The adverse effects of short-term contracts on young workers: evidence from Italy[1]

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Abstract

Short-term employment contracts have been deployed rapidly across European countries in the past decades. In this paper we investigate theoretically their effects on individual income using a new micro-founded search model. Comparing the economy pre-reforms and post-reforms, we study firm and worker dynamics and quantify income changes for different categories of workers. We find that workers of high productivity fare better post-reforms, while junior and low productivity workers are worse off. By evaluating a policy intervention which calls for an open-ended contract with lower firing costs for junior workers we find that all workers are better off.

Keywords: Income analysis, temporary contracts, young workers, policy evaluation.

JEL Classification: E24, J31, J41, J64, J78.

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1. Introduction

High and persistent unemployment rates in Europe have often been associated with strong labour market rigidities and strict employment protection legislations (EPL). Particularly in Southern Europe, permanent contracts characterised by high hiring and firing costs, have represented for many decades the traditional way to hire workers. However, starting in the mid eighties, milder EPL short-term contracts were introduced and coexisted with the unchanged stricter EPL permanent contract, in an attempt to inject flexibility into the market. While the effects of this policy intervention have been studied theoretically for several macroeconomic variables (e.g., employment, unemployment, productivity, turnover),[3] the income effects of such reform, which are crucial to properly assess optimal policies toward short-term contract regulations, remain largely unexplored.

To address this important gap, this paper performs an analysis of individual income to understand whether workers benefited from the introduction of short-term contracts. We use Italy as a case-study since it is one of the European countries where the share and the variety of short-term contracts have increased significantly since the mid 1990s. The analysis of the changes registered in the labour market is the basis for developing a search model, with different types of contracts. Calibrating the model, we are able to recreate working careers of different groups of workers and compute the present discounted value of their income. One of our major findings is that, on average, high productivity *senior* workers face a substantial increase in income after the reforms. In contrast, *junior* workers as well as low productivity experienced workers are worse off. When computing the present discounted value of the lifetime income, we find lower values for all types of workers. We then evaluate the effect of a timely policy intervention which envisages the creation of a unique flexible contract with

[3]See for instance the work of Bentolila and Bertola (1990), Bertola (1990), Bentolila and Saint-Paul (1992), Hopenhayn and Rogerson (1993), Cabrales and Hopenhayn (1997), Wasmer (1999), Bruegemann (2007), Autor et al. (2007), Cahuc et al. (2016) and Aguirregabiria and Alonso-Borrego (2014). See also Addison and Teixeira (2003) for a survey of empirical studies on the topic.

lower firing costs for *junior* workers. We find that this policy has positive effects, both on the labor market (employment and unemployment rates) and in terms of individual income.

The theoretical basis of this study is a micro-founded search model in the spirit of Mortensen and Pissarides (1994), where workers are heterogenoeus with respect to productivity. We consider two labour markets, one for *junior* workers, at the early stage of their working career and whose productivity is at the entry level, and one for *senior* workers, who have already accumulated work experience and differ according to their productivity level. The model describes a pre-reforms economy, characterised solely by permanent contracts, associated with firing costs to be paid by the employer in case of layoffs.[4] In order to analyse the way the income of workers has changed after the introduction of short-term contracts, we enrich the model with three distinctive features. First, we allow for the availability of both permanent and short-term contracts. Second, we characterise the latter with fixed duration and zero firing costs at termination. These two assumptions propose a trade off which is known in the empirical literature[5] and analysed in the theoretical work of Cahuc et al. (2016) and Varejão and Portugal (2009). The importance of this trade-off is justified by its antithetical related implications. If firms use short-term contracts as a screening device, higher productivity is expected in the long-term since the objective is to find a better match (Nagypál, 2007). If they are used as a churning mechanism, they may instead cause a decrease in job stability, on the job training, and productivity growth (Blanchard and Landier,

[4]In Italy (and several other European countries, such as Spain and France) firing costs associated with permanent contracts include high severance payments, long and convoluted bureaucratic processes, long trials, and high uncertainty associated with the court rulings. Therefore, it is very costly for firms to fire workers, also due to the difficulty to estimate *ex ante* the magnitude of such costs (Ichino, 1996; Ichino et al., 2003). This reflects in a low inflow rate into unemployment for workers on permanent contracts.Elsby et al. (2013) reported for Italy a monthly inflow rate to unemployment equal to 0.4%, which is quite low compared to the inflow rate in Anglo-Saxon and Nordic countries (above 1.5% on average), and lower than the average Continental Europe inflow rate of 0.5% to 1% per month.

[5]Please see the work by Adam and Canziani (1998); Abowd et al. (1999); Berton et al. (2007); Guell and Petrongolo (2007) which show that in Southern Europe short-term contracts are used both as a screening device and as a churning mechanism.

2002). These features lead all types of workers to experience several sequences of short-term employment and unemployment during their working careers, as observed in the data.

