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Reassessing Labor Market Reforms: Temporary Contracts as a Screening Device*

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Abstract

Standard models of temporary contracts are either inconclusive, or fail to account for the positive correlation between temporary contracts and the employment rate, and for the high transition rates into permanent employment measured in Europe. This paper shows that a matching model in which firms use temporary contracts to screen workers for permanent positions can successfully fulfill this task. When the model is calibrated to the Italian economy, it accounts for salient statistics including the worker turnover rate, the transition rates into permanent employment, and the drop in the unemployment rate following the reforms implemented in the late 1990s. When temporary contracts are used as a screening device, they can increase both productivity and welfare. Their quantitative impact crucially hinges on dismissal costs and minimum wages.

Keywords: job-search, temporary contracts, labor market institutions, screening, hiring procedures, turnover rates, wage differentials.
JEL Classification: J31; J41; J63; J64; J65

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1 Introduction

Labor market rigidities are believed to be at the heart of the surge and persistence in European unemployment after the mid 1970s. To date, the major policy response to high unemployment rates has been the reduction of employment protection for new hires through the liberalization of temporary contracts. However, theoretical models investigating temporary contracts are either inconclusive about the effects on employment and unemployment, or predict an increase in the unemployment rate. Furthermore, several studies have also pointed out that two-tier labor market reforms are likely to create segmented labor markets, in which part of the workers are trapped in low-paid, low-productivity temporary jobs, with little prospect of upward mobility. These predictions are in conflict with recent empirical evidence showing that, in Europe, temporary contracts correlate positively with employment rates, and temporary workers enjoy considerably high rates of transition into permanent employment.

This paper presents an equilibrium model of the labor market which is able to account for this empirical evidence. Furthermore, it provides a useful framework which is suited to address most of the questions raised in the literature, that is, how temporary contracts interact with other labor market institutions, and how they affect productivity, hiring practices, turnover rates, wage differentials, career prospects and welfare. The central assumption is that firms use temporary contracts to screen workers for permanent positions. As I show in the paper, this hypothesis has been recently supported by a large amount of empirical evidence.

The model extends the matching framework of Pries and Rogerson (2005) by introducing the possibility for the firms to offer both temporary and permanent contracts. In particular, it is assumed that firms can offer a temporary contract with an exogenous probability, which depends on the strictness of labor market regulations. It is further assumed that the two contracts differ only in the associated dismissal costs. With Pries and Rogerson (2005), the model shares the assumption that workers are both an inspection good and an experience good. At the time of matching, both the employer and the worker receive a signal over the true quality of the match. A match is formed only if this signal exceeds a certain threshold. If the match is formed, both parties learn about the true quality of the match over time. A temporary match which turns out to be good is upgraded to a permanent position, while a match which turns out to be unsuitable is destroyed. The main mechanism of the model, which drives all welfare gains, is very simple and can be summarized as follows. In a framework where most of the separations at short tenure are driven by learning about match quality, temporary contracts increase the value of posting vacancies since they allow workers to be screened on the job without incurring any cost if a bad match is terminated.

The main contribution of this paper is to present a model which, embedding the screening hypothesis, can account both for the transition rates observed in most European countries and for the evidence that temporary contracts correlate positively with the employment rate. The model also offers a new explanation for the existence of wage differentials between temporary and permanent workers. Since the firm does not face dismissal costs if a temporary worker is fired, the threshold signal required to

hire a worker is lower for temporary positions. Temporary workers are therefore less productive and earn lower wages. Besides explaining wage differentials, the dynamic properties of the model are also consistent with the finding that workers starting their career in temporary positions are expected to catch up over time with the wages of workers starting in permanent positions. Another important contribution of this paper is that it offers a rationale for the finding that temporary contracts seem to act as an important screening device in European countries but not in the US. In Europe, where it is expensive to destroy a permanent position, temporary contracts increase the expected profits of a vacancy by allowing firms to screen new hires on the job at no cost; in an economy -the US- with no firing restrictions, on the other hand both types of contracts are equivalent and there is no reason to resort to temporary contracts to screen workers. In general, the model shows that temporary contracts can reverse most of the negative effects associated with permanent-employment protection and with its interactions with minimum wages. Overall it is found that temporary contracts increase the worker turnover rate, the average quality of the matches and welfare. For each of these results, I will elaborate on the intuition below.

The model is calibrated to the Italian economy. Italy is a sensible choice to judge the performance of the model for a number of reasons. First, Italy is the OECD country with the lowest probation period on permanent positions. Second, Italy ranks second in terms of the OECD (1999) employment protection index and undertook major liberalizations of temporary contracts in the last ten years. For these reasons, Italy is the country where the gains from screening through temporary contracts are expected to be the largest, and offers the best available laboratory to test the screening hypothesis. When the model is calibrated with parameter values reflecting labor market institutions in Italy, the simulated economy can account for the transition probabilities from temporary to permanent positions, the worker turnover rate and the existence of a wage gap between temporary and permanent workers. Furthermore, a simple exercise of comparative statics can quantitatively replicate the behavior of the unemployment rate in Italy in the last ten years.

The paper is organized as follows: the next Section relates the paper to the literature, while Section 3 discusses some stylized facts. Section 4 presents the model. Section 5 calibrates the model and presents the quantitative analysis. The results are discussed in Section 6, and Section 7 concludes.

2 Literature review

This paper brings together the investigations initiated by Pries (2004) on how learning about match quality affects separations in the labor market and the vast literature that analyzes the macroeconomic effects of temporary contracts. Most of the existing models in this field embed the mainstream view that temporary contracts are an instrument which offers more flexibility to the firms to adjust employment faced with changing business cycle conditions or idiosyncratic demand shocks. This perspective has always been well rooted among both academics and policy-makers, as

historically, the main reason temporary contracts were introduced into Europe was the idea that higher labor market flexibility would permanently decrease unemployment.

Most studies in this literature have analyzed the impact of temporary contracts within the traditional partial equilibrium framework of labor demand under uncertainty, pioneered by Nickell (1986), and extensively analyzed by Bentolila and Bertola (1990) and Bertola (1990). In this class of models the firm has a stable permanent workforce, and adjusts the stock of temporary workers to fluctuations in economic activity (Bentolila and Saint Paul, 1992; Boeri and Garibaldi, 2007). The main reason firms use temporary contracts, in these frameworks, is therefore to maintain a *buffer stock* of workers who can be readily dismissed when there is a need to adjust to economic downturns. Typically, in these models workers are segregated according to their employment contract and enjoy no upward mobility. The most important contribution that these papers have made in the literature is to show that higher turnover and higher volatility over the business cycle is as much as one could reasonably expect from the very much advocated flexibility in the labor market. In an application to the Swedish labor market, Holmund and Storrie (2002) find evidence of temporary employment being more volatile. While this class of models is typically inconclusive on the long-term impact on employment and unemployment rates, Alonso-Borrego et al. (2005) present a general equilibrium model following the same perspective and show that when it is calibrated, unemployment should unambiguously increase following the liberalizations of TC.

Another important contribution in the literature is the paper by Blanchard and Landier (2002). They take a different angle on the analysis of temporary contracts, and show that besides failing to reduce unemployment, TC might also create segmented labor markets with low transition into permanent employment. The main idea is that due to the existence of non-renewal clauses, if firing costs on permanent positions are high compared to search costs, when a temporary contract expires a firm is better off not renewing the contract, even if the temporary match was of relatively high quality. In this case, high turnover on temporary positions becomes part of the firm's personnel policies. In other words, temporary contracts are mainly used as *instruments of churning policies*, implying that workers may go through different spells of unemployment before finding a permanent job. As a result, transition rates into permanent employment are low. Under this scenario, two-tier reforms of the labor market decrease welfare, and most likely increase the unemployment rate at the steady state. Similar conclusions have been reached by Cahuc and Postel-Vinay (2002).

Both the buffer stock and the churning hypotheses have cast serious doubts on the gains that can be obtained through the liberalization of temporary contracts. However, both perspectives lead to predictions which are, to some extent, counterfactual. The fact that most OECD countries are characterized by massive yearly flows from temporary to permanent employment, that temporary workers enjoy substantial continuity in employment, and that temporary contracts are found to correlate positively with employment rates within European countries, cannot be accounted for within these frameworks of analysis. I will discuss these findings in more detail in the following section. Furthermore, a growing body of empirical evidence in recent years, based on

the observation of most European countries, has suggested that there might be another important reason behind the use of TC whose implications are still relatively unexplored in macro theory. There is now substantial evidence supporting the hypothesis that firms use temporary contracts to screen workers for permanent positions.

