a great deal of research has been devoted to studying the effects of skill on many aspects of the labor market, such as wages or unemployment rates. However, one issue that remains unexplored is the role of skill in workers' labor market history.

In this paper we show the existence of two opposite dynamics of temporary contracts for skilled and unskilled workers. We explain the different conversion patterns by the impact of employment protection in combination with differences in productivity between workers.

In the theoretical part of the paper we propose a model that directly relates the dynamics of temporary contracts with the level of productivity of workers. We assume that some workers are skilled, while others are unskilled and the distribution of workers skills is exogenous. Firms hire workers in temporary jobs and are later faced with the decision of offering them a permanent contract or firing them. When a new firm is created, it starts with the same productivity, regardless of the type of worker the firm is matched to. Productivity then changes depending on worker's skill. One could interpret this change of productivity either as the outcome of a learning process in which skilled workers learn while unskilled workers do not or by differences in specific human capital investments for both groups of workers.

We obtain three different cases which yield different conversion rates for skilled and unskilled workers. In all equilibria, unskilled workers are never more likely to be converted into a permanent contract than skilled workers. Moreover, the model allows to derive a simple relationship between conversion rates for both groups of workers and the institutional labor market framework of the economy: lower firing costs make it easier for skilled and unskilled workers to gain access to permanent contracts. Lower firing costs reduce the threshold productivity level above which workers may access to permanent contracts and make firms less reluctant to keep workers in those contracts. This, in turn, increases the conversion rates for both groups of workers but especially for the unskilled who display lower productivity if the match turns out to be productive.

The empirical analysis in the paper tests whether there are significantly different conversion patterns for skilled and unskilled workers. Moreover, we test whether, as the theoretical model predicts, the conversion patterns can be explained by the impact of employment protection in combination with differences in productivity between workers.

We do so by means of a competing risks model with multi-spells which focuses on Spain. A study of Spain is compelling for many reasons. First, the proportion of temporary contracts is the highest in Europe (see Table 1 and

Figure 1). While the average share of temporary contracts in the European Union of 15 States remained around 12% throughout the nineties, in Spain it was well above 30%. Secondly, Spain presents the highest level of employment protection in Europe. Hence, this country provides an interesting case of study to test the relationship between employment protection and the use of temporary contracts.

Our data are from the European Community Household Panel Survey (ECHP) for Spain that contains a rich variety of individuals, household and labor market characteristics. We use this data to estimate a competing risks model with multi-spells. We distinguish between transition rates to permanency and other states<sup>1</sup>. The transition rates of importance are modeled as functions of observed and unobserved explanatory variables. Unobserved heterogeneity is correlated across states and determined internally<sup>2</sup>. Allowing for variation of observed and unobserved explanatory variables is necessary in order to correct for non random inflow into permanent jobs. The main advantage of our dataset is that it contains more than one spell for some individuals. Multi-spell data greatly facilitates the identification and estimation of the joint distribution of the unobserved heterogeneity variables (see Honoré (1993) and van den Berg (2001)).

Our results suggest that workers' skills play an important role in all transitions. We identify differences in transitions rates by educational level. More specifically, temporary contracts serve as stepping stone for high educated workers. In contrast, workers with a low level of education seem to experiment a penalty, that is, this group of workers seem to get stuck in temporary contracts. Controlling for unobserved heterogeneity is important in order to obtain clear estimates.

The different conversion rates for skilled and unskilled workers are explained by differences in productivity measured by changes in wages for both groups of workers. We observe that positive changes in wages increase the probability of conversion into permanency. In addition, changes in employment protection affect the probability of getting a permanent job. There is a positive effect of 1997 reform which shows the important role of employment protection in affecting the threshold productivity level above which workers access to a permanent contract.

The paper is organized as follows. In Section 2 we introduce the related literature. Section 3 presents the theoretical model. Section 4 empirically tests the different conversion patterns for skilled and unskilled workers. Finally, Section 5 concludes and summarizes.

## 2 Related literature.

The theoretical model could be viewed as closer to Wasmer (1999) and Blanchard and Landier (2002) in the sense that they also analyze the coexistence

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<sup>1</sup>These include unemployment, inactivity or a new temporary contract.

<sup>2</sup>See Heckman and Singer (1984).

of temporary and permanent contracts. The former has an endogenous coexistence of both types of contracts but no transition between contracts, while the latter assumes the exogenous coexistence of both types of contracts but has an endogenous transition into permanent contracts. However, the present model can generate a full range of conversion rates into permanent contracts (0, 1 or in between), given the skill heterogeneity of workers. This is an improvement on Blanchard and Landier (2002) and the fact that the conversion rate is endogenous is also an improvement over Wasmer (1999).

In the empirical literature, Guell and Petrongolo (2003) estimate a duration model with competing risks of terminating into permanent employment versus alternative states. They also assume that unobservables are independent across states. This is also the case that Booth et al., D'Addio and Rosholm (2005) also develop a competing risk model, although assuming that unobservables are uncorrelated and spells of different individuals are treated as independent.

We follow the alternative approach suggested by Zijl et al. (2004) and Gagliarducci (2004) that develop a multi-spell multi-stage model with correlated unobserved heterogeneity. In contrast to previous studies, they estimate correlated unobserved heterogeneity that is determined internally. Moreover, they use multiple observations per spell time. This allows to control for selectivity bias in the estimates.

### 3 Theoretical model

#### 3.1 Model

Assume an economy with a continuum of workers of size one in which match-idiosyncratic productivity shocks differ for skilled and unskilled workers. In this sense, there are two types of workers: high-skilled and low-skilled ( $H$ -type and  $L$ -type workers), which differ in their productivity when the match turns out to be good. We also assume that firms know the type of worker<sup>3</sup> before hiring. The mass of  $H$ -type workers is  $\mu$ , and the mass of  $L$ -type workers is  $1 - \mu$ .

The number of firms is determined endogenously. Each firm offers one job, which can be either vacant or filled and costs  $c$  to set up. In the former case, the firm is actively engaged in hiring at a cost  $k$ . We assume that when a new firm is created, a temporary job<sup>4</sup> is offered which starts with productivity  $y$ , regardless of the type of worker the firm is matched to. Productivity then changes with instantaneous probability  $\lambda$ . The new level of productivity can take two values. With probability<sup>5</sup>  $p$ , it changes to a low productivity level. As a result, the match is destroyed and the position becomes vacant again, that is, this is the probability of facing a destructive shock. With probability  $1 - p$ , it

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<sup>3</sup>In this sense, we are ruling out the existence of private information about the worker's productivity. Hence, the type of worker is not defined as normally the case in models with private information. Here, "type" only refers to whether the worker is skilled or unskilled.

<sup>4</sup>This assumption was first introduced by Blanchard and Landier (1999).