Third, as in Cahuc et al. (2016), we do not allow firms to dismiss temporary workers before the termination date stipulated when the job starts. This is justified by the fact that while in the "Spanish regulation" which covers Spain and Portugal, the rule for dismissals before the expiration date of temporary contracts is the same as for permanent contracts, in the "French type" regulation, that prevails in Belgium, France, Greece, Italy and Germany, temporary contracts can not be terminated before their expiration date. Therefore, it is generally at least as costly to terminate a temporary contract before its date of termination as to terminate a regular contract.[6]

By calibrating the model using data from Italy we find that *junior* workers are worse off after the reforms. *Senior* workers, if high productive, enjoy higher wages and the benefits associated with permanent contracts. Low productivity *senior* workers instead fall into cycles of unemployment and short-term employment, facing lower salaries and reduced benefits. We then compute the present discounted value of income for the lifetime of more and less productive workers and we find that both are worse off after the reforms. When we test for the introduction of a unique open-ended contract, which allows firms to fire *junior* workers at lower costs, we find that this system is beneficial for all categories of workers. This policy is particularly relevant since not only has been discussed at length by several European economists (Lepage-Saucier et al., 2013; García Pérez and Osuna, 2012), but it has also been recently implemented in Italy.

This paper is related to the limited literature that studies theoretically the effects of short-term contracts on individual income. Cahuc and Postel-Vinay (2002) adopt a political

[6]The assumption which is present in most of the literature which assumes that it is costly to terminate permanent contracts, whereas temporary contracts can be terminated at no cost at any time, is not in line with the current regulations. Moreover, it introduces a distortion in the explanation of how firms choose between permanent and temporary jobs.

economy approach to study the impact of the simultaneous utilisation of high EPL and short-term contracts. After identifying the political support for these two instruments, they compute their effects on the economy's total output and the aggregate welfare. Using a similar framework, we depart from their setup by allowing for the ageing of individuals and therefore by focusing on the impact of high EPL and short-term contracts on different types of workers. By modelling short term contracts as a mechanism to screen workers for permanent positions, Faccini (2014) shows that aggregate welfare gains derived from using temporary contracts as a screening device might be large. Even though both papers study the role of short-term contracts within a search model, their objective is to study the effect on aggregate welfare and not on individual income by worker's type which is the scope of this paper. The theoretical framework described by Casquel and Cunyat (2011) is conceptually very similar to the model presented in this paper, however they limit their study to the analysis of the different conversion patterns of temporary contracts into permanent contracts. The landmark paper by Blanchard and Landier (2002) is the closest to this work. They use a search and matching model to show that dual track reforms might have perverse effects on the labour market and specifically on the welfare of young workers in France. We increase generality in two dimensions. First, using a single model, they compute the present discounted value of the worker's utility by comparing different transition probabilities across states before and after the reforms, while we specify two versions of the same model to accommodate institutional changes. Second, we consider workers ageing over time and changing from *junior* to *senior* when their productivity is revealed. Therefore, we are able to follow the workers over time and to perform a specific income analysis at different stages of their lives. Nevertheless, regarding the effect of short-term contracts on the welfare of young workers, we are able to reach similar conclusions.

This paper is organised as follows: in Section 2 we provide empirical evidence to assist us in designing the proper model specification. Section 3 describes the search model, and

Section 4 presents the calibration approach to test the model. Section 5 illustrates our findings regarding the change in income for different categories of workers and explores a policy intervention which calls for a unique contract with lower firing costs for *junior* workers. Section 6 concludes with a discussion of future research.

2. Motivating Empirical Evidence

In this section we investigate from an empirical point of view the changes registered in the Italian labour market after the reforms to help us properly design the model. Our empirical analysis[7] is based on two data sets: the Survey on Household Income and Wealth (SHIW, 2010) and the Work Histories Italian Panel (WHIP, 2005) provided by the National Social Security Institute.

Table 1 reports descriptive statistics regarding short-term workers. Controlling for individual characteristics, we perform a probit regression testing for the probability of a worker to be hired on a temporary basis (Table 2). Female workers as well as young workers are shown to have higher chances to be hired short-term, as in Barbieri and Sestito (2008). As reported by ILO and OECD (2012), similar trends are also observed in countries such as Spain, France and Portugal. We also find that managers as well as white collar workers have higher chances to be hired permanently compared to blue collar workers. In addition, education plays a significant role in explaining the probability to be hired on a short-term contract. Surprisingly having earned a five-year bachelor degree raises the chance of being hired temporary. In particular, the interaction effect of high education level (bachelor's degree) and young age is positive and significant,[8] confirming the findings of Barbieri and

[7]We do not claim any causal effect; we present here simple trends observed in the raw data.

[8]Following the approach of Norton et al. (2004) who claim that interaction terms in nonlinear models can not be interpreted as marginal effects, while the sign may be different for different observations and statistical significance cannot be determined from the z-statistic, we re-run the regression using the Stata command *inteff* which computes the correct marginal effect of a change in two interacted variables for a probit model. We still find a positive and statistically significant coeffient associated with the interaction

Scherer (2009) and Naticchioni et al. (2010) that recent college graduates are likely to be hired short-term when they first step into the labour market.[9]

Stylised Fact 1: Workers hired short-term are mostly young, female, less educated, and recent college graduates.

Data show that workers hired short-term tend to have lower income.[10] By analysing the income distribution by age groups, we notice that across all ages, workers tend to earn lower salaries when they are hired on short-term contracts compared to permanent contracts (Figure 2).