There are a series of papers, as surveyed by Ichino et al. (2008), showing that being assigned to a temporary position has a large causal effect on the probability of finding a permanent match. The bottomline of this empirical literature is that temporary contracts are stepping stones into permanent employment rather than dead-end jobs, and has been interpreted as evidence in favour of the screening hypothesis. While these results are robust across European countries[1], they are in contrast with those found for the US (Autor and Houseman, 2005). Furthermore, a recent paper by Nunziata and Staffolani (2007) using data on the 15 major European countries, shows that measures of temporary-employment protection are negatively correlated with the rate of employment in permanent positions. This finding has also been interpreted as evidence in favour of the screening hypothesis. Finally, Varejao and Portugal (2003), using data on the Portuguese labor market, show that "screening workers for permanent positions is the single most important reason why firms use these types of contracts". This paper embeds the screening hypothesis documented by these studies into an equilibrium model of the labor market.

To sum up, the literature has identified the following three main reasons for the use of temporary contracts:

1. as a buffer stock against downturns in economic activity;
2. as instruments of churning policies;
3. as a screening device.

While the macroeconomic effects of temporary contracts under the first two hypotheses have received a great deal of attention in the literature, the implications of temporary contracts as a screening device have sofar been analyzed only by Nagypal (2002). With respect to her contribution, this paper shares the result that as experimentation in the economy increases with the use of temporary contracts, so does the productivity of the workers and welfare. However, this paper differs in several ways from Nagypal's (2002). First, it uses a simpler process to describe the process of learning about match quality, and abstracts from learning-by-doing. Second, the assumptions of an all-or-nothing learning process together with the use of hiring practices produces a different mechanism through which firing costs affect the equilibrium and reverse her findings that temporary contracts increase the unemployment rate. Third, this paper calibrates the model on the Italian labor market. Finally, this paper differs in the scope of the analysis, investigating the interactions of temporary contracts with

[1] Among other European countries, evidence in this direction is available for Italy (Adam and Canziani, 1998 and Ichino et al., 2005), for the United Kingdom (Booth et al. 2002), for Germany and the Netherlands (Lechner et al. 2000; Dekker, 2001; Zijl et al., 2004), and for Sweden (Holmund and Storrie, 2002).

other labor market institutions, the transition rates implied by the model, and the impact on hiring practices, turnover rates and wage differentials.

This paper is also directly related to the work of Pries (2004), who estimates for the US labor market the process of learning about match quality. Pries (2004) shows that the estimated process of learning by matching the high rates of job destruction at short tenures, is key to reconciling the remarkable persistence of the unemployment rate over the business cycle with the high job finding rate measured in the data. Pries and Rogerson (2005) exploit the process of learning about match quality estimated by Pries (2004) to build up a model which is able to explain differences in turnover rates between Europe and the US. In this paper, I investigate how the process of learning about match quality estimated by Pries (2004) can contribute to improving our understanding of the macroeconomic implications of temporary contracts.

3 Stylized facts

3.1 Stylized facts for European countries

This section highlights some important stylized facts accounted for by the model, which refer to cross-sectional studies on European countries.

As reported by the OECD (2002), for most European countries workers employed on a temporary contract in 1996 had at least a probability of about 40% to be employed in a permanent position one year later[2]. In other words, close to half of the total stock of temporary workers moves into permanent employment within a year of time. Further more, quoting the OECD (2002), p.131, "the evidence for European countries suggests that the majority of temporary workers have considerable continuity in employment: being in employment one year earlier and remaining in employment one and two years later". These statistics reveal that most European countries are characterized by massive yearly flows from temporary to permanent employment and by substantial continuity in employment, suggesting that only a relatively small fraction of the workforce might be trapped into recurring spells of temporary employment and unemployment. This considerable degree of upward mobility and integration in the labor markets is difficult to reconcile with the idea that temporary contracts are used as instruments of churning policies. The yearly transition probabilities among European countries range between 36% and 56% with only two notable exceptions, Spain and France. In these countries a worker on a temporary contract had in 1996 only about a 20% chance of being in a permanent contract one year later. Only in these two countries have the reforms created a rather segmented labor market with low mobility from temporary to permanent employment, suggesting that alternative forces leading to market segmentation and churning could be dominant. I therefore summarize the first stylized fact as follows:

[2]The OECD (2002) computes transition probabilities across the states of unemployment, temporary employment and permanent employment. They restrict the sample to the individuals beginning in dependent employment or unemployment in 1996 and moving neither in self-employment nor in inactivity during 1997-98. This makes their statistics directly comparable to our model.

Stylized Fact 1: European countries appear to be characterized by high rates of transition into permanent employment.

While there has been considerable empirical literature focusing on firing costs and severance payments, little empirical work has investigated the effects of temporary contracts on employment and unemployment. A recent paper by Nunziata and Staffolani (2007) provides the most careful multi-country analysis aiming to identify the correlations between employment rates and a set of employment regulation reforms, including two-tier reforms, implemented over the period 1983-1999 in 15 European countries. The regression analysis controls for a large set of institutions, which include union density, bargaining coordination, the tax wedge, and unemployment benefits, and for interaction effects between these institutions. Importantly, following Nickell et al. (2005), the regressions also control for a number of factors that can influence employment and unemployment rates in the short run. These control variables include labor demand shocks, long-term interest rates, acceleration in money supply, and terms of trade shocks. The authors find that looser regulations on fixed-term contracts and lower dismissal costs on permanent positions are significantly correlated with an increase in the employment rate. In particular, fixed-term contracts, which constitute the bulk of all types of temporary contracts, seem to be associated with increases in the employment rate in permanent positions, and this has been interpreted as suggestive evidence in favor of the screening hypothesis. These results are robust to various changes in the econometric specification. Previous studies focusing on broad indicators of employment protection have often found positive correlations with the unemployment rate, although this result is not always significant across studies (Howell et al., 2007). I summarize these findings as follows:

Stylized Fact 2: Fixed-term contracts are found to correlate positively with the employment rate at the European level.

Another important finding in the literature of temporary contracts, which has prompted research in the field, is the existence of wage differentials between temporary and permanent workers. The OECD (2002) reports evidence of wage penalties associated with temporary contracts for all European countries. The average wage gap ranges from 17% in Germany, to 47% in Spain. Controlling for worker and job characteristics, the average wage penalty for the countries surveyed by the European Commission Household Panel is 15%, and ranges from 7% in Austria to 24% in the Netherlands. Findings on the wage penalties for temporary workers have been reported also by Booth et al. (2002) for Britain, by Dekker (2002) for the Netherlands, Germany and the United Kingdom, by Blanchard and Landier (2002) for France and by Houseman (1997) for the US. I summarize these findings as follows:

Stylized Fact 3: Controlling for worker and job characteristics, workers on temporary contracts are paid less than workers on permanent contracts.

There are a couple of papers in the literature which provide an explanation for the existence of wage differentials. Güell (2005) presents a theory based on an efficiency wage perspective. The basic idea is that firms do not need to offer an efficiency premium in order to provide workers with non-shirking incentives, since the possibility of non-renewal for temporary contracts can achieve the same results. Alternatively, Bentolila and Dolado (1994) suggest that if unions are dominated by permanent workers subject to firing restrictions, the existence of a buffer stock of temporary workers might increase their bargaining power and their wages. This paper offers a different explanation for the existence of wage differentials. Since firms that offer a temporary contract incur no dismissal costs, should the match turn out to be of low quality, firms have an incentive to use less selective hiring practices. Therefore, temporary workers are paid less simply because they are less productive.

3.2 The case of Italy

In the model, learning that a match is bad entails costs of dismissal that are to be paid only on permanent positions, not on temporary positions. However, it is known that in the real world, no dismissal costs are to be paid if a worker employed on a permanent position is fired during the probationary period. This trial period, which follows the beginning of a new relationship, usually ranges in Europe between three and six months. Therefore, from the perspective of this paper, there are gains to be obtained from temporary contracts so long as it takes more than three or six months to discover the true productivity of a worker. The shorter the period of probation, the larger the gains expected from screening workers through temporary contracts.