<sup>5</sup>This is a reasonable assumption and although it is not as intuitive as assuming that transition rate  $p$  is skill-specific, nothing important would change in the latter case.

changes to a new value  $y_i$ ,  $i \in \{H, L\}$ , which depends on the type of worker the firm is matched to. In this sense, one could interpret this change in productivity either as the outcome of a learning process in which skilled workers learn while unskilled workers do not or by differences in specific human capital investments for both groups of workers. When productivity changes from  $y$  to  $y_i$ , the firm can decide to either lay off the worker (and, hence, hire a new worker in a temporary job), or keep the worker in a permanent job. In the latter case, the permanent job can be destroyed with instantaneous probability<sup>6</sup>  $\phi < \lambda$ , in which case there are firing costs,  $f$ , which are pure waste.

Unemployed workers and vacancies are assumed to meet each other randomly according to a conventional function  $m(v, u)$  with constant returns to scale, where  $v$  and  $u$  denote, respectively, the masses of job vacancies and of unemployed workers. We denote the arrival rate for workers as  $h(\theta)$ , where  $\theta = \frac{v}{u}$  is labor market tightness. We assume that  $h'(\theta) > 0$  and that  $\lim_{\theta \rightarrow 0} h(\theta) = 0$ . We suppose that H and L-type workers meet vacancies at the same rate. Similarly, vacancies meet unemployed workers at the rate  $l(\theta)$ . We assume that  $l'(\theta) < 0$  and that  $\lim_{\theta \rightarrow 0} l(\theta) = \infty$ . Let  $\eta$  denote the fraction of the unemployed workers who are L-type, then the arrival rate for vacancies of L-type workers is  $\eta l(\theta)$ . The link between  $\mu$  and  $\eta$  will depend on the conversion rates of the economy, which will be determined below.

When a match is formed, the firm and the worker divide the surplus of the match according to the asymmetric Nash bargaining solution. The worker's share of the surplus is exogenous and denoted by  $\beta \in (0, 1)$ .

In deriving the asset value equations we use the following notation. Let  $U_i$  be the value of an unemployed worker of type  $i \in \{H, L\}$ , and  $V$  the value of a vacancy.  $J_{ij}$  the value of a type of contract  $j \in \{T, P\}$  filled with a worker of type  $i$ . Similarly, let  $W_{ij}$  denote the value of employment for a worker of type  $i$  in a contract of type  $j$ . The surplus of a match between a worker of type  $i$  and a job with contract of type  $j$ , will then be given by

$$S_{iT} = W_{iT} + J_{iT} - U_i - V \quad (1)$$

$$S_{iP} = W_{iP} + J_{iP} - U_i - V + f \quad (2)$$

Hence, the wage  $w_{ij}$  is given by the Nash Bargaining solution of

$$\beta(J_{iT} - V) = (1 - \beta)(W_{iT} - U_i) \quad (3)$$

$$\beta(J_{iP} - V + f) = (1 - \beta)(W_{iP} - U_i) \quad (4)$$

Finally, we assume that the common discount rate of workers and firms is  $r$ . Moreover, unemployed workers earn a flow income  $z < y$ . We now develop expressions for the asset value equations.

First, the value to a firm of employment of a worker of type  $i$  on a job with a temporary contract is given by:

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<sup>6</sup>This assumption was introduced by Wasmer (1999) and can be interpreted as follows: temporary contracts are terminated either by destruction or due to reaching the maximum duration, which is proxied as another Poisson process, that is,  $\lambda = \phi + s_{\text{maximum duration}}$ .

$$rJ_{iT} = y - w_{iT} + \lambda [p(V - J_{iT}) + (1 - p)(\max(V, J_{iP}) - J_{iT})] \quad (5)$$

and for a permanent contract:

$$rJ_{iP} = y_i - w_{iP} + \phi(V - J_{iP} - f) \quad (6)$$

Next, the value to a worker of type  $i$  of employment on a job with temporary contract is:

$$rW_{iT} = w_{iT} + \lambda [p(U_i - W_{iT}) + (1 - p)\{\max(U_i, W_{iP}) - W_{iT}\}] \quad (7)$$

and for a permanent contract:

$$rW_{iP} = w_{iP} + \phi(U_i - W_{iP}) \quad (8)$$

The value of unemployment for a worker of type  $i$  is:

$$rU_i = z + h(\theta)(W_{iT} - U_i) \quad (9)$$

Finally, the value of a vacancy is given by:

$$rV = -k + \eta l(\theta)(J_{HT} - V) + (1 - \eta)l(\theta)(J_{LT} - V) \quad (10)$$

### 3.2 Equilibrium

There exist three different cases which yield different conversion rates for skilled and unskilled workers. In all equilibria, we obtain that unskilled workers are never more likely to be converted into a permanent contract than skilled workers. The nature of equilibrium will depend crucially on the institutional labor market framework of the economy, given by firing costs and unemployment benefits.

From (1), (2), (5), (6), (7) (8), and (9), the surplus of a job in a permanent and temporary contract occupied by a worker of type  $i \in \{H, L\}$  is given, respectively, by:

$$S_{iP} = \frac{y_i - z + r(f - c)}{r + \phi} - \frac{\beta h(\theta)}{r + \phi} S_{iT} \quad (11)$$

$$S_{iT} = \frac{y - z - rc - \lambda(1 - p)f}{r + \lambda + \beta h(\theta)} + \frac{\lambda(1 - p)}{r + \lambda + \beta h(\theta)} (\max\{f, S_{iP}\}) \quad (12)$$

From (12), we derive the following condition.

**Corollary 1** *A match between a firm and an  $i$ -type worker is only profitable under a permanent contract when:*

$$S_{iP} \geq f$$

Corollary 1 states that after a positive change in productivity the firm decides to keep an  $i$ -worker in a permanent job only if the surplus generated under a permanent job is greater or equal to the firing costs.

Rearranging condition of Corollary 1 in terms of the productivity of the match, we obtain the following Lemma.

**Lemma 2** *There is a threshold productivity value,*

$$\bar{y} = z + \frac{\beta h(\theta)}{r + \lambda + \beta h(\theta)} (y - z) + \left(1 - \frac{\beta h(\theta)}{r + \lambda + \beta h(\theta)}\right) rc + \phi f$$

*such that if  $y_i \geq \bar{y}$ , where  $i \in \{H, L\}$ , a temporary job with an  $i$ -type worker will be converted into permanent. In contrast, if  $y_i < \bar{y}$ , a temporary job with an  $i$ -type worker is not converted into permanent.*

**Proof.** It follows immediately from (11), (12) and Corollary 1. ■

Lemma 2 states that a temporary job is converted into permanent only if the worker's productivity exceeds the worker's outside option, the set up costs and the firing costs.

Now, we are ready to characterize the equilibrium of this model. The type of equilibrium will depend on whether the productivity of a skilled and unskilled worker exceeds threshold productivity  $\bar{y}$ . Three possible equilibria may arise.