To test for the presence of a wage gap between permanent and short-term employees, we perform an OLS regression, controlling for the characteristics of workers, employers, and jobs. As expected, being hired on a permanent position rather than short-term significantly increases the wage (Table 3). Even though it may be due to a selection bias, this result is in line with the conclusions of Addison and Teixeira (2003), Brown and Sessions (2005), Picchio (2008) and Berton et al. (2015), who have robustly shown that temporary workers earn systematically less than permanent employees.

Stylised Fact 2: A wage gap exists between permanent and short-term workers.

effect of young age and tertiary education.

[9]Barbieri and Scherer (2009) show that students that recently graduated from college are likely to be offered a short-term contract as their first job. Naticchioni et al. (2010) show that the likelihood that young workers with tertiary education are assigned to low quality jobs under fixed term contracts has increased in Italy after the implementation of labour market reforms. Those indeed have progressively favoured policies based on cost savings for newly hired workers.

[10]For some specific types of short-term contracts, the law requires workers to be paid as much as workers hired permanently, given the same work responsibilities. For other contracts, the law allows employers to frame the workers within a lower occupational level to offer a lower salary.

We then analyse transitions across non-employment, short-term, and permanent employment.

Table 4 shows that while in 1995 40% of workers hired short-term were at their first job experience, this share is down to 3% in 2003. Among individuals with previous working experience, two thirds were not employed before the short-term spell in 1995, while in 2003 90% were coming from another short-term position. Interestingly, in 1995 at expiration of the short-term contract, 40% of the workers moved to a permanent position and only 10% to another temporary job. In 2003, almost half of the workers signed afterwards a new short-term contract and one third moved to non employment.[11] Similar results are found by Centeno and Novo (2012) for Portugal and by Bentolila et al. (2012a) for Spain and France, who show that fixed-term contracts are positively associated with excess worker turnover.

Stylised Fact 3: Workers turnover has increased after the introduction of short-term contracts.

We use these stylised facts within a theoretical framework, described in the next section, to reconstruct the dynamics of the labour market before and after the reforms.

3. The Search Model

In this section we design a Mortensen and Pissarides (1994) search and matching model, based on the empirical evidence described above. To analyse the firms' behaviour in response to the introduction of short-term contracts, we compare the model before the reforms, when only permanent contracts are accessible, and after the reforms, with both permanent and

[11] Although the sample in 1995 is much smaller than the sample in 2003, the statistics are robust. In fact, evidence that sequences of short-term contracts became more and more common in Italy after the reforms has also been presented by Bruno et al. (2012), Berton et al. (2007) and Gagliarducci (2005).

short-term contracts. The option for firms to offer short-term contracts, defined by fixed duration and no firing costs at expiration, creates a meaningful trade off (Varejão and Portugal, 2009). As shown in the empirical literature (Guell and Petrongolo, 2007), we allow both the screening and the churning mechanisms to act as determinants for firms to offer short contracts. Moreover, to better model the choice between the two types of contracts and in line with the regulation, we do not allow firms to terminate short-term contracts before the expiration (Cahuc et al., 2016).

3.1. The Set up

The set up is described by a set of parameters, which define the model dynamics (Table 5). The economy is composed by a population of measure one. Every instant a measure of individuals are born and each instant the same measure of individuals pass away (at rate d). When the individuals are born, they are *junior* and they are out of the labour force. At rate m, which is the parameter of a Poisson arrival process, they join the labour force as unemployed and start looking for jobs. When they find a job, at rate μ, their productivity is the entry level productivity y_0. At rate λ, a productivity shock hits the match, they become *senior* and their productivity is revealed. The new productivity level y is drawn randomly from a distribution with cumulative distribution function $H(y)$. *Senior* workers may exit the labour force by retiring (at rate s). We define b as the value of home production, e.g., unemployment benefits.

Firms hire both *junior* and *senior* workers.[12] Firms without workers post vacancies at cost c and they fill them with probability α, which is the parameter of a Poisson arrival process. In equilibrium, job creation is governed by profit maximisation by taking into account expected revenues and costs of a new match. Firms and workers come together

[12]This is socially desirable since we assume that the value of work production is always higher than home production, i.e., $y_0 > b$.

via a standard matching function $M(u, v)$ where u is the rate of unemployment and v is the vacancy rate. This function is twice differentiable, increasing in its arguments, and exhibits constant returns to scale. The flow of matches for a vacancy may be defined as $M(u, v)/v = \alpha(\theta)$, which is a decreasing function, where θ is the tightness of the labour market defined by v/u. The flow of matches for an unemployed worker may be defined as $M(u, v)/u = \mu(\theta) \equiv \theta\alpha(\theta)$, which is an increasing function.[13]

Existing matches may terminate at Poisson rate δ as a consequence of an exogenous shock. Therefore, each party goes through a costly search process in order to meet its next partner. We assume that wages are set through an asymmetric Nash Bargaining process, where the bargaining parties are workers and employers. In this setup, β represents the bargaining power of the workers.

3.2. The Benchmark Model (Pre-Reforms)

In the basic set up, we assume that only permanent contracts are available and firing costs $F > 0$ need to be paid by the firm in case of dismissal.[14]

3.2.1. The Firm's Problem[15]

When deciding whether to offer a permanent contract, the firm does not incur firing costs if the match is not formed, since firing costs are only paid when an ongoing relationship is severed. Therefore, the outside option is different whether the contract is new or pre-existing. This asymmetry between new and ongoing matches implies that the employer-employee match must also indicate whether the match is newly signed or pre-existing. The superscript $j = \{N, E\}$ refers to *new* (N) or *existing* (E) matches. The subscripts Y and O

[13] Standard Inada conditions apply.