Italy is the OECD country with the lowest probationary period and with the second highest index of employment protection. In Italy, the common length for trial periods, as established in the enforceable collective agreements, ranges between one and two weeks for blue collar workers and between three to eight weeks for white collar workers (OECD 1999, p.103). Italy is therefore the country where the effects produced by temporary contracts through the screening channel are expected to show up most clearly in the data. Furthermore, in the last ten years, major liberalizations of temporary contracts have been implemented.

In Italy, the first important wave of reforms of temporary contracts took place in 1997. As discussed by Boeri and Garibaldi (2007), the adoption of temporary contracts had already been partially liberalized in 1984 and 1987, but unions were given the power to hinder their diffusion. Only when this obstacle was finally removed in 1997, could the use of temporary contracts be adopted. A second wave of reforms, in 2003, further enhanced access to temporary contracts. The picture in the Appendix describes the behavior of the labor market, in terms of both the share of temporary contracts and the quarterly unemployment rate, between 1996 and 2007. Both 1996 and 2007 were periods of expansionary economic activity, and reflect comparable business cycle conditions.

What emerges is a clear-cut negative association between temporary contracts and the unemployment rate. In the ten years following the beginning of the reforms, the

share of temporary contracts almost doubled, increasing from 7.5% to 13%, while the unemployment rate halved, dropping from 11.3% in 1997 to 5.7% in the second quarter of 2007, which is below the European average. Furthermore, the quarterly unemployment rate steadily decreased also during the downturns of economic activity early after the turn of the century. This decrease in the unemployment rate was mirrored by an increase in the employment rate, from 60.2% in 1996 to 65.9% in 2006. This increase in the employment rate is, to some extent, a phenomenon that has characterized other European labor markets in the last ten years. However, the magnitude of the phenomenon in Italy largely outweighs the European experience. Moreover, in the last ten years Italy has been among the countries in Europe with the highest employment content of growth, exceeding by far the average European performance. The participation rate also increased over the period, from 59% in 1996 to 63% in 2006[3]. However, it is difficult to tell what impact this increase has had on the unemployment rate. To the extent that the increase in the participation rate reflects the regularization of immigrant workers or, more generally, an emerging hidden economy, this increase should reduce the unemployment rate. To the extent that it reflects an increase in the number of job seekers, attracted by the existence of new contractual arrangements, the increase in the participation rate should increase the unemployment rate. Both phenomena have certainly been relevant in the last decade.

The picture that arises is therefore one of a permanent decrease in the long-run unemployment rate. The thesis put forward in this paper is that the drop in the unemployment rate was mainly produced by the liberalization of temporary contracts, which was, undoubtedly, the major labor market reform of the last decade. Furthermore, the impact on unemployment and employment rates might have been more apparent in Italy than in other European countries because of the unique combination of high employment protection and low probationary period. Up to date, very few models in this literature are calibrated, and none can qualitatively account for a decrease in the unemployment rate. Section 5 shows that when our model is calibrated to reflect labor market institutions in Italy, it is able to qualitatively and quantitatively account for the drop in the unemployment rate that occurred in the ten years following the reforms of 1997.

4 The model

4.1 The Economy

This section presents a matching model of the labor market that builds on Pries and Rogerson (2005).

The matching technology:

There is a frictional labor market and a unit mass of workers who can be either employed or unemployed. On-the-job search is ruled out so that workers can only

[3]The statistics in this paragraph have been reported by the Italian national institute of statistics, Istat (2006).

search for a job if unemployed. Firms must post a vacancy to fill a job, and the cost of keeping a vacancy open per period is denoted by c. The measure of vacancies and unemployed workers at time τ is denoted by v_τ and u_τ. A standard constant-returns-to-scale matching technology, $M(v_\tau, u_\tau)$, determines the number of job matches per unit of time as a function of vacancies and unemployed workers. Every period, a vacancy meets a worker with probability $M(v_\tau, u_\tau)/v_\tau = M(1, u_\tau/v_\tau) = m(\theta_\tau)$, where $\theta_\tau = v_\tau/u_\tau$ denotes labor market tightness. Similarly, a worker meets a firm with probability $M(v_\tau, u_\tau)/u_\tau = \theta_\tau m(\theta_\tau)$. It is assumed that $m(\theta_\tau) \to 1$ and $\theta_\tau m(\theta_\tau) \to 0$ as $\theta_\tau \to 0$, and $m(\theta_\tau) \to 0$ and $\theta_\tau m(\theta_\tau) \to 1$ as $\theta_\tau \to \infty$.

Production technology and learning about match quality:

The production technology and the process of learning about match quality are identical to Pries (2004), and Pries and Rogerson (2005). A unit of production is a matched worker-firm pair. All workers are ex-ante identical, but ex-post different, since productivity is match-specific. The output of a match at any time τ is only observed at the end of the period, and is given by $y_\tau = \bar{y} + \epsilon_\tau$, where ϵ_τ is a mean zero random variable, uniformly distributed over the domain $[-z, z]$. $\bar{y}$ denotes the true quality of a match, which can either be good or bad: if good $\bar{y} = y_g$, while if bad $\bar{y} = y_b$. When a worker and a firm meet, the true productivity of the match is unknown both to the worker and to the firm, but they both observe the realization of a signal π, which denotes the probability that the match turns out to be good. Any draw of π is taken from a cumulative distribution $H(\pi)$ and is independent across matches. The hiring decision takes place at the beginning of the period, and is based only on the realization of this signal.

If a match is formed, each period the unit of production will try to infer the true quality of the match by observing realized output. Whenever production falls in the range of $y_\tau \in (y_b + z, y_g + z]$, the worker and firm pair learn that the match is good, since a low type worker is not able to produce such a high level of output. Similarly, if output falls in the range of $y_\tau \in [y_b - z, y_g - z)$ the match is revealed to be of low quality, since none of such realizations is compatible with a high type worker. With probability denoted by $\alpha = (y_g - y_b)/2z$, the true quality of the match is therefore discovered. With the complement probability $1 - \alpha$ nothing is learned since, due to the assumption of a uniformly distributed noise term, the posterior probability equals the prior. The process of learning about match-specific productivity therefore takes an "all-or-nothing" form. Since I am only interested in characterizing the stationary equilibrium of this economy, in what follows I will omit the time subscript.

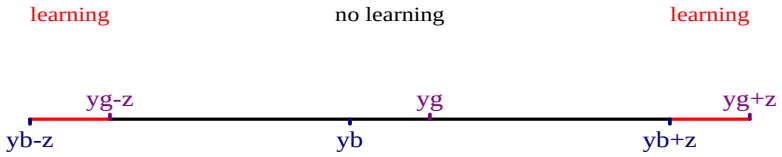

Figure1: Learning about match quality

Contracts:

There are two types of contracts in the economy: temporary contracts and permanent contracts. The existence of a dismissal cost $d > 0$, which is specific for permanent positions, is the only difference between the two contracts. The productivity of a match is therefore independent of the contract, and remains unchanged throughout the duration of the relationship, unless an exogenous shock of job destruction denoted by λ, and identical across contracts, renders the match unproductive. Every period, a relationship ends either if the quality of the match is discovered to be bad, or if an exogenous shock renders the match unproductive.

The model is built to embed the hypothesis that firms screen suitable workers for permanent positions. If a worker is hired on a temporary basis, the contract is then maintained until the true productivity of the match is revealed. At that time, it is assumed that the contract is either transformed into a permanent one, if the match turns out to be good, or the relationship is severed at no cost, if the match turns out to be bad.[4] If instead the worker is hired on a permanent contract, the relationship is severed whenever the match is discovered to be bad, at the cost d. Temporary contracts then allow employers to save on the dismissal costs which would otherwise be paid if bad workers were hired on permanent contracts. Therefore, firms always prefer to hire on temporary positions. Yet, it is assumed that the firm is allowed to offer a temporary contract only with probability ϕ. This parameter thus represents the strictness of the regulation on temporary contracts. Labor market reforms enhancing access to temporary contracts can therefore be represented by an increase in ϕ.[5]

Wages:

There is an exogenous minimum wage in the economy, which is denoted by $\bar{\omega}$. Wages are negotiated at the beginning of each period and cannot be conditional on

[4] Endogenizing the decision to upgrade temporary contracts into permanent contracts is beyond the scope of this paper. The most cited reason for the conversion of a temporary contract is the existence of non-renewal clauses. Usually, among European countries temporary contracts are no longer renewable after two or three years. Given the learning process estimated by Pries (2004), and embedded in this model, by the end of two years of tenure, virtually all of the matches would be classified as good or bad. At that time, all good matches and only the good matches would be upgraded into permanent positions. In order to keep the model as simple as possible, I do not explicitly model an up-or-out clause, and assume that temporary matches are upgraded as soon as they are discovered to be good. It is important to notice that this simplification, which implies perfect screening ability, does not bias the selection of good matches into permanent positions. Furthermore, Güell and Petrongolo (2007) find that in Spain, most conversions into permanent employment take place before the end of their legal duration. They build a model where workers search on the job and prefer a permanent contract over a temporary contract, everything else equal. In their framework firms are willing to upgrade the contract to reduce the probability that temporary workers quit. Güell and Petrongolo (2007) provide evidence that conversion rates are higher for workers with a higher outside option, which increases their probability of quitting. Their interpretation is that "as soon as a job match is perceived to be productive enough, a firm may have a sufficient incentive to promote a temporary worker, instead of keeping him/her in a temporary contract for the entire legal duration " (Güell and Petrongolo 2007, p.160).