The first one is no conversion equilibrium in which neither type of worker can gain access to permanent jobs. The new value of productivity of either a skilled or unskilled worker is too low and the firm prefers to lay-off the worker and hire another one under a temporary contract rather than convert the current temporary contract into permanent. In this case, temporary contracts are dead-end jobs for skilled and unskilled workers (trap effect). The second is full conversion equilibrium, in which both types of workers can gain access to permanent jobs. Temporary contracts are a way to obtain permanent contracts for both groups of workers (stepping-stone effect). The third is segmentation equilibrium in which only skilled workers can access permanent jobs. The stepping stone effect dominates for skilled workers, while the trap effect dominates for unskilled workers.

**Proposition 3**

- i) If  $y_L < y_H < \bar{y}$ , there is a unique no conversion equilibrium, where temporary jobs with skilled and unskilled workers are never converted into permanent.*
- ii) If  $\bar{y} \leq y_L < y_H$ , there is a unique full conversion equilibrium, where temporary jobs with skilled and unskilled workers are always converted into permanent.*
- iii) If  $y_L < \bar{y} \leq y_H$ , there is a unique segmentation equilibrium, where only temporary jobs with skilled workers are converted into permanent.*

**Proof.** See Appendix 1. ■

What determines whether the stepping stone effect or the trap effect dominates for skilled and unskilled workers is whether or not the value of productivity exceeds the threshold productivity value. The latter depends crucially on the institutional labor market framework of the economy under study. This is analysed in some detail in the next subsection.

### 3.3 Comparative statics

In this section we run some simulations in order to quantitatively illustrate the comparative statics of the model. In the baseline case, we use the matching function  $m(\theta) = 2\sqrt{\theta}$  and we assume that  $y = 1$ ,  $y_H = 1.2$ ,  $y_L = 0.8$ ,  $\mu = 0.25$ ,  $f = 0.2$ ,  $\beta = 0.5$ ,  $\lambda = 0.3$ ,  $\phi = 0.1$ ,  $p = 0.5$ ,  $r = 0.03$ ,  $z = 0.2$ ,  $k = 0.01$  and  $c = 0.3$ .

The benchmark simulation is presented in Table 8. These parameters are configured so as there is segmentation equilibrium. We do this because this type of equilibrium is confirmed by the empirical part of the paper. This case generates an unemployment rate of about 11% percent. An equilibrium value of  $\theta = 1.01$ , which implies that the average duration of unemployment is 5.94 months and the average duration of a vacancy is 6.05.

In Tables 9 to 12, we show the comparative statics of a change in unemployment insurance, firing costs, destruction rate of temporary contracts ( $\lambda$ ) and destruction rate of permanent contracts ( $\phi$ ).

We find that when unemployment insurance decreases, the worker's outside option is lower and threshold productivity decreases, making the conversion of temporary contracts into permanent less difficult. Furthermore, the equilibrium value of  $\theta$  decreases. Lower firing costs make permanent contracts more profitable, and therefore, they reduce threshold productivity. Moreover, they increase the equilibrium value of  $\theta$ . A higher destruction rate of temporary contracts makes the conversion into permanency more profitable, thus, diminishing threshold productivity. It also yields a lower equilibrium value of  $\theta$ . A higher destruction rate of permanent contracts makes conversion into permanency less profitable, hence increasing threshold productivity. Besides, it yields a lower equilibrium value of  $\theta$ .

Therefore, the model allows to derive a simple relationship between conversion rates for both groups of workers and the institutional labor market framework of the economy: lower firing costs or unemployment benefits make it easier for skilled and unskilled workers to gain access to permanent jobs. The intuition is as follows. Lower firing costs reduce the threshold productivity value and make firms less reluctant to keep workers in permanent contracts. This, in turn, increases the conversion rates for both groups of workers but especially for the unskilled who display lower productivity if the match turns out to be productive. This testable implication along other ones is explicitly stated in the following subsection.

### 3.4 Hypotheses

The theoretical model yields the following predictions:

1. A positive change in productivity increases a worker's likelihood of conversion into a permanent contract.
2. After a positive change in productivity, a worker's likelihood of conversion increases with skill.
3. Changes in employment protection legislation affect the likelihood of conversion into a permanent contract. More specifically, lower firing costs increase the likelihood of conversion for skilled and unskilled workers, especially for the latter.
4. Negative demand shocks reduce the likelihood of conversion into permanency.

Firms, after hiring workers in temporary contracts, find out how good the matches are and then they have to decide whether to keep the workers in higher productivity permanent contracts. Then, the model predicts more conversions into permanency for those workers that experience an increase in productivity (Hypothesis 1).

There is a threshold productivity level above which workers may access to permanent contracts. Since positive changes in productivity are higher for skilled workers, the model predicts that the likelihood of conversion is higher for skilled workers (Hypothesis 2). Hypotheses 1 and 2 imply that temporary contracts are used as a probation device to test the quality of the match. Workers on initial temporary contracts who display high ability are later offered permanent employment at the firm.

Lower firing costs imply lower costs the firm has to endure if the match is destroyed after the conversion and, thus, it reduces the threshold productivity level above which workers may access to a permanent contract. Therefore, the model predicts that lower firing costs will make firms more willing to keep workers in permanent contracts, increasing the likelihood of conversion (Hypothesis 3).

When there is a negative demand shock, workers are more likely to be facing a destructive shock and less likely to have a positive change in productivity. Therefore, the model predicts that workers are less likely to be kept in a permanent contract (Hypothesis 4).

These predictions will be tested using a competing risks model with multi-spells. Worker's productivity will be proxied by changes in wages before and after the conversion into permanency and other states. Worker's skill is proxied by education level. Firing costs are determined by the institutional environment and the demand shocks are captured using regional unemployment rates.

## 4 The Empirical Model

### 4.1 Data and variables

We use individual records from the seven first waves of the ECHP (1994-2000)<sup>7</sup>. The ECHP has been designed to compare different aspects of European countries and annually interviews a representative sample of 80,000 households, of which 8,000 are Spanish. The same individuals are re-interviewed each successive year and if they leave their original households to form a new one, all adult members of these new households are also interviewed. Similarly, children in the original households are interviewed when they are sixteen. The sample remains broadly representative of the Spanish population.

In the ECHP an extensive effort is made to collect detailed information about several aspects of individuals, including their labor market history. At each date of interview, individuals are asked detailed questions related to their current employment status (type of contract, occupation, industry, size of firm, etc.). More importantly, individuals are asked when they started their job and if it was preceded by unemployment. In addition to this, there is a group of variables containing information on individuals' previous jobs. Recently, some studies have used this dataset for worker transition analysis, such as Jolivet et. al. (2004) and D'Addio and Rosholm (2005).

In order to test the predictions of the theoretical model, we are interested in both analyzing the determinants of transitions from temporary employment to other states and the duration of these contracts. One way is to analyze transitions from temporary to permanent contracts with the same employer and compare them with transitions to permanency to another firm. Unfortunately, in the sample the number of transitions to permanency with a different employer is very small. Following Booth et al (2002), we follow the alternative approach of allowing the determinants of exit behavior to vary between spells starting in casual jobs and spells starting in fixed-term contracts<sup>8</sup>. Therefore, we select only those individuals who have had at least one fixed-term contract or one casual job during the period under study.