[14] Following 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, they can be considered as equivalent to a separation tax.

[15] In the standard Mortensen-Pissarides (1994) model, decisions are taken simultaneously by the firm and the worker. Therefore, the Bellman's equations for the workers reflect the same decisions the firm is asked to undertake. As such those equations are reported in the Appendix.

denote *junior* and *senior* workers, respectively.

When the firm posts a vacancy, the Bellman's equations are:

$$
\begin{aligned}
rJ_Y^V &= -c + \alpha_y^p [J_Y^E - J_Y^V], && (1)\\
rJ_O^V &= -c + \alpha_o^p \int_{\underline{y}}^{\overline{y}} \max\left[(J_O^N(y), J_O^V) - J_O^V\right] \, dH, && (2)
\end{aligned}
$$

where c and α^p are respectively the vacancy cost and the rate at which the vacancy is filled. In case of *senior* workers, let y^n be the threshold of productivity above which the worker is hired permanently. For levels of productivity below the threshold ($y < y^n$) the worker is unemployed and no firing costs are paid by the firm. The firm's Bellman equations for a filled position read:

$$
\begin{aligned}
rJ_Y^E &= y_0 - w_y + \delta[J_Y^V - F - J_Y^E] + \lambda \int_{\underline{y}}^{\overline{y}} \left[\max(J_O^E(y), J_O^V - F) - J_Y^E\right] \, dH, && (3)\\
rJ_O^j(y) &= y - w_o^j(y) + \delta[J_O^V - J_O^j(y) - F] + s^p[J_O^V - J_O^j(y)]. && (4)
\end{aligned}
$$

Equation 41 is the expected present value of profits from a permanent position filled by a *junior* worker. His entry level productivity is y_0 and the firm pays him the *junior* wage w_y. When the match is exogenously destroyed at rate δ, the firm pays firing costs F and opens a new vacancy. At rate λ the firm learns the worker's productivity level. Let y^e be the threshold level above which the firm keeps the worker within the workforce and below which the firm lays him off. If the drawn productivity level of the worker is above the threshold ($y > y^e$), the worker is kept as a permanent *senior* worker. Otherwise, the firm pays firing costs F and opens a new vacancy.

Equation 42 is the expected present value of profits from a *new* (N) or *existing* (E) permanent position filled by a *senior* worker with productivity y. The match may terminate if the worker retires at rate s^p or if the match is destroyed at rate δ. In the latter case the

firm pays firing costs F. In both situations, the firm opens a new vacancy.

3.2.2. Wage Determination and Equilibrium Conditions

We assume that wages are bargained using a Nash Bilateral Bargaining mechanism, where β represents the bargaining power of the workers. Wages are contingent on the type of contract and on the productivity level of the worker. Therefore, w_y is the wage of *junior* workers, while there is a distribution of wages $w_o^N(y)$ and $w_o^E(y)$ for *senior* workers in new or existing matches, respectively.

The sharing rules for the determination of the wages are described by the following equations:

$$\beta[J_Y^E + F - J_Y^V] = (1-\beta)[W_Y^E - W_Y^U], \tag{5}$$

$$\beta[J_O^E(y) + F - J_O^V] = (1-\beta)[W_O^E(y) - W_O^U], \tag{6}$$

$$\beta[J_O^N(y) - J_O^V] = (1-\beta)[W_O^N(y) - W_O^U], \tag{7}$$

The termination of a match involving *junior* workers and *senior* workers in existing relationships implies the payment of firing costs F by the employer. These costs enter into the equations for the determination of wages with a positive sign. However, in case of *senior* workers in new relationships, when deciding whether to form a new match, the firm does not incur firing costs if the match is not formed.

The free entry conditions imply that on both markets (for *junior* and *senior* workers) the values of the vacancies are equal to zero. In case of *senior* workers, we compute the optimal threshold levels y^e and y^n for the optimal allocation of workers. Please see the Appendix for further details. By maximizing the total surplus, we compute the wage setting conditions. The Nash wage equations for *junior* and *senior* workers in existing and newly

formed matches read:

$$w_y = \beta y_0 + \beta r F + (1-\beta) r W_y^U - (1-\beta)\lambda[W_o^U - W_y^U]. \quad (8)$$

$$w_o^E = \beta y + \beta(r+s^p)F + (1-\beta)(r+s^p)W_o^U - (1-\beta)s^p W_o^{OLF}, \quad (9)$$

$$w_o^N = \beta y - \beta\delta F + (1-\beta)(r+s^p)W_o^U - (1-\beta)s^p W_o^{OLF}. \quad (10)$$

As in Mortensen and Pissarides (1994), the firing costs enter with a positive sign ($+\beta(r+s^p)F$) in the wage equation for existing matches (Eq. 9), and with a negative sign ($-\beta\delta F$) in the wage equation for new matches (Eq. 10).