[5] The assumption that all firms prefer to hire a new worker with a temporary contract might seem restrictive. However, in Spain, which is the most deregulated country in Europe with respect to fixed-term contracts, the fraction of new hires that were signed under temporary contracts in the period 1985-2002 has constantly ranged between 91% and 97% (Guell and Petrongolo 2007).

the observation of output at the end of the period. The wage of a worker in a match that is expected to be good with probability π is denoted by $\omega_i(\pi)$, for $i = T, I$ and is the solution of the generalized Nash bargaining criterion for values of π at which the minimum wage does not bind. The subscripts T and I are used to denote temporary and permanent contracts respectively. For reasons that will become clearer below, I is an indicator function equal to zero if the contract is new, and equal to one if the contract is renegotiated.

4.2 Workers and firms

This section characterizes the steady-state behavior of workers and firms. Both are risk-neutral.

The firms:

The present discounted value of a vacancy, denoted by V, solves the following Bellman equation:

$$V = -c + \beta m(\theta) \left[\phi \int J_T(\pi) dH(\pi) + (1-\phi) \int J_0(\pi) dH(\pi) \right], \tag{1}$$

where β is the discount factor, and $J_i(\pi)$ for $i = T, 0$ denotes the value to the firm of having a worker matched with signal π employed in a temporary contract or in a new permanent contract, respectively.

Let b denote the disutility of work, and satisfy $b \geq y_b$. As long as the value of search for an unemployed worker is positive, this condition is sufficient to ensure that bad matches are terminated at equilibrium.

The value to the firm of having a worker employed on a temporary contract reads as follows:

$$\begin{aligned} J_T(\pi) = \max \{ & V, \pi y_g + (1-\pi) y_b - \omega_T(\pi) + \beta \lambda V \\ & + \beta(1-\lambda) \left\{ \alpha \left[\pi J_0(1) + (1-\pi) V \right] + (1-\alpha) J_T(\pi) \right\} \}. \end{aligned} \tag{2}$$

The first three terms represent current period expected profits. If the match breaks down, with probability λ, the firm is left next period with a vacant job, whose present value is given by the fourth term. The last term represents expected future discounted profits if the match does not break down. If the quality of the match is discovered, the firm upgrades the temporary contract into a permanent one if, with probability π, the worker is revealed to be good, and fires the worker if, with probability $1-\pi$, the worker is revealed to be bad. Therefore, the firm gets with probability π the value of having a worker, who is good with probability one, employed in a new permanent contract, and with probability $1-\pi$ the value of a vacant job. If, on the contrary, the productivity of the worker is not revealed, the firm keeps the worker in a temporary position.

Following a standard practice in the literature, it is assumed that dismissal costs are a pure resource waste, which occurs whenever a job is destroyed. As such, firing

costs can be considered as equivalent to a separation tax. When deciding whether to form a permanent match, the firm does not incur dismissal costs if the permanent match is not formed. Then, dismissal costs are only paid when an ongoing relationship is severed. The outside option of the firm will therefore be different whether the permanent contract is new or renewed. This asymmetry between new and ongoing matches implies that the matched firm-worker pair must also be indexed to indicate whether it is a newly formed match or whether it is a pre-existing match. The indicator I is then used to indicate a new permanent match when it equals zero, and a pre-existing permanent match when it equals 1. The value to an entrepreneur of a match that has received the signal π, for new and continuing matches therefore satisfies:

$$J_I(\pi) = \max\{V - Id, \pi y_g + (1-\pi)y_b - \omega_{_I}(\pi) + \beta\lambda(V-d) + \beta(1-\lambda)\{\alpha[\pi J_1(1) + (1-\pi)(V-d)] + (1-\alpha)J_1(\pi)\}\}. \quad (3)$$

The interpretation of this equation is similar to the previous one, but here the negotiated wage $\omega_{_I}(\pi)$ depends on whether the match is new or pre-existing. The wage function $\omega_{_I}(\pi)$ equals the maximum between the minimum wage and the outcome of the generalized Nash criterion.

The workers:

The lifetime discounted value of an unemployed worker, denoted by U, satisfies the following equation:

$$U = \beta\left\{\theta m(\theta)\left[\phi\int W_T(\pi)dH(\pi) + (1-\phi)\int W_0(\pi)dH(\pi)\right] + [1-\theta m(\theta)]U\right\}, \quad (4)$$

where ϕ denotes the probability that the worker is offered a temporary contract, and $W_i(\pi)$ for $i = T, 0$ denotes the value to the worker of being employed with signal π in a temporary contract or in a new permanent contract, respectively.

In the standard matching model, both the worker and the firm decide simultaneously whether to form a match. With Nash bargaining there is agreement on the decision of forming the match, and the match is formed as long as the surplus is positive. The wage then adjusts to split the surplus between the two parties according to a simple sharing rule. This is no longer the case in this model since the minimum wage is binding. It might therefore be possible, for some "low" values of π, that the worker would like to form a match, but the firm would not. If a match is formed only if both parties agree, then the decision of whether to form a match depends only on the firm, and the worker takes the decision rule of the firm as given.

The value to the worker of a temporary match that received the signal π, reads as follows:

$$W_T(\pi) = \max\{U, \{\omega_{_T}(\pi) - b + \beta\lambda U + \beta(1-\lambda) \times \{\alpha[\pi W_0(1) + (1-\pi)U] + (1-\alpha)W_T(\pi)\}\}X_T(\pi)\}, \quad (5)$$

where $X_T(\pi)$ is the firm's decision rule of forming a match, which is equal to 1 whenever $J_T(\pi) \geq V$, and equal to zero otherwise. Similarly, the value to the worker of a permanent position in a match that received the signal π is written as follows:

$$W_I(\pi) = \max\{U, \{\omega_{_I}(\pi) - b + \beta\lambda U + \beta(1-\lambda) \times \{\alpha[\pi W_1(1) + (1-\pi)U] + (1-\alpha)W_1(\pi)\}\} X_I(\pi)\}, \quad (6)$$

where $X_I(\pi)$ is the firm's decision rule of forming a match, which is equal to 1 whenever $J_I(\pi) \geq V - Id$, and equal to zero otherwise.

4.3 Equilibrium

The steady-state measure of temporary matches is denoted by $e_{_T}$, the measure of permanent matches by $e_{_P}$, the measure of matches known to be of good quality by e_g, the measure of matches of unknown quality by e_n, the measure of vacancies by v, and the measure of unemployed workers by u. At the stationary equilibrium job creation for each type of match must equal job destruction. Denoting by E the expectation operator, the following equations must therefore hold:

$$[\lambda + (1-\lambda)\alpha] e_{_T} = vm(\theta)\phi E[X_T(\pi)], \quad (7)$$

$$\lambda e_g = (1-\lambda)\alpha e_{_T} E[\pi|X_T(\pi)=1] + (1-\lambda)\alpha(e_{_P} - e_g)E[\pi|X_0(\pi)=1], \quad (8)$$

$$\lambda e_g + (1-\lambda)\alpha(e_{_P} - e_g)\{1 - E[\pi|X_0(\pi)=1]\} = vm(\theta)(1-\phi)E[X_0(\pi)] + e_{_T}(1-\lambda)\alpha E[\pi|X_T(\pi)=1], \quad (9)$$

$$e_n = e_{_T} + (e_{_P} - e_g), \quad (10)$$

$$u = 1 - e_{_T} - e_{_P}. \quad (11)$$

Definition 1 *A stationary equilibrium is a list of prices* $\{\omega_{_T}(\pi),\ \omega_{_I}(\pi)\}$, *quantities* $\{v,\ u,\ e_{_T},\ e_{_P},\ e_g,\ e_n\}$, *values* $\{V,\ J_T(\pi),\ J_I(\pi),\ U,\ W_T(\pi),\ W_I(\pi)\}$, *and rules* $\{X_T(\pi),\ X_I(\pi)\}$, *such that the following conditions hold:*

1. Value functions: Given $\omega_{_T}(\pi)$, $\omega_{_I}(\pi)$, u, and v, V, $J_T(\pi)$, $J_I(\pi)$, U, $W_T(\pi)$, and $W_I(\pi)$ satisfy the Bellman equations (1) to (6).