The duration of each spell is constructed by using information from the individual questionnaire provided by the successive waves. Spell duration is defined as months in the same job with the same employer and not involving a promotion to a permanent position. To each job spell has been attached a vector of demographic, household, job related and local labor market conditions, and the details of previous labor market status. As the dataset is annual<sup>9</sup>, we determine the spell duration by relying on the information concerning the type of contract held and main activity. Moreover, we are able to construct job spell

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<sup>7</sup>The wave of 1994 is only used to obtain the starting points of spells since it does not contain information about contract types.

<sup>8</sup>The precise question in the ECHP is as follows "What type of employment contract do you have in your main job?". The possible answers can be "permanent employment", "fixed term or short term contract" and "casual work".

<sup>9</sup>Despite its annual nature, retrospective information on past labour market status over the last five years enables to identify short spells.

duration by combining the ending dates of previous jobs and the starting dates of current jobs.

We are also interested in where workers go when a fixed-term contract or a casual job ends. The data allow us to determine four different states: a) having a permanent position<sup>10</sup> (regardless of the firm)<sup>11</sup> b) unemployment<sup>12</sup> c) other states as inactivity d) other temporary contract<sup>13</sup>. For the empirical analysis we merge three of the states: unemployment, inactivity and temporary work in another firm, since all these states can be considered "negative" transitions.

Finally, right censoring occurs in either wave six or when the individual drops out of the survey. To deal with left censoring we follow the approach adopted by D'Addio and Rosholm (2005) and Guell and Petrongolo (2007) and we delete all the spells that start before 1994.

One particular advantage of our dataset is that it allows to obtain more than one single spell per individual. We have 3,278 individuals and the final sample provides 4,989 spells. We use up to four spells per individual. We drop some spells because we have missing information about the elapsed duration.

To test the predictions derived from the theoretical model we introduce the following explanatory variables. Education levels are included to establish whether more educated workers are more likely to make transitions to permanency and less likely to go to "negative states". Wage differences before and after worker's transition are used as a proxy for changes in worker's productivity. A dummy for the 1997 tests whether firing costs affect the probability of achieving a permanent contract. A variable measuring the unemployment rate disaggregated by gender and area at the starting point of each spell tests whether demand shocks affect the likelihood of conversion into permanent contracts. Other variables we include are: a continuous variable for age; a dummy for marital status; a dummy reflecting whether the individual has been long term unemployed; a public sector dummy. In Table 2 we present the descriptive statistics of the sample for casual and fixed-term contracts.

A first look at the data indicates two different patterns of transitions. Table 3 shows the transition in successive spells by destination. We observe that 77 per cent of permanent transitions are made in the first spell. By contrast, if a individual have a first spell of other states he increase the probability to end in other states. This clearly indicate a rough persistence in the transitions to "bad states" for some individuals.

Finally, in Figures (1) and (2) we provide the Kaplan-Meier survival functions from fixed-term contracts to permanency and to other states, respectively, disaggregated by education. The differences between the survival functions to permanency are important indicating the influence of education. At the start of

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<sup>10</sup>It is considered an absorption state since in our sample it is observed that workers do not move from a permanent contract to other states.

<sup>11</sup>When the individual obtains a permanent position in the same firm we have no information about the timing. We assume that in this case the spell finishes in december.

<sup>12</sup>In order to define this state we use the LFS classification.

<sup>13</sup>As no direct information is provided, we follow the variable year starting the current job and year finishing last job during different waves in order to obtain if the individual switches the contract.

the spell they are quite similar, but once twelve months of a temporary contract have passed, the survival rate of high educated workers declines significantly.

Survival functions to other states also indicate the role of education in fixed-term contracts exit rates. We observe that high educated workers have a lower exit rate to other states than low educated workers. The difference between the survival functions widens with the duration of the temporary contracts.

## 4.2 The Econometric Model

Competing risk hazard models are used to examine the transition to temporary and other states<sup>14</sup>. Two origin states are considered  $l = 1, 2$ ; "fixed-term contracts",  $l = 1$ , and "casual contracts"  $l = 2$ . In addition, each spell can end in two states  $j = 1, 2$ ; "permanency",  $j = 1$ , and other states,  $j = 2$ . The specification of the hazard rates for all spells of type  $k$  takes the logistic hazard form. Then,

$$\theta_{lj}(t_k) = F[\alpha_{lj}(t_k) + \beta_{lj}X] \quad (j = 1, 2), (l = 1, 2)$$

where  $\alpha_{lj}(t)$  is the baseline hazard for each transition modeled in a flexible way, where  $t$ ,  $t^2$  and  $\beta_{jl}$  are vectors of individual, sectorial and aggregate parameters, respectively.

In line with Prentice and Gloeckler (1978) and Meyer (1990) we consider the hazard rates to adopt a discrete form. This approach provides a useful perspective from both a statistical and computational point of view, as it has been noted by a great number of authors including Meyer (1990) and Meghir and Whitehouse (1997)<sup>15</sup>.

The individual loglikelihood for each spell of each individual to each transition is defined as:

$$\log L_{jik}^l = \sum_{t_k=1}^{T_k-1} ((1 - \delta_{jik}) \log(1 - \theta_{lji}(t_k)) + \delta_{jik} \log(\theta_{lji}(T_k)))$$

where  $T_k$  is the length of  $k$ -spell,  $\delta_{jik}$  is equal to 1 if spell  $k$  exits to state  $j$ . In the absence of unobserved heterogeneity, each spell can be considered as conditionally independent and the likelihood function can be maximized separately.

## 4.3 Unobserved Heterogeneity

An alternative to the above model would involve transition equations depending on unobserved heterogeneity. In this case, estimation becomes more complicated since transition probabilities cannot be treated a priori as independent conditional on the unobservables, and the spells cannot be treated separately. Better

<sup>14</sup>See Lancaster (1990) for a detailed discussion of competing risks models.

<sup>15</sup>See Han and Hausman (1990) for the identifiability of this kind of models.

individuals have a higher transition rate to permanency than bad individuals. To deal with this selectivity inflow, we need to specify the likelihood function for all transitions for any individual and integrate out the random effects. If the random effects are not included in this way, we cannot interpret our results in a causal way. The inclusion of unobserved heterogeneity also allows for measurement errors in the dependent variable as well as omitted unobserved covariates.