3.3. The Model with Short-term Contracts

The model with short-term contracts differs from the benchmark model in the possibility for firms to hire workers on a short-term basis, in addition to the permanent basis. The main features of the short-term contract are the limited duration, which is established when the contract is stipulated, and the absence of firing costs at termination. Moreover, short-term contracts can not be terminated before the expiration, which is established at the time of the stipulation of the contract (Cahuc et al., 2016).

3.3.1. The Firm's Problem[16]

Let the superscripts P and S denote permanent and short-term contracts, respectively. Keeping the same notation as described in section 3.1, we compute the Bellman's equations for the firm hiring a *junior* worker:

[16] As with the benchmark model, given that decisions are taken simultaneously by the firm and the worker, we report the Bellman's equation for the workers in the Appendix.

$$rJ_Y^V = \max\{-c + \alpha_y^s[J_Y^S - J_Y^V], -c + \alpha_y^p[J_Y^P - J_Y^V]\}, \quad (11)$$

$$rJ_Y^P = y_0 - w_y^p + \lambda \int_{\underline{y}}^{\overline{y}} \max\left[(J_O^{EP}(y), J_O^V - F) - J_Y^P\right] dH + \delta[J_Y^V - F - J_Y^P], \quad (12)$$

$$rJ_Y^S = y_0 - w_y^s + \lambda \int_{\underline{y}}^{\overline{y}} \max\left[(J_O^{EP}(y), J_O^S(y)) - J_Y^S\right] dH + t[J_Y^V - J_Y^S] \quad (13)$$

The firm has the option to hire a *junior* unemployed worker on a permanent or short-term contract (Eq. 11). The trade-off is driven by the parameters associated with the firing costs (F) and the length of the short-term contract (t). By picking the first contract type (Eq. 12), when the productivity of the worker is revealed (at rate λ) and the worker turns *senior*, the firm is able to fire the worker by paying firing costs F (if his productivity level is too low) or to keep him on a permanent basis (if his productivity level is above the reservation threshold). With the second contract choice (Eq. 13), when the productivity of the worker is revealed (at rate λ) and the worker turns *senior*, the firm can not dismiss the worker. The firm may keep the worker short-term or upgrade him to a permanent position, according to his productivity level. Even in case of a very low productivity worker, the firm is forced to keep the worker until the contract's termination.

The Bellman's equations for the firm hiring a *senior* worker on a new or existing match ($j \in \{N, E\}$) read:

$$rJ_O^V = -c + \alpha_o \int_{\underline{y}}^{\overline{y}} \max\left[(J_O^{NP}(y), J_O^S(y), J_O^V) - J_O^V\right] \, dH, \tag{14}$$

$$rJ_O^{jP} = y - w_o^{jp} + \delta[J_O^V - F - J_O^{jP}] + s^p[J_O^V - J_O^{jP}], \tag{15}$$

$$rJ_O^S = y - w_o^s + (t + s^s)[J_O^V - J_O^S]. \tag{16}$$

Also in case of *senior* workers, the permanent match is destroyed at rate δ by paying firing costs F or in case the worker retires (Eq. 15), while the temporary contract may only be terminated at expiration (at zero costs) or in case of retirement on the worker's side (Eq. 16).

3.3.2. Equilibrium Conditions and Wage Determination

In order to characterise and select among possible equilibria, we consider different possible scenarios[17] and we focus on the equilibrium in which it is optimal for firms to offer a short-term contract to *junior* workers.[18]

In case of *senior* workers, we compute the optimal threshold levels for the allocation of unemployed workers among permanent contracts, short-term contracts and unemployment. If the productivity level of the worker is higher than y^{nh}, the worker is hired on a permanent basis; if the level of productivity is included between y^{nh} and y^{nl}, the worker is hired short-term. For values of productivity below y^{nl}, the worker keeps the status of unemployed. We

[17]Note that in this model the equilibrium does not involve the segregation of the market into four groups. The firm opens a vacancy for a *junior* worker and then it decides whether to offer the worker a permanent or a short-term contract. Since *junior* workers are homogenous the firm will offer the same contract to all *junior* workers.

[18]If it is optimal for the firm to offer a permanent contract to *junior* workers, the opportunity to offer a short-term contract will arise again only when the worker is *senior*.[19] Therefore in equilibrium the share of short-term contracts would be minimal and would involve only *senior* workers. This hypothesis would rule out the screening device argument for the utilisation of short-term contracts. Moreover, this is not observed in the data, which instead reveal a significant share of young individuals hired on a temporary basis.

compute also the productivity threshold y^e for which the firm is indifferent whether to offer a permanent or a temporary contract when the productivity of the worker is revealed, at rate λ. See the Appendix for further details.

Finally, by maximizing the surplus of the employer-employee match, we get the following wage levels for *junior* and *senior* workers:

$$w_o^{np} = \beta y + \beta(r+s^p)F + (1-\beta)(r+s^p)W_O^U - (1-\beta)s^p W_O^{OLF}, \quad (17)$$

$$w_o^{ep} = \beta y - \beta\delta F + (1-\beta)(r+s^p)W_O^U - (1-\beta)s^p W_O^{OLF}, \quad (18)$$

$$w_o^{s} = \beta y + (1-\beta)(r+s^s)W_O^U - (1-\beta)s^s W_O^{OLF}, \quad (19)$$

$$w_y = \beta y_0 - \beta\lambda F(1-H(y^*)) + (1-\beta)(r+\lambda)W_Y^U - (1-\beta)\lambda W_O^U. \quad (20)$$

4. Calibration

The main criteria used to select the calibration parameters are: consistency with the previous literature and matching with labour force statistics extracted from the data. Our objective is to match the rates of unemployment, employment, as well as the average wages for different categories of workers in 1995 (before the reforms) and in 2006 (after the reforms). A summary of the parameter values and their source can be found in Table 6.