2. Temporary match formation: Given $\omega_{_T}(\pi)$, $\omega_{_I}(\pi)$, u and v, $X_T(\pi)$ is an optimal decision rule for the firm.

3. Permanent match formation: Given $\omega_{_I}(\pi)$, u and v, $X_I(\pi)$ is an optimal decision rule for the firm.

4. Free entry: Given $\omega_{_T}(\pi)$ and $\omega_{_I}(\pi)$, the ratio θ must be such that $V = 0$.

5. Bargaining on temporary contracts: the wage function must be such that $\omega_{_T}(\pi) = \max[\omega_{_T}^N(\pi), \bar{\omega}]$, where the Nash wage function $\omega_{_T}^N(\pi)$ solves

$$W_T(\pi) - U = \gamma \left[J_T(\pi) + W_T(\pi) - V - U \right], \tag{12}$$

and γ denotes the bargaining power of the workers.

6. Bargaining on permanent contracts: the wage function must be such that $\omega_{_I}(\pi) = \max[\omega_{_I}^N(\pi), \bar{\omega}]$, where the Nash wage function $\omega_{_I}^N(\pi)$ solves

$$W_I(\pi) - U = \gamma \left[J_I(\pi) + W_I(\pi) - (V - Id) - U \right]. \tag{13}$$

7. Steady state: equations (7) to (11) hold.

The permanent match formation rule:

In order to solve for the equilibrium of the model, it is necessary to characterize the hiring rules for the firm. This implies finding two cutoff values for the signal, denoted by $\bar{\pi}_{_T}$ and $\bar{\pi}_0$, below which the firms are unwilling to offer temporary contracts and permanent contracts, respectively. Let $S_I(\pi) = J_I(\pi) + W_I(\pi) - (V - Id) - U$ denote the surplus functions for permanent contracts. Then $S_1(\pi) - S_0(\pi) = d$. Intuitively, the surplus is higher for ongoing matches since the existence of dismissal costs lowers the combined outside option of the two parties. Substituting equations (3) and (6) together with the free-entry condition $V = 0$ yields:

$$S_I(\pi) = \max \{0, \pi y_g + (1-\pi) y_b - b - (1-\beta)U + (I-\beta)d$$

$$+\beta (1-\lambda) \left[\alpha \pi S_1(1) + (1-\alpha) S_1(\pi) \right] \}.$$

In a non-trivial equilibrium where $\bar{\pi}_0 < 1$, the value of $S_1(1)$ can be easily obtained from the above expression, and equals:

$$S_1(1) = \frac{y_g - b - (1-\beta)U + (1-\beta)d}{1 - \beta(1-\lambda)}.$$

At the calibrated equilibrium the minimum wage is binding only for all the new permanent contracts; for all the pre-existing permanent contracts and for all temporary contracts instead, the minimum wage is not binding. I briefly anticipate here the role played by the minimum wage in this model. Intuitively, with Nash bargaining workers and firms share the costs of employment protection, through an initial transfer of resources. In calibrated matching models of the labor market with employment protection, wages in the first period of the relationship are usually negative. However, in the real world we do not observe transfers of resources, and wages are never negative. A minimum wage in this setting simply puts an upper bound on the transfer of resources that can take place at the beginning of the relationship. The quantitative impact of the minimum wage and its interactions with the other labor market institutions will be extensively discussed in Section 5.

The value to the firm of having a worker employed on a new permanent contract can therefore be rewritten from eq.(3) substituting the wage function with the minimum wage, and substituting $J_1(\pi)$ with $(1-\gamma)S_1(\pi) - d$ using the Nash sharing rule. The value function now reads as follows:

$$J_0(\pi) = \pi y_g + (1-\pi)y_b - \bar{\omega} - \beta\lambda d + \beta\,(1-\lambda) \times \{(1-\gamma)\,[\alpha\pi S_1(1) + (1-\alpha)S_1\,(\pi)] - d\}\,. \tag{14}$$

Given that $J_0(\pi)$ is strictly increasing in π, setting $J_0(\bar{\pi}_0) = 0$ implicitly defines a unique threshold value of $\bar{\pi}_0$. The permanent match formation equation then reads as follows:

$$\bar{\pi}_0 y_g + (1-\bar{\pi}_0)y_b - \bar{\omega} - \beta\lambda d + \beta\,(1-\lambda)\,\{(1-\gamma)\,[\alpha\bar{\pi}_0 S_1(1) + (1-\alpha)S_1\,(\bar{\pi}_0)] - d\} = 0. \tag{15}$$

Since the surplus of pre-existing matches is higher than the surplus of new permanent matches, any given value of π which is found acceptable at the beginning of a permanent relationship also remains acceptable in future periods. This implies that $\bar{\pi}_0$ is the single cutoff value which is relevant to characterize acceptance decisions in permanent matches.

The temporary match formation rule:

The match formation equation for temporary contracts can be found using a similar procedure. As before, it is convenient to define by $S_T(\pi) = J_T(\pi) + W_T(\pi) - V - U$ the surplus function for temporary contracts. Plugging equations (2) and (5) into the above expressions, and substituting $S_0(1) = S_1(1) - d$ the surplus reads as follows:

$$S_T(\pi) = \max\left\{0, \frac{\pi y_g + (1-\pi)y_b - b - (1-\beta)U + \beta(1-\lambda)\alpha\pi\,[S_1(1) - d]}{1 - \beta(1-\lambda)(1-\alpha)}\right\}.$$

Since the minimum wage is not binding for temporary contracts at the calibrated equilibrium, a match will be formed only as long as the surplus is positive, with common agreement between the parties. Given that $S_T(\pi)$ is strictly increasing in π, the match formation equation for temporary contracts can therefore be obtained by setting $S_T(\bar{\pi}_{_T}) = 0$. This equation reads:

$$\bar{\pi}_{_T} y_g + (1-\bar{\pi}_{_T})y_b - b - (1-\beta)U + \beta(1-\lambda)\alpha\bar{\pi}_{_T}\,[S_1(1) - d] = 0. \tag{16}$$

Free entry and job search:

At the stationary equilibrium, with free entry the value of a vacancy is zero. Substituting $J_T(\pi) = (1-\gamma)S_T(\pi)$ using the Nash sharing rule, equation (1) reads:

$$c = \beta m(\theta)\left[\phi(1-\gamma)\int S_T(\pi)dH(\pi) + (1-\phi)\int J_0(\pi)dH(\pi)\right], \tag{17}$$

where $J_0(\pi)$ is given by (14).

The value of unemployment can also be rearranged as follows, using the free entry condition, the Nash bargaining rule $\gamma S_T(\pi) = W_T(\pi) - U$ and substituting $W_0(\pi) - U = S_0(\pi) - J_0(\pi)$, and $S_0(\pi) = S_1(\pi) - d$:

$$U = \frac{\theta m(\theta)}{1-\beta}\left\{\phi\gamma\int S_T(\pi)dH(\pi) + (1-\phi)\int \left[S_1(\pi) - d - J_0(\pi)\right]dH(\pi)\right\}. \qquad (18)$$

Duly substituting for the surplus equations and for $J_0(\pi)$, the equations (7) to (11) together with the equations (15) to (18) constitute a non-linear system of nine equations in the following nine unknowns: v, u, $e_{_T}$, $e_{_P}$, e_g, e_n, $\bar{\pi}_0$, $\bar{\pi}_{_T}$ and U. This system can be solved numerically using Newton's method.