We introduce two unobserved random vectors,  $u_{lj}$ ,  $j = 1, 2$  and  $l = 1, 2$  as in the previous section. Then, the previous hazard rates take the form:

$$\theta_{lj}(t, u_{lj}) = F[\alpha_{lj}(t_k) + \beta_{lj}X + u_{lj}]$$

We assume that the heterogeneity term varies for a given individual, as assumed by Bonnal et. al. (1997), van den Berg et. al. (2002) and Zijl et. al. (2005). In this case, the marginal individual likelihood, given  $X$  contribution and  $u = [u_1, u_2]$  for a given individual is:

$$L_i^l = \int \prod_{j=1}^2 \prod_{k=1}^{m_i} \prod_{t_k=1}^{T_k-1} (1 - \theta_{lji}(t_k, u_{lji}))^{(1-\delta_{jik})} \prod_{j=1}^2 \theta_{lji}(T_k, u_{lji})^{\delta_{jik}} dG(u)$$

where, as before,  $\delta_{jik} = 1^{16}$  if the individual moved to state  $j$  in  $k$  spell.

Following the work of Heckman and Singer (1984), we consider  $G$  a bivariate discrete distribution, yielding a mixture proportional model. In this sense, Flinn and Heckman (1983), Honoré (1993) and Abbring and van den Berg (2003) show that the mixed proportional hazard model with multispells data is identified under much weaker assumptions. We assume that each transition rate has two mass points  $(u_1^1, u_1^2)$  and  $(u_2^1, u_2^2)$ , that give us a distribution with four points of support. The associated probabilities are as follows:

$$\begin{aligned} \Pr(u_1 = u_1^1, u_2 = u_2^1) &= p_1 & \Pr(u_1 = u_1^2, u_2 = u_2^1) &= p_2 \\ \Pr(u_1 = u_1^1, u_2 = u_2^2) &= p_3 & \Pr(u_1 = u_1^2, u_2 = u_2^2) &= p_4 \end{aligned}$$

where  $0 \leq p_i \leq 1, i = 1, \dots, 4$ . We model  $p_i = \frac{\exp(\alpha_i)}{1 + \sum \exp(\alpha_i)}$  to have a

multinomial logit specification. The sum of  $p_i$  probabilities ought to be equal to one. Notice that we have to jointly estimate the likelihood function because of the introduction of unobserved heterogeneity.

## 4.4 Results

In Tables 4 and 5 we show the estimates of the covariate effects and the baseline hazards from fixed-term contracts with and without unobserved heterogeneity, respectively. In Table 6 we present the estimates from casual jobs controlling

<sup>16</sup>We consider that "fixed-term contracts" and "casual contracts" are independent states.

for unobserved heterogeneity. Table 7 shows the estimates of the parameters of the distribution of the correlated unobserved heterogeneity.

We estimate three models in order to test the main predictions from the theoretical model. In model (I) we control for the 1997 reform. In model (II) we drop this dummy and we control for unemployment rate. Finally in model (III) we control for changes in wages<sup>17</sup>.

Comparing Tables 4 and 5, we observe that models with and without unobserved heterogeneity present different estimates. Moreover, the models allowing for correlated unobserved heterogeneity in the exits rate yield a considerably higher likelihood than the models without unobserved heterogeneity.

We first examine the transition rate from fixed-term contracts to permanency. In model (I) we observe that the dummy introduced to control the 1997 reform is significant and has a positive sign. This result becomes stronger when we control for unobserved heterogeneity. The reform act of 1997 promoted permanent contracts by reducing the cost of dismissal. This reform act created a new type of permanent contract, with lower severance costs in the case of unfair dismissal (33 days wage per year) and with tax benefits in the first two years of the contract (reductions in employers' payroll taxes). This result indicates that lower firing costs increase the probability of conversion into permanency and is in line with prediction (3) of Section 3. In model (II) we obtain that the impact of labor market conditions increases from -0.038 to -0.052 when we control for unobserved heterogeneity, but remain significant. This indicates that adverse labor market conditions decrease the rate to obtain a permanent contract and is in line with prediction (4) of Section 3. This result also indicates that fixed-term contracts provide firms with an additional instrument to face adjustments in their product demand. Finally, in model (III) we find that positive changes in wages increase the probability of conversion into permanency. This result is stronger when we control for unobserved heterogeneity. We use changes in wages as a proxy<sup>18</sup> for changes in productivity. Then, this result is in line with prediction (1) of Section 3.

In all models we obtain that workers with a high level of education have a strong probability of finding a permanent job and this effect becomes lower when we control for unobserved heterogeneity. Secondary education becomes no significant when we control for unobserved heterogeneity. This result is in line with prediction (2) of Section 3. Therefore, fixed-term contracts serve as a stepping stone for more educated workers.

Other interesting results are worth to be mentioned. A particularly strong effect is obtained for married people. The negative effect of having experimented a long term unemployment disappear in models I and II when we control for unobserved heterogeneity indicating that this effect is likely to be spurious. Moreover, sector dummies show that renewal rates into permanency are higher in services. Public sector workers have lower rates of exit into permanency than those in the private sector. This result is consistent with Dolado et al (2002).

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<sup>17</sup>As we have some censored observations, the sample size is reduced to 1949 observations for this model.

<sup>18</sup>We thank Gerard van den Berg for this suggestion.

They find that the public sector has witnessed a large increase in the proportion of temporary contracts for this period due to the fiscal consolidation pursued by the Spanish government after the Maastricht Treaty. This change in the hiring behavior of the public sector has also been reflected in a higher exit of public workers into unemployment.

Next, we analyze the transition from fixed-term contracts to other states. Not surprisingly, the estimates change substantially when we control for unobserved heterogeneity.

Positive changes in wages reduce the probability of conversion into other states. As opposed to the former transition, high educated workers have lower rates of exit into other states than no qualified workers. Tertiary education also plays an important role in this transition and this value becomes larger when we control for unobserved heterogeneity. Adverse labor market conditions increase the probability of conversion into other states. These results provide indirect empirical evidence for predictions in Section 3.

The dummy introduced to control the 1997 reform is significant and has a positive sign when we control for unobserved heterogeneity. This result could indicate that lower firing costs also yields higher turnover rates.

We summarize other interesting results. This probability is higher for females than males. Workers who have experienced long-term unemployment spells have a higher probability of ending in other states. Sector effects also emerge in the data. Individuals employed in agriculture have the highest probability of ending up in unemployment. When we control for unobserved heterogeneity sector effects highly increase.

Regarding the transitions from casual jobs, we only estimate a model that includes the 1997 reform and unemployment rate. We observe that having experimented a long term unemployment and adverse labor market conditions have a negative effect in the transition rates from casual to permanency<sup>19</sup>. In the transition into other states, age and working in the public sector have a negative effect whereas long term unemployment has a positive effect.

The empirical results are in line with the predictions of the theoretical model. Workers's skills play a key role in all the transitions from fixed-term contracts. More specifically, fixed-term contracts serve as stepping stone for more educated workers. By contrast, low educated workers seem to be penalized, that is, this group of workers seem to get stuck in fixed-term contracts. The different conversion rates for skilled and unskilled workers are explained by differences in productivity measured by changes in wages for both groups of workers. The positive effect of 1997 reform shows the important role of employment protection in affecting the threshold productivity level above which workers access to a permanent contract. By contrast, casual contracts follow a completely different pattern. The distinction between these two categories of temporary contracts allows to obtain better estimates of the fixed-term contracts transitions.