Following Blanchard and Landier (2002) and Faccini (2014), we consider the length of a month as the unit time period. The discount factor r is set to match an annual interest rate of 5%. We normalize the number of entrants in the labour market to 100 and we set the rate at which people die d to 0.03 to ensure that the population is constant. The parameter m, which represents the rate at which people join the labour force is set to 0.046 to match the rate of *junior* individuals out of the labour force. The rate at which workers retire ranges in the literature from 1.5% (Blanchard and Landier, 2002) to 1.9% (Ichino et al., 2013). In line with the OECD (2015) statistics, we set the parameter s equal to 1.8%.

The exogenous job destruction rate δ is set to 0.0085 as in Pries and Rogerson (2005) and Faccini (2014) to match a yearly job destruction rate of 10%,[20] which is consistent with the values reported by Bertola and Rogerson (1997) for Italy as well as for other European countries.

Although there are no direct estimates, in the literature firing costs in Mediterranean countries vary from six weeks (Nagypál, 2007) to six months (Blanchard and Portugal, 2001) to one year and a half (Blanchard and Landier, 2002). In this paper, we follow Boeri and Burda (2007) and Pries and Rogerson (2005) and set the firing costs equal to three months of the average salary observed in equilibrium. The vacancy cost, represented by c, is set equal to 0.15 as in Boeri and Burda (2007).

Following a common practice in the literature, we assume a Cobb-Douglas matching technology of the form $m(u, v) = hu^{\kappa}v^{(1-\kappa)}$, where h is the mismatch parameter which captures the overall efficiency of the matching process and κ is the elasticity of the matching function with respect to unemployment. We calibrate the parameters of the matching technology according to the estimates of Peracchi and Viviano (2004). Specifically, we set the elasticity of the matching function with respect to unemployment for *junior* workers to 0.154, which is the weighted average of the estimated values for the population aged 16-24 and 25-34. Similarly, we set the same parameter for *senior* workers to 0.299, as the weighted average of the estimated values for the population aged 35-44 and above 45. The mismatch parameter h is also calibrated as the weighted average by population groups and is set equal to 0.384 and 0.227 for *junior* and *senior* workers, respectively. Moreover, we use the weighted average of the estimated values of the market tightness by population age to derive the rate at which workers and firms meet, i.e, the parameters μ and α in the model.

We set the parameter which defines the bargaining power of the workers equal to 0.5,

[20]The sensitivity analysis performed in Table 10 explores the robustness of the results to changes in this parameter.

which is standard in the literature (Petrongolo and Pissarides, 2001). We normalize the productivity level of *junior* workers to 2.8. We select a uniform distribution for the function $H(y)$ and set the bounds of the distribution equal to 0 and 5, respectively.

The monthly probability of a productivity change on an entry level job is set by Blanchard and Landier (2002) to 10% and by Dolado et al. (2007) to 5% and 2% for more and less productive workers, respectively. In line with the literature, we set the value of the parameter to a conservative level, 5% to match the employment and unemployment rates of *junior* workers. The sensitivity analysis performed in Table 10 explores the robustness of the results to changes in this parameter.

Finally, we calibrate the parameter b of unemployment benefits. Selecting an appropriate value is quite controversial since b includes not only unemployment benefits, but also other non measurable entities, such as the disutility of work, the home production, etc. Moreover, in Italy benefits are less generous compared to most European countries (Schindler, 2009).[21]As it is possible to notice from Table 7, the replacement ratio in Italy is the lowest in Europe. The chosen values of 0.15 is set to match the employment and unemployment rates of *senior* workers.

Regarding the average length of a short-term contract, which characterises only the post-reforms economy, we set the parameter t, which represents the rate at which the contract expires, equal to 0.1. This value defines the average length of a contract approximately equal to ten months, which corresponds to the average length seen in the data (Cappellari and Leonardi, 2013; Lilla and Staffolani, 2012).

We allow only two institutional parameters to change after the reforms as a consequence

[21]The Italian unemployment insurance (UI) system is complex and uneven. While ordinary UI benefits are initially relatively high, with a net replacement rate of 60 percent, they drop to zero after 8 months (12 months for workers aged over 50), and complex eligibility rules imply that only few unemployed individuals actually receive such UI benefits (Demekas, 1995). In 2005, 2.3% of the labour force received UI benefits, about a third the rate in other EU countries.

of important implemented reforms. In the post-reforms economy we set the value of the retirement rate to 1.4% and the unemployment benefits to 0.25 to match the higher employment and unemployment rates of *senior* workers.[22]

5. Findings

Using the parameter values described in Section 6, we simulate the model for 10000 random individuals in the labour market.