The wage equations:

When the system is solved, it is possible to recover the Nash wage equations for new and pre-existing permanent contracts by substituting (3) and (6) into (13). With a binding minimum wage for new permanent contracts, the equilibrium wage functions are $\omega_0(\pi) = \bar{\omega}$ for all $\pi \in [\bar{\pi}_0, 1]$ and $\omega_1(\pi) = \omega_{_1}^{^N}(\pi)$ for all $\pi \in [\bar{\pi}_1, 1]$. Even if $\bar{\omega}$ is binding for all new permanent contracts, the Nash wage equation $\omega_{_0}^{^N}(\pi)$ gives the shadow wage that would occur if wages were freely contractible, given the surplus at equilibrium. The Nash wage equations are written:

$$\omega_{_I}^{^N}(\pi) = b + (1-\beta)U + \gamma S_I(\pi) - \beta(1-\lambda)\left[\alpha\pi\gamma S_1(1) + (1-\alpha)\gamma S_1(\pi)\right].$$

Similarly, it is possible to recover the wage equation for temporary contracts by substituting (2) and (5) into (12). Since the minimum wage does not bind for temporary contracts, $\omega_{_T}(\pi) = \omega_{_T}^{^N}(\pi)$, and the wage equation is written as follows:

$$\omega_{_T}^{^N}(\pi) = b + (1-\beta)U + \gamma S_T(\pi) - \beta(1-\lambda)\left\{\alpha\pi\left[W_0(1) - U\right] + (1-\alpha)\gamma S_T(\pi)\right\}.$$

5 Calibration

5.1 Parameter values

The model is calibrated to the Italian labor market in 1996, just before the first wave of major reforms of temporary contracts, which took place in 1997. The calibration strategy assumes that both Italy and the US share the same technology and the same process of learning about match quality. Alternatively, this assumption implies that any difference in the functioning of the two labor markets stems from different labor market institutions, namely firing costs, minimum wages, unemployment benefits and the degree of liberalizations of temporary contracts. In the special case in which $d = 0$, the minimum wage is no longer binding, temporary and permanent contracts become equivalent, and the equilibrium of this model collapses to the one in the benchmark economy of Pries and Rogerson (2005). The calibration strategy therefore allows me to use several parameter values which were calibrated in their paper to match US stylized facts.[6]

[6] More precisely, in the case of $d = 0$ and $\phi = 0$, a minor difference with respect to the bechmark model of Pries and Rogerson (2005) remains. As opposed to their paper, in this model I abstract

One period of time in the model equals one month in the calibration. Following Pries and Rogerson (2005), the distribution function for π is obtained from a normal with zero mean and standard deviation σ, truncated below zero and above one and re-scaled to integrate to 1 in the support. The parameter values used for the benchmark calibration are represented in the following table:

σ	.32	A	.4
α	.13	η	.5
y_b	1	γ	.5
y_g	1.9	λ	.0085
b	1	ϕ	.278
β	.9966	d	5.16
c	.249	$\bar{\omega}$	1.22

Table 1: Calibrated parameter values

The parameters σ and α are crucial, since they capture the process of learning about match quality. Their values, $\sigma = .32$ and $\alpha = .13$, were calibrated by Pries and Rogerson (2005) in order to match relevant statistics estimated by Pries (2004) for the US labor market. Since the results of the calibration are left unchanged if y_b, y_g, b, c, $\bar{\omega}$ and d are all multiplied by a constant value, the value of productivity in the bad state, y_b, can be normalized to one. y_g is set to 1.9, as in Pries and Rogerson (2005). The spread in productivity was backed up to match the percentage spread between the lowest and the highest wage observed at the equilibrium with estimates by Topel and Ward (1992) on the wage increases associated with job changes in the US. The discount factor β is set to match an annual interest rate of 4%.

Following a common practice in the literature, the matching function is assumed to be Cobb-Douglas, with the explicit functional form $M(v,u) = Au^{\eta}v^{1-\eta}$. Both the elasticity of the matching function with respect to unemployment, and the bargaining power of the workers are set to .5. These parameters are selected in order to preserve comparability with Pries and Rogerson (2005) and with most of the literature in this field. The constant of the matching function is set to .4 also in accordance with Pries and Rogerson (2005). Yet, as pointed out by Shimer (2005), matching models of the labor market offer a degree of freedom in the choice of the constant of the matching function, as there exist infinite combinations of that constant with the flow cost of a vacancy which leave the equilibrium of the labor market unchanged.

The exogenous job destruction rate λ is set to .0085 as in Pries and Rogerson (2005), implying a yearly job destruction rate of about 10%. As shown by Bertola and Rogerson (1996), the yearly job destruction rate is about 10% both for Italy - and more in general for most European countries - and for the US. The value for the cost

from fixed costs of opening vacancies since I am not interested in distinguishing between job flows and worker flows. However, this detail is irrelevant for what concerns the calibration. With respect to the benchmark calibration of Pries and Rogerson (2005), a version of the model without vacancy fixed-costs simply requires setting the vacancy flow cost to .298; all other parameters must remain unchanged to match the same stylized facts.

of a vacancy is set to .249, in order to match an unemployment rate of 11.3%, as in Italy in 1997.

The value for the disutility of the working activity, b, is normalized to 1, implying that bad matches are severed at equilibrium. It is easy to show that in this setting an increase in the unemployment benefits, or in the value of leisure is equivalent to an increase in b (Mortensen and Pissarides, 1999). If interpreted only as unemployment compensation, this value for b implies a replacement ratio with respect to the average wage of about 58%. Selecting an appropriate value for the replacement ratio is often controversial, since b includes, besides unemployment benefits, also non measurable entities such as the disutility and the opportunity cost of the working activity. In the literature, values for the replacement ratio in the US have been used, which range from 40% (Shimer, 2005) to 98.8% (Hagedorn and Manovskii, 2007). Costain and Reiter (2008) argue that an intermediate value of about 75% is more appropriate and consistent with the estimated elasticity of the unemployment rate to unemployment benefits for the OECD countries. As shown by Table 4 in the Appendix, Italy is characterized by a very low level of unemployment benefits. A somewhat lower value of 58% for Italy might therefore be appropriate. Moreover, changes in the value of b show that the normalization in the benchmark parametrization is not essential for the quantitative conclusions.

The level of firing costs, d, is set to equal three months of the average wage observed in the equilibrium. Although there are no direct estimates for administrative costs of dismissal, this value for d is often used to represent an average European country. Three months is a conservative choice in this framework since the higher the level of firing costs, the stronger the quantitative impact of temporary contracts. The values for the dismissal cost used in the literature to represent a Mediterranean country range from six weeks (Nagypal, 2002), to six months (Blanchard and Portugal, 2001), or even one year and a half (Blanchard and Landier, 2002).

In Italy, a set of minimum wages is determined in sectorial collective arrangements, and is then extended to all employers who were not parties to the original agreement. Therefore, as opposed to other countries in Europe, there does not exist a single minimum wage. Dolado et al. (1996) report values of the Kaitz index for many OECD countries. This index measures the ratio of the minimum wage to the average wage, weighted by the fraction of workers covered by the agreements, and it is used in this calibration to pin down a value for $\bar{\omega}$. As it is possible to see from Table 4 in the Appendix, the Kaitz index measured for Italy is higher than for other OECD countries. Finally, the last parameter to set in the calibration, the value of ϕ, is targeted to match a share of temporary contracts equal to 7.5%, as in Italy, prior to the reforms of 1997.

5.2 Quantitative analysis

The benchmark economy:

I begin this section by judging how well the model in the benchmark parametrization performs along some important dimensions which are not a direct target of the

	Benchmark	Post-Reforms
ϕ	0.278	0.744
$e_T/(e_T + e_P)$	0.075	0.13
$\bar{\pi}_T$	0.16	0.20
$\bar{\pi}_0$	0.44	0.51
$1 - H(\bar{\pi}_T)$	0.62	0.54
$1 - H(\bar{\pi}_0)$	0.17	0.11
Wage gap	0.21	0.21
Productivity gap	0.27	0.29
Productivity change	0	0.02
Annual worker turnover (%)	50	62
Contact finding rate	0.47	0.60
Unemployment rate	0.113	0.069
Output	1.63	1.70
Output change (%)	0	4.2

Table 2: Simulated results for the labor market reforms in Italy

calibration exercise. A crucial statistic to appraise the performance of the model is the transition rate from temporary contracts into permanent contracts. The hypothesis that firms use temporary contracts as instruments of churning policies was indeed criticized for implying excessively low transformation rates. On the other hand, excessively high transformation rates might shed doubts on the assumption that Europe and US share the same learning technology.