In Table 7 we present the results for the unobserved heterogeneity distri-

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<sup>19</sup>The explanation for the different dynamics of casual contracts are beyond the scope of this paper.

bution of the three models for fixed-term and the model for casual contracts, respectively. We proceed to describe the results of model (I) for fixed-term contracts<sup>20</sup>. The parameter of  $p_1$  is in the boundary of the parameter space ( $p_1 = 0$ ). We compute the standard errors of the other parameters conditional on this. This indicates that there are three groups of individuals in the sample. The first group, (37 % of the population) has a relatively low hazard rate to permanency ( $u_1 = -5.012$ ), but a relatively low hazard rate to go to other states ( $u_2 = -7.099$ ). There is a second group (40% of the population) with a low entry rate into permanency ( $u_1 = -5.268$ ) and a high entry rate into other states ( $u_2 = -3.819$ ). Finally, a third group (23% of the population) has a low entry rate into permanency ( $u_1 = -5.268$ ) and a high entry rate into other states ( $u_2 = -3.819$ ).

## 5 Conclusions

In this paper we show the existence of two opposite dynamics of temporary contracts for skilled and unskilled workers. We explain the different conversion patterns by the impact of employment protection in combination with differences in productivity between workers.

In the theoretical part of the paper we propose a model that directly relates the dynamics of temporary contracts with the level of productivity of workers. We obtain three different cases which yield different conversion rates for skilled and unskilled workers. In all equilibria, unskilled workers are never more likely to be converted into a permanent contract than skilled workers. Moreover, the model allows to derive a simple relationship between conversion rates for both groups of workers and the institutional labor market framework of the economy.

Our results suggest that workers' skills play an important role in all transitions. We identify differences in transitions rates by educational level. More specifically, temporary contracts serve as stepping stone for high educated workers. In contrast, workers with a low level of education seem to experiment a penalty. Furthermore, the different conversion rates for skilled and unskilled workers are explained by differences in productivity measured by changes in wages for both groups of workers. We observe that positive changes in wages increase the probability of conversion into permanency. In addition, we obtain that lower firing costs increase the probability of getting a permanent job. This result shows the importance of employment protection in affecting the threshold productivity level above which workers access to a permanent contract.

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<sup>20</sup>Model (I) yields the higher log-likelihood value and, thus, fit better the data.

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Table 1: The proportion of temporary contracts in Europe (%).

	Spain	UK	Sweden	Portugal	Netherlands	Italy	France	Germany	Denmark	EU15
1992	34.2	5.9	-	12.5	10.4	-	10.6	10.5	10.7	11.1
1993	33.0	6.3	12.0	11.5	10.5	6.2	10.9	10.3	10.6	11.0
1994	34.2	6.9	14.1	11.4	11.3	6.8	11.5	10.4	11.6	11.5
1995	35.2	7.2	14.7	12.0	11.4	7.4	12.4	10.5	11.6	12.0
1996	34.1	7.3	14.4	13.6	12.3	7.4	12.8	11.2	10.9	12.3
1997	33.8	7.6	15.1	15.4	11.8	7.9	13.4	11.8	10.6	12.7
1998	33.2	7.3	16.1	17.2	13.0	8.6	13.9	12.4	9.9	13.1
1999	32.9	7.0	16.5	18.7	12.3	9.5	14.5	13.0	9.6	13.4
2000	32.0	6.9	15.8	19.9	13.7	10.1	15.2	12.7	9.7	13.6
2001	31.7	6.7	15.2	20.4	14.3	9.8	14.6	12.4	9.2	13.3
2002	31.0	6.3	15.2	21.7	14.4	9.9	13.5	12.1	9.1	13.0
2003	30.6	6.1	15.1	21.1	14.6	9.9	12.9	12.2	9.3	12.8

Source: Eurostat.

Table 2: Summary statistics by type of contract (%).

	Fixed Term		Casual	
	mean	sd	mean	sd
Age	30.91	9.94	32.94	10.93
Woman	0.37	0.48	0.43	0.50
Married	0.46	0.50	0.52	0.50
Single	0.54	0.50	0.48	0.22
Agriculture	0.06	0.24	0.14	0.35
Industry	0.41	0.49	0.32	0.47
Services	0.52	0.50	0.52	0.50
1997 reform	0.65	0.48	0.44	0.50
Primary education	0.57	0.49	0.05	0.22
Secondary education	0.29	0.46	0.26	0.44
Higher education	0.13	0.34	0.32	0.47
Public sector	0.13	0.33	0.10	0.30
Long term unemp.	0.35	0.48	0.35	0.48
Unemp. rate	18.15	7.73	19.95	7.98

Note: The values of these variables are attached at the beginning of the spell.

Table 3: Number of spells by destination.

	First spell	Second Spell	Third Spell	Fourth Spell	TOTAL
Censored	1227 (37.43%)	355 (28.22%)	89 (25.95%)	26 (23.64%)	1698 (34.03%)
Permanent	809 (24.68%)	218 (17.33%)	30 (8.75%)	1 (0.91%)	1060 (21.25%)
Other States	1242 (37.89%)	685 (54.45%)	224 (65.31%)	83 (75.45%)	2237 (44.84%)
TOTAL	3278 (100%)	1258 (100%)	343 (100%)	110 (100%)	4989 (100%)

Table 4: Estimation results from fixed term contracts without unobserved heterogeneity.

	Exit to permanent			Exit to temporary		
	Model I	Model II	Model III	Model I	Model II	Model III
Age	-0.001 (0.004)	-0.003 (0.004)	-0.008 (0.005)	-0.004 (0.003)	-0.003 (0.003)	0.001 (0.003)
Woman	0.022 (0.072)	0.461 (0.101)	0.041 (0.095)	0.163 (0.049)	-0.043 (0.071)	0.177 (0.064)
Married	0.171 (0.076)	0.189 (0.076)	0.222 (0.102)	0.005 (0.051)	-0.005 (0.051)	-0.071 (0.066)
Agriculture	-0.106 (0.168)	-0.063 (0.168)	-0.230 (0.209)	0.464 (0.084)	0.431 (0.084)	0.164 (0.107)
Services	0.252 (0.073)	0.249 (0.073)	0.303 (0.096)	0.013 (0.051)	0.007 (0.051)	-0.143 (0.065)
1997 reform	0.236 (0.064)			0.143 (0.044)		
Secondary education	0.186 (0.075)	0.139 (0.076)	0.145 (0.100)	-0.128 (0.051)	-0.100 (0.052)	-0.116 (0.067)
Higher education	0.423 (0.096)	0.370 (0.096)	0.557 (0.129)	-0.493 (0.080)	-0.454 (0.080)	-0.330 (0.106)
Public sector	-0.479 (0.105)	-0.450 (0.105)	-0.447 (0.149)	0.010 (0.069)	-0.012 (0.069)	0.185 (0.087)
Long term unemp.	-0.273 (0.068)	-0.240 (0.069)	-0.332 (0.093)	0.171 (0.044)	0.145 (0.044)	0.184 (0.057)
Unemp. rate		-0.038 (0.006)			0.017 (0.004)	
Dif. in wages			0.002 (0.001)			-0.001 (0.000)
t	0.298 (0.003)	0.20 (0.032)	0.66 (0.041)	0.134 (0.012)	0.116 (0.013)	0.122 (0.024)
t <sup>2</sup>	-0.003 (0.0003)	-0.004 (0.0004)	-0.006 (0.0005)	-0.004 (0.020)	-0.003 (0.021)	0.126 (0.022)
Spells	4989	4989	1949	4989	4989	1949
Log like	-7.750	-7739	-3803	-17038	-17035	-8939

Note: Standard errors in brackets.