We compute the productivity thresholds for the allocation of workers among contracts before and after the reforms. We find that in the pre-reforms economy, the threshold level y^e above which a *junior* worker who is turning *senior* is kept on a permanent basis and below which is fired, is equal to 0.69. In the post-reforms economy the threshold level for which the firm is indifferent whether to offer a permanent or a short-term contract to a *junior* worker who is turning *senior* is equal to 1.34. Moreover, the productivity threshold y^n above which unemployed *senior* workers are hired before the reforms is 0.85. In the post-reforms economy the two thresholds defining the allocation of workers between permanent and short-term contracts and unemployment are equal to 1.23 and 0.85, respectively. Therefore, all threshold values shift upward after the reforms, except for the hiring of *senior* workers from unemployment. As a consequence only those workers who are highly productive are hired permanently after the reforms, while a share of less productive workers who were hired permanently before the reforms, are hired short-term in the post-reforms economy, confirming the substitution effect hypothesis discussed in the literature at length. Given the threshold values, we compute the present discounted value of income for all workers before

[22] A lower value of s post-reforms is justified by several pension reforms approved between 1995 to 2004 to increase the average retirement age in Italy. OECD (2015) reports indeed that the effective retirement age went from 59.6 in 1995 to 60.5 in 2004 for men and from 57.4 in 1995 to 61.6 in 2004 for women. On the other hand an higher value for b is selected according to the OECD statistics, which show that the full unemployment benefit in Italy has increased significantly after 1998.

and after the reforms.

Junior workers before the reforms are subject to lower termination rates compared to *junior* workers in the post-reforms economy ($\delta < t$). In fact, the short duration of temporary contracts causes *junior* workers to experience several cycles of temporary employment and unemployment after the reforms. Therefore, even though the wage level is comparable before and after the reforms, we find that the present discounted value of their income is lower after the reforms.

When considering high productivity *senior* workers, i.e., those workers who would have been permanent both before and after the reforms, we find that they are better off with short-term contracts (Table 9). In fact, the productivity threshold above which firms decide to offer a permanent contract is higher, both when upgrading a temporary worker and when hiring a new worker. Therefore, the average productivity level among permanent employees is higher, as well as the average wage. In expectation, the present discounted value of their income is therefore higher. When considering less productive workers, i.e., those workers that were hired permanently before the reforms and short-term after, we find that they are worse off after the reforms. Not only the destruction rate associated with their contract is higher, but also their wage level is lower. Therefore, the present discounted value of their income is lower. These results are only partially in line with the findings of Cahuc and Postel-Vinay (2002), who show that the coexistence of both firing restrictions and fixed-term jobs seemed to improve the well-being of every type of worker, even though aggregate output and aggregate welfare are consistently lower. Yet, even in their model, for high values of the firing costs, the value functions of most types of workers show declining numbers.

Finally, we compute the present discounted value of income accumulated in the lifetime by more and less productive workers. As expected, the average present discounted value of income of less productive workers during their lifetime is lower after the reforms. They are indeed worse off both when *junior* and *senior*. However, surprisingly, even more productive

workers, turn out being worse off after the reforms. Even though they are worse off when *junior* but better off when *senior*, the total present discounted value of income during their lifetime is smaller.

5.1. Policy interventions

In this section we describe a policy intervention which calls for a unique contract, which is open-ended and associated with firing costs increasing with tenure. We study its effects on the distribution of employment and unemployment as well as on the welfare of different categories of workers. We have in mind a contract which is more flexible in the beginning of the worker's career and it gets more rigid as the worker collects work experience with the same employer. This type of policy has been recently implemented in Italy, however the effects are not observable yet. In our model specification, this translates into a contract type similar to the one in the pre-reforms economy, but with firing costs which are lower for *junior* workers and higher for *senior* workers.[23] We use the same calibration values as in the equilibrium model to be able to capture specifically the effect of the change in firing costs.[24] Table 12 illustrates the distribution of employment and unemployment for *junior* as well as *senior* workers whenever the above-mentioned policy is implemented. We can notice that the statistics for all workers are better with the increasing firing costs system compared to the pre-reforms and the post-reforms economies. The effect is particularly relevant for young workers, who face a significantly lower unemployment rate and a higher employment rate. As a side effect, also the labour force participation turns out to be lower. The results are less important for *senior* workers, who face a lower unemployment rate, while the employment rate is rather stable. These findings are due to the fact that since the firing costs are lower

[23]Please see Section 7.3 for details.

[24]We set the firing costs for *junior* workers equal to 0.86 and the ones for *senior* workers to 5.16, the latter as in the equilibrium model. The former value is chosen to reflect the Italian legislation which calls for a minimum firing cost which is 6 times smaller than the maximum firing cost, i.e., 4 month salary and 24 month salary, respectively.

for *junior* workers, the turnover is higher as well as the rate at which workers find a job. Since the job creation effect prevails on the job destruction effect, we observe an increase in employment and a decrease in unemployment. This is reflected only partially on the equilibrium statistics of *senior* workers, for whom the firing costs are unchanged.

In terms of welfare, Table 13 shows the present discounted value of income for all workers. With the policy intervention system, *junior* workers are better off, compared to both the pre-reforms and post-reforms economies. The results are also positive for *senior* workers who enjoy a higher income. Even when we compute the present discounted value of lifetime income, we find that all workers are better off with a system with increasing firing costs, compared to the pre-reforms and post-reforms economies.

We can therefore conclude that a system with a unique open-ended contract associated with firing costs increasing with tenure seems to be beneficial for the Italian labor market. Since this reform has been implemented already, empirical studies can be performed in the near future to confirm these results.