The model was therefore simulated generating 100 repetitions of 100000 employment-unemployment paths for a worker starting in a temporary job. It was found that a temporary worker has a probability of 41.3% to be employed in a permanent contract one year later.[7] The 95% confidence interval around the mean ranges from 41% to 41.65%. Calculations reported by the (OECD, 2002), based on the European Community Household Panel show that exactly 41.3% of temporary workers in Italy in 1996 had moved into permanent job positions one year later. For most European countries the same transition probabilities range from about 36% to 56%, with only two notable exceptions: Spain, 23.1% and France, 20.8%. Such a low degree of upward mobility in these two countries looks like an exception in the European scenario and suggests that alternative forces leading to market segmentations could be dominant.

The contact finding rate for a worker in the model economy is .47 per month. This value is close to the monthly job finding rate of .48 measured by Hall (2005) for the US. However, in this framework, the job finding rate does not depend uniquely on the contact finding rate, but also on the average probability of passing the hiring test. At the calibrated equilibrium, the acceptance rates for temporary and permanent positions is .62 and .17, respectively. As expected, the absence of dismissal costs for temporary contracts increases the willingness of the firms to experiment new workers, lowering the threshold value of expected productivity required for hiring. The job

[7] See footnote 2.

finding rate is .14 at equilibrium, implying an average unemployment duration of 7.3 months.

Since hiring practices are less selective for workers employed on temporary positions, temporary workers are on average less productive than permanent workers, and earn lower wages. The wage gap implied by the calibration is about 21%, and reflects a productivity gap of about 27%. The OECD (2002) reports that in 1997 the wage penalty for temporary workers in Italy was about 28%. Controlling for worker and job characteristics, the wage penalty decreases to 13% in Italy, and is ranging between 6% and 24% in Europe, with an average value of 15%. The wage gap implied by the model seems somewhat larger than in the data.

The performance of the model is also consistent with evidence on the dynamic relative wage profile for temporary and permanent workers. Having assumed that heterogeneity is only match specific implies that any temporary worker will sooner or later be employed in a high productivity permanent match. Consequently, temporary workers are expected to catch up completely with the wages earned by workers on permanent positions. This is consistent with the results of Booth et al. (2002) in a study on the British labor market. They find that the wage gap between workers who start working on temporary and permanent contracts substantially tapers off with full-time work experience. In particular, women who start in fixed-term employment and move to permanent jobs are found to fully catch up to those who start in permanent jobs.

Following the standard practice, I compute the gross annual worker turnover rate by multiplying the monthly turnover rate by 12. The monthly turnover rate is in turn computed as the sum of employment entry and exit rates, where a transition from a temporary to a permanent position is recorded as a simultaneous entry and exit. The gross annual worker turnover rate implied by the model is about 50 percent. In the data, Contini (2006) find a turnover rate of about 62 percent in Italy, for the period 1986-1999. If transitions from temporary to permanent contracts are not recorded, the turnover rate implied by the model is about 42 percent. Accounting for these types of transitions can therefore improve the fit of the model, which is able overall to capture a large fraction of the measured turnover rate.

Comparative statics:

I now turn to evaluate how well the model is able to replicate the performance of the Italian labor market in the last decade following the reforms of temporary contracts. As it is possible to see from Figure 1 in the Appendix, the unemployment rate decreased, in these ten years, from 11.3% in 1996 to 6.8% in 2006, while the share of temporary contracts increased over the same period from 7.5% to 13%. A simple exercise of comparative statics is then performed, in which the strictness of the regulation on temporary contracts is reduced in order to match a share of 13% in the total stock of contracts. The results of this exercise are summarized in Table 2.

The exercise is particularly successful at reproducing the pattern of the unemployment rate in Italy, which decreases to 6.9% following the reforms. The intuition for the

decrease in unemployment is straightforward. When the share of temporary contracts in the economy is increased, screening workers on the job is less costly, on average, and more firms enter the market. A higher entry of firms together with a higher experimentation of workers in temporary contracts both contribute to increase the rate of exit from unemployment. In turn, this decreases both the rate and the duration of unemployment.

The exercise also predicts an increase in productivity of about 2%. The intuition is as follows. An increase in the share of temporary contracts generates two opposite effects on productivity. Since temporary workers are less productive than permanent workers, increasing their share will tend to decrease average productivity. However, as the expected cost of screening workers on the job decreases with the share of temporary workers, labor market tightness increases, and the combined outside option of workers and firms increases. In turn, this reduces the surplus of a match and translates into a higher threshold value of expected productivity required to form both temporary and permanent matches. This effect, which leads to lower acceptance rates and higher productivity, is found to dominate at the calibrated equilibrium, and proves robust to changes in the value of dismissal costs.

Given that total employment also increases at equilibrium, welfare, measured as total output in the economy, increases by 4.2%. If we consider the lifetime discounted value of search as an alternative measure of welfare, then welfare raises by 7.7%. This increase is due to lower unemployment duration, which in turn is triggered by higher contact rates, and by higher chances to pass the hiring test. Overall, the calibration clearly suggests that welfare gains derived from using temporary contracts as a screening device might be large, depending on firing restrictions on permanent positions and on the length of probationary periods. Given the process of learning about match quality estimated by Pries (2004), it takes more than seven months, on average, to discover the productivity of a worker. The probability that the true productivity of a match is still unknown after three months is about 66%, and after six months about 43%. Without access to temporary contracts, trial periods of three months, or six months, which are common across European countries, might therefore be too short to allow for an efficient reallocation of workers across existing jobs.

By generating a higher experimentation of workers in the economy, temporary contracts lead to a higher turnover rate, which is close to 62% in the calibration. The reason is that a higher share of temporary contracts increases both rejections of bad matches, and transformations into permanent employment. Finally, while the productivity gap increases by about 2%, the wage gap is not substantially affected by the reforms. The elasticity of the wage gap with respect to the productivity gap is only 5% at the calibrated equilibrium. The intuition is that the firm-worker pair in a temporary match has an option value on a permanent relationship which is exerted if the match turns out to be good. An increase in the productivity of permanent workers, raising the surplus of a permanent match, will then translate into an increase of the surplus of a temporary match. With Nash bargaining, both wages will then increase.

	Flexible wage Pre-reforms	Flexible wage Post-reforms
ϕ	0.393	0.765
$e_T/(e_T + e_P)$	.075	.13
$\bar{\pi}_T$	0.12	0.14
$\bar{\pi}_0$	0.24	0.26
$1 - H(\bar{\pi}_T)$	0.71	0.67
$1 - H(\bar{\pi}_0)$	0.45	0.41
Wage gap (%)	0.15	0.16
Productivity gap	30.0	30.5
Productivity change	0	0
Annual worker turnover (%)	56.6	64.9
Contact finding rate	0.29	0.30
Unemployment rate	.113	.104
Output	1.61	1.62
Output change (%)	0	0.6

Table 3: Simulated results for a flexible wage economy

The interactions of temporary contracts, dismissal costs, and the minimum wage:

The results indicate that so long as temporary contracts are used as a screening device, their introduction in an economy with both firing costs and a minimum wage can have strong implications in terms of unemployment, productivity and welfare. In order to disentangle how dismissal costs and the minimum wage interact with each other, and how the two together in turn interact with temporary contracts, I calibrate, following the same procedure outlined above, a version of the economy with flexible wages. Next, I perform the same exercise of comparative statics in order to assess how much the minimum wage matters when temporary contracts are introduced in an economy with dismissal costs. The results are reported in Table 3.

If flexible wages are introduced in an economy otherwise identical to the one in the benchmark parametrization, the unemployment rate drops to 6.7%. It is therefore clear that the interaction of dismissal costs with the minimum wage has a strong negative effect on job creation. The intuition is simple: with Nash bargaining, wages in the first period adjust in order to equally split the burden of future firing costs between the parties. If such a transfer of resources from the worker to the firm is prevented, the negative impact of firing costs on expected profits is larger, and thus entry is lower. In order to match an initial unemployment rate of 11.3% in the model with flexible wages, the vacancy cost must then be increased to 1. Furthermore, ϕ must be set to 0.393 to match a share of temporary contracts of 7.5% when all the other parameter values are left unchanged with respect to Table 1.

The strong increase in the vacancy posting cost with respect to the benchmark calibration implies a lower contact finding rate. Given that with a low contact rate the combined outside option of both workers and firms is lower, the threshold values for $\bar{\pi}_T$

and $\bar{\pi}_0$ are also lower, implying higher acceptance rates. When the share of temporary contracts is increased to 13%, the impact on productivity is negligible, output increases by only 0.6%, and the unemployment rate decreases by only 1%. With respect to the benchmark calibration, an economy with flexible wages can barely reproduce one fifth of the drop in the unemployment rate. The interaction between firing costs and the minimum wage is therefore crucial to account for the behavior of the Italian labor market following the reforms. In general, it seems that if temporary contracts are used as a screening device, labor market reforms enhancing flexibility at the margin can reverse most of the negative effects associated with employment protection, and with its interaction with the minimum wage.