Table 5: Estimation results from fixed term contracts with correl. unobserved heterogeneity.

	Exit to permanent			Exit to temporary		
	Model I	Model II	Model III	Model I	Model II	Model III
Age	-0.001 (0.056)	-0.003 (0.005)	-0.009 (0.0057)	-0.006 (0.003)	-0.007 (0.0037)	0.0014 (0.006)
Woman	0.084 (0.099)	0.659 (0.1289)	0.044 (0.1016)	0.1876 (0.067)	-0.109 (0.099)	0.149 (0.0076)
Married	0.2102 (0.1042)	0.218 (0.0959)	0.2286 (0.107)	0.034 (0.067)	0.0282 (0.0725)	-0.096 (0.08)
Agriculture	0.0496 (0.2109)	0.0843 (0.1981)	-0.237 (0.2166)	0.4552 (0.113)	0.4242 (0.1177)	0.2386 (0.1246)
Services	0.2703 (0.0965)	0.2583 (0.0965)	0.3094 (0.1009)	0.042 (0.065)	0.02975 (0.0702)	-0.129 (0.076)
1997 Reform	0.4562 (0.080)			0.184 (0.671)		
Sec. education	0.1654 (0.104)	0.1166 (0.0967)	0.1694 (0.104)	-0.183 (-0.073)	-0.161 (0.076)	-0.087 (0.0671)
Higher education	0.3222 (0.13478)	0.2482 (0.1236)	0.5806 (0.137)	-0.599 (0.1048)	-0.595 (0.1106)	-0.371 (0.1249)
Public sector	-0.425 (0.1387)	-0.379 (0.1303)	-0.439 (0.1571)	-0.009 (0.0886)	-0.045 (0.0937)	0.24775 (0.1036)
Long term unemp.	-0.104 (0.0965)	-0.096 (0.088)	-0.322 (0.0968)	0.1265 (0.06237)	0.125 (0.067)	0.20149 (0.0682)
Unemp. rate		-0.052 (0.008)			0.0276 (0.006)	
Dif. in wages			0.0016 (0.0006)			-0.003 (0.0004)
t	0.18 (0.02)	0.1685 (0.0164)	0.1526 (0.0241)	0.18172 (0.0133)	0.1355 (0.0094)	0.1828 (0.0165)
$t^2$	-0.002 (0.0002)	-0.002 (0.0094)	-0.002 (0.0005)	-0.002 (0.0002)	-0.002 (0.0002)	-0.0035 (0.0004)
Spells	4989	4989	1949	4989	4989	1949
Log Like	-8222	-8512	-4516	-18536	-19146	-10542

Note: Standard errors in brackets.

Table 6: Estimation results from casual contracts with correl. unobserved heterogeneity.

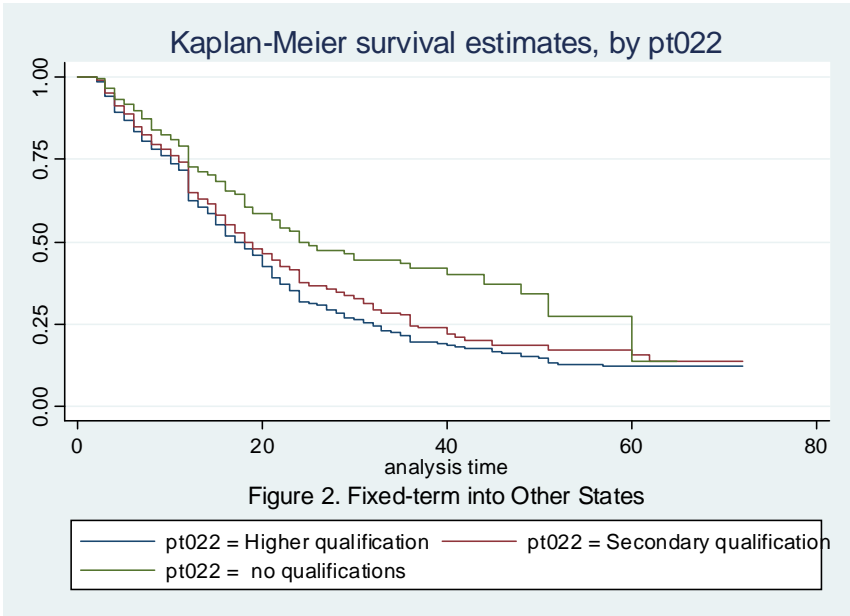
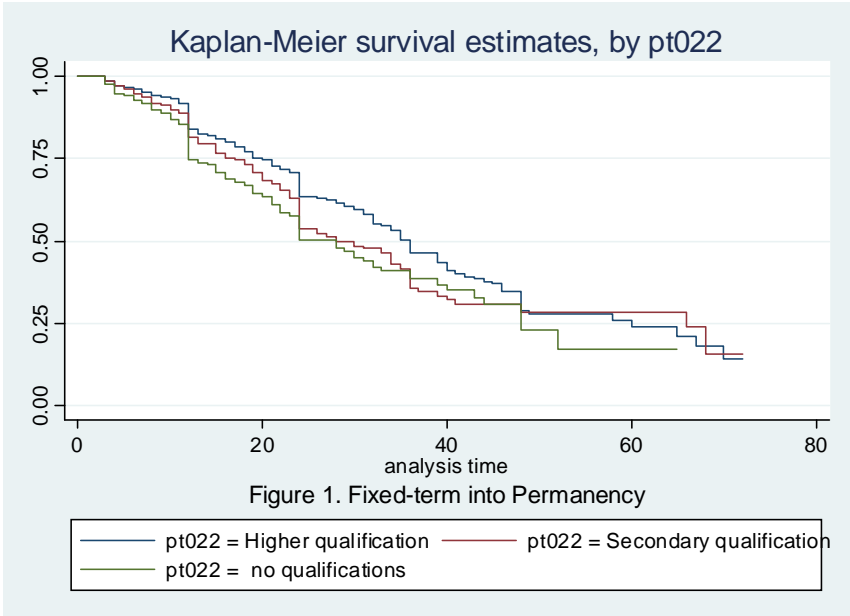
	Exit to Permanent	Exit to Other States
Age	0.007 (0.0112)	-0.02575 (0.007)
Woman	0.6097 (0.3206)	-0.023 (0.215)
Married	0.1008 (0.2269)	-0.0606 (0.013)
Agriculture	0.0927 (0.453)	0.011 (0.200)
Services	-0.0405 (0.2832)	-0.3123 (0.1538)
1997 Reform	0.564 (0.782)	-0.567 (0.567)
Sec. education	-0.2224 (0.2832)	0.088 (0.173)
Higher education	-0.0912 (0.2442)	-0.0027 (0.145)
Public sector	0.1915 (0.2787)	-1.259 (0.3118)
Long term unemp.	-0.4853 (0.2406)	0.265 (0.1283)
Unemp. rate	-0.0431 (0.0206)	0.0085 (0.0136)
t	0.3763 (0.057)	0.1824 (0.022)
$t^2$	-0.0056 (0.001)	0.003 (0.0005)
Log Like	-1.169	-1167
Spells	1.235	1235