6. Conclusion and Discussion

In this paper we study theoretically and empirically the effect of the introduction of short-term employment contracts on the labour market. The objective is to draw conclusions regarding the change in expected income for different categories of workers.

We present a set of stylised facts regarding the Italian labour market, in line with the evidence provided for other Mediterranean countries. We show that individuals hired short-term are mostly young, female, less educated, poorly qualified and recent college graduates. We provide also evidence that short-term contracts, which are associated with lower wages, often come in sequences. To explain these patterns, we develop a standard Mortensen and Pissarides search model, allowing for workers heterogeneity with respect to productivity and differentiated contracts. We analyse the working careers of individuals before the reforms,

when only permanent contracts are available, and after the reforms, when permanent and short-term contracts coexist.

Using data from Italy, we perform the calibration of the model in order to quantify the change in expected income for different categories of workers. We find that *junior* workers are worse off after the reforms. *Senior* workers, if more productivity, enjoy higher wages and the benefits of permanent contracts. Less productive *senior* workers are hired on a temporary basis in the post-reforms economy. They fall into cycles of unemployment and short-term employment, facing lower salaries. Accounting for the lifetime income, we can additionally identify, in the post-reforms era, a decrease in income for all workers.

The model is then used to study the effects of labour market policy interventions, such as the introduction of a unique permanent contract, more flexible for *junior* workers and less flexible for *senior* workers, as suggested by several economists (Boeri et al., 2013; Bentolila et al., 2012b; Lepage-Saucier et al., 2013; Saint-Paul, 1996).[25] We investigate the effect of this reform and find that *junior* workers are the ones who benefit the most, by enjoying a significantly higher employment rate as well as a lower unemployment rate. The unemployment rate of *senior* workers is also lower, however the employment rate is rather unchanged. In terms of welfare, all workers are better off, when looking both at the present discounted value of income for single categories of workers and at the lifetime income of more and less productive workers.

[25]These economists suggest a system of firing costs, which increase with seniority or job tenure such that younger workers face higher turnover, while the job stability of older workers is partially preserved.

7. Appendix

7.1. Changes in the Italian labour Market Regulatory Framework

In Italy, since 1942 open ended contracts associated with quite rigid EPL and high firing costs represented the traditional legal instrument to hire workers. These contracts are also characterized by the highest wedge between gross salary and labour costs, due to high labour taxes and social security contributions. Since the early 60s, short-term contracts were regulated. They share the same characteristics as the open-ended contracts, but for the limited duration established at stipulation (up to two years, with only one possibility of renewal). Due to strict rules for adoption, which limited significantly the scope for utilization, their percentage was small until the nineties. Two other types of quasi substitute fixed-term contracts were available since the 70s: apprenticeship and *Contratto di Formazione Lavoro* (vocational training contract). They were meant to train individuals to learn a profession and therefore, were specifically designed for young people below the age of 34.[26] They differed in the maximum length of the contract, however both required training to be provided by the employer. The apprenticeship contract was in general longer and demanded more training, compared to the vocational training contract. However, firms were entitled to a reduction in the labour taxes for the workers hired with an apprenticeship contract. Moreover, controls for training were much stricter for apprenticeship and were organized at both national and local levels.

On the wave of liberalization of the European labour markets, in the past two decades many reforms have been approved in Italy to relax the rules for the utilization of fixed-term contracts and several new types of employment contracts (with fixed duration) have been legislated.[27] The objectives of these interventions, in accordance with the European guidelines, were the reduction of unemployment, particularly among young people, the increase of labour

[26]Together they represented less than 10% of the total number of contracts.
[27]See Tealdi (2011) for an extensive description of these reforms.

force participation, and the boosting of employment. Indeed, employment, unemployment, and labour force participation in the nineties in Italy were significantly worse compared to other European countries. Young and long term unemployment rates were higher than the EU average (respectively 31% and 70% compared to 16% and 44%),[28] labour force participation and employment were among the lowest in Europe, particularly among women (44% and 36% compared to the average 54% and 49% among the EU countries).[29] In order to promote the utilization of these new forms of employment contracts, new government subsidies were provided to reduce the relative cost of fixed-term contracts (social security fees) compared to open-ended contracts. Moreover, the shorter and flexible length of fixed-term contracts and the possibility to dismiss the worker at expiration at no cost created additional incentives for their adoption by firms. The combination of more flexible and cheaper hiring/firing decisions, and the lower labour cost burden, was the recipe adopted to trigger a more competitive labour market.

Specifically, three were the major reforms implemented with the objectives of improving labour market flexibility. The first reform known as Legge Treu was approved in 1997. It represents a milestone in the history of the recent Italian labour market. Some of the major innovations brought by Law-196/1997 are the regulation of agency contracts and collabouration contracts and the relaxation of the rules for the utilization of fixed-term contracts and apprenticeships. Few years later, with Law-368/2001, the Italian legal system by implementing a 1999 EU Directive removed the strict rules for adoption of short-term contracts and allowed firms to use short-term contracts under many different circumstances.[30] Prior to

[28] Average rate across 19 European countries. 15-24 years old cohort. Unemployment duration longer than 1 year. Year: 1990. Source: OECD.