In the case in which $d = 0$, the minimum wage is not binding and does not affect the equilibrium of the labor market. As firing costs increase, the wage bargained in the first period of a permanent relationship decreases, and the minimum wage eventually becomes binding. Therefore, in the model economy, minimum wages have no direct effect on the equilibrium, but only an indirect effect through the interaction with dismissal costs. Minimum wages affect the economy to the extent that they set an upper bound on the transfer of resources that can take place in the first period of a relationship. The higher the minimum wage, the stronger the impact of temporary contracts. However, reasonable changes in the minimum wage with respect to the value set in the benchmark calibration do not substantially affect the quantitative result.

6 Discussion

Numerical solutions of the model show that the effects produced by the introduction of temporary contracts hinge on labor market institutions. If screening workers for permanent positions is the main reason why firms use these types of contracts, liberalizing their use increases productivity and welfare and decreases the unemployment rate so long as firing workers with permanent contracts is costly. In general, the higher the dismissal costs, the higher the benefits associated with a reduction of employment protection at the margin. Moreover, the existence of a minimum wage strongly magnifies the negative effects associated with employment protection. Since the introduction of temporary contracts can reverse most of these effects, their impact on the economy will therefore be stronger in connection with a strong minimum wage legislation.

These results were also obtained under the assumption that firing costs are a pure resource waste. This is probably the most conventional way of modeling firing costs, although it is not unique. Alternatively, dismissal costs can be modeled as severance payments. In this case firing costs are simply a transfer of resources from the firm to the employee in case of dismissal. It is well-known that with flexible wages, severance payments have no impact on the labor market equilibrium since a transfer of resources conditional on a separation does not affect the size of the surplus. With flexible wages and severance payments, wages in the first period of a relationship adjust in order to fully compensate firms for future expected dismissal costs, without altering their incentives to enter the market. Yet, in the presence of a minimum wage, this transfer

cannot take place, entailing a negative effect on job creation. The choice of modeling firing costs as a pure waste of resources is therefore not essential for the results.

It was noted that in the case in which $d = 0$, temporary contracts have no impact on the labor market equilibrium. Obviously, if there are no firing costs on permanent positions, temporary contracts and permanent contracts are equivalent in this setting, and there are no gains that can be obtained through screening workers for permanent positions. Thus, in an economy with no firing restrictions, such as the US, there is no reason why firms should resort to temporary contracts to screen workers. This can explain why temporary contracts are found to be a port of entry into regular employment in Europe, but not in the US.

A common result in the literature on temporary contracts is that enhancing flexibility at the margin is a second best solution, the first best being a reduction in firing costs. This holds true also in this framework, as long as some waste of resources is associated with firing permanent workers. Even in the case of $\phi = 1$, when only good workers are hired for permanent positions, the exogenous source of job destruction is still costly for the matched worker-firm pair, and is therefore a source of welfare drain.

The mechanism highlighted in this paper reverses some of the conclusions obtained through the standard models of temporary contracts, helping to reconcile the theory with the empirical evidence. However, the main policy implications remain in line with the common opinion expressed in the current debate. It cannot be excluded that some part of the workforce, of debatable magnitude, might be harmed by the introduction of temporary contracts, and remain trapped in recurring spells of temporary employment and unemployment. Several economists have therefore proposed replacing various chategories of temporary contracts with a unique permanent contract with extended probation. This view could be shared also in the light of this paper, as all the gains that arise through temporary contracts could likewise be generated by extended probationary periods on permanent positions.

7 Conclusions

A growing body of empirical evidence has recently documented that in most European countries, temporary contracts play a fundamental role in the labor market as a screening device. For the case of Portugal, Varejao and Portugal (2003) show that screening workers for permanent positions is the single most important reason why firms use these types of contracts. This paper presents a framework which embeds the screening hypothesis into an equilibrium model of the labor market. The aim is to understand how temporary contracts interact with other labor market institutions, and how they affect the labor market equilibrium and welfare.

The model can account for the relatively high mobility rates into permanent employment measured for most European countries, and for the recent empirical findings indicating that temporary contracts correlate positively with employment at the European level. These results are important since models assuming that firms use temporary contracts as instruments of churning policies have opposite predictions. Models

which assume that firms use temporary contracts as buffer stocks are instead inconclusive on the long-run effects on employment and unemployment, and are unsuited to study the transition rates.

The paper also shows that when temporary contracts are used as a screening device, they can substantially increase both productivity and welfare. Temporary contracts can thus reverse most of the negative effects associated with employment protection, and with its interactions with the minimum wage. The calibration of the model can account for salient statistics of the Italian labor market, including the transition probabilities, the worker turnover rate, the wage gap between temporary and permanent workers and the drop of the unemployment rate, following the reforms.

The model presented in this paper isolates a single mechanism through which temporary contracts generate welfare gains. However, this story captures only a part of the whole picture. On the other hand, it is found that firms offer less training to temporary workers. By affecting the expected duration of a relationship, temporary contracts might presumably also influence workers' investment in firm-specific human capital. It is possible that in European labor markets, where systems of payment based on performance are scarce, employment protection provides an alternative incentive to exert effort, and invest in firm-specific human capital. Investigating how reductions of employment protection affect the pattern of human capital accumulation, is beyond the scope of this paper, and remains an important question to explore in future research.

A Figures and Tables

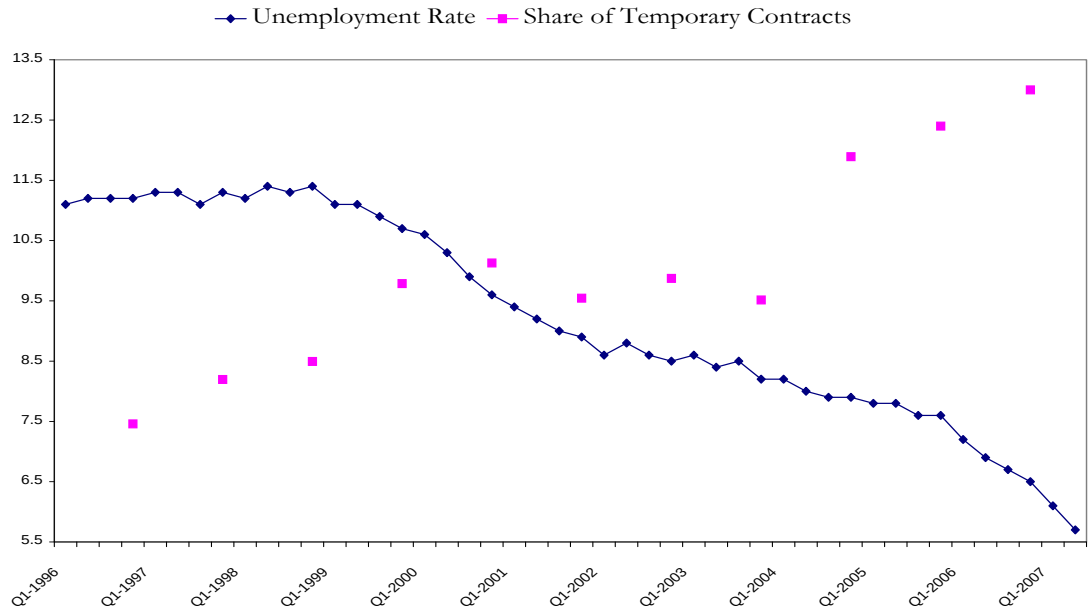

Figure 1: Share of Temporary Contracts and Unemployment Rate in Italy. 1996-2007

Country	EPL Strictness	Kaitz index	Replacement ratio
United States	0.7	.39	.50
United Kingdom	0.9	.40	.38
Denmark	1.5	.54	.90
Finland	2.1	.52	.63
Sweden	2.6	.52	.80
Germany	2.6	.55	.63
France	2.8	.50	.57
Spain	3.1	.32	.70
Italy	**3.4**	**.71**	**.20**
Portugal	3.7	.45	.65

Table 4: Sources: OECD (1999,table 2.5, pp.62) and Dolado et al. (1996)

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