Note: Standard errors in brackets.

Table 7: Estimation results for unobserved heterogeneity distribution.

	Exit from Fixed Term to Permanency				Exit from Fixed Term to Other States		
	Model I	Model II	Model III		Model I	Model II	Model III
Mass Point							
$u_1^1$	-5.268 (0.252)	-4.0072 (0.31)	-4.1223 -1.081	$u_2^1$	-7.099 (0.375)	-5.449 (0.386)	-4.90 (0.30)
$u_1^2$	-5.012 (0.227)	-5.572 (0.27)	-4.43 (0.1968)	$u_2^2$	-3.819 (0.139)	4.016 (0.169)	-2.74 (0.23)
Probability							
$p_2$	0.370 (0.084)	0.388 (0.071)	0.806 (0.059)				
$p_3$	0.397 (0.086)	0.282 (0.107)	0.255 (0.255)				
$p_4$	0.231	0.328 (0.000)	0.140 (0.000)	(0.000)			
	Exit from Casual to Permanency			Exit from Casual to Other States			
Mass Point							
$u_1^1$		-5.268 (0.252)		$u_2^1$		-7.09 (0.3755)	
$u_1^2$		-5.012 (0.227)		$u_2^2$		-3.81 (0.1397)	
Probability							
$p_2$		0.370 (0.084)					
$p_3$		0.397 (0.086)					
$p_4$		0.231 (0.000)					

Note: Standard errors in brackets.



## Appendices

### Appendix 1. Proof of Proposition 3

A steady-state equilibrium in this model is a collection of three variables  $\{\theta, u, \eta\}$  that meet the following conditions:

- (a) firm vacancy creation satisfies free entry condition
- (b) the flow of H-type workers into and out of unemployment is equal, and the same for L-type workers.

Applying free entry condition to (10), we obtain:

$$k + (r + l(\theta))c = \eta l(\theta) J_{HT} + (1 - \eta) l(\theta) J_{LT} \quad (13)$$

Using (3),  $J_{iT} = (1 - \beta) S_{iT}$ . (13) can be rewritten as:

$$(1 - \beta) [\eta S_{HT} + (1 - \eta) S_{LT}] - \frac{k + (r + l(\theta))c}{l(\theta)} = 0 \quad (14)$$

The flow of workers into and out of unemployment depends on the type of equilibrium.

*Case (i). No conversion equilibrium.*

This equilibrium arises if a match between a firm and any type of workers is never profitable under a permanent contract. From Lemma 2, this happens when  $y_L < y_H < \bar{y}$ .

We have to prove that this equilibrium exists and is unique.

From Corollary 1, (12) can be rewritten as:

$$S_{LT} = S_{HT} = \frac{y - z - rc}{r + \lambda + \beta h(\theta)} \quad (15)$$

Since in this case a permanent contract is never profitable and, therefore,  $S_{LP} < f$  and  $S_{HP} < f$ .

From (15), free entry condition (14) in no conversion equilibrium is given by:

$$\frac{k + (r + l(\theta))c}{l(\theta)} = (1 - \beta) \left[ \frac{y - z - rc}{r + \lambda + h(\theta)\beta} \right] \quad (16)$$

Condition (b) in no conversion equilibrium implies:

For H-type workers:

$$h(\theta) \eta u = \lambda(\mu - \eta u) \quad (17)$$

For L-type workers:

$$h(\theta) (1 - \eta) u = \lambda(1 - \mu - (1 - \eta) u) \quad (18)$$

The two steady-state conditions can be solved for  $\eta$  and  $u$  in terms of  $\theta$ . This yields:

$$\eta = \mu \tag{19}$$

$$u = \frac{\lambda}{\lambda + h(\theta)} \tag{20}$$

Therefore, no conversion equilibrium is a vector of endogenous variables  $\{\theta^*, u^*, \eta^*\}$  satisfying conditions (14), (19) and (20), that is, the free entry condition and the two steady state conditions.

To solve for the equilibrium given our assumptions on  $m(v, u)$ , (16) has a unique solution for  $\theta$ . If we insert this solution on (19) and (20) we get a unique solution for  $\eta$  and  $u$ . Therefore, when we have a no conversion equilibrium, it is unique.

For cases (ii) and (iii) we would proceed in the same way.

## Appendix 2. Comparative statics

Table 8: Benchmark Simulation

Type of Equilibrium	$\bar{y}$	$\theta$
Segmented	0.8249	1.017

Table 9: Comparative Statics for z

z	0.2	0.4	0.6	0.8
Type of Equilibrium	<b>Segmented</b>	Segmented	Segmented	Segmented
$\bar{y}$	<b>0.8249</b>	0.8301	0.839	0.864
$\theta$	<b>1.017</b>	0.4862	0.1466	0.0055

Table 10: Comparative statics for f

f	0.01	0.2	0.4	0.6
Type of Equilibrium	Segmented	<b>Segmented</b>	Segmented	Segmented
$\bar{y}$	0.8064	<b>0.8249</b>	0.8445	0.864
$\theta$	1.0228	<b>1.017</b>	1.0109	1.0048

Table 11: Comparative statics for  $\lambda$ 

$\lambda$	0.2	0.3	0.4	0.5
Type of Equilibrium	Segmented	<b>Segmented</b>	Fully Conversion	Fully Conversion
$\bar{y}$	0.8814	<b>0.8249</b>	0.7806	0.7405
$\theta$	1.1736	<b>1.017</b>	0.9826	0.9410

Table 12: Comparative statics for  $\phi$ 

$\phi$	0.05	0.1	0.15	0.2
Type of Equilibrium	Segmented	<b>Segmented</b>	Segmented	Segmented
$\bar{y}$	0.8169	<b>0.8249</b>	0.8336	0.8425
$\theta$	1.0452	<b>1.017</b>	0.9981	0.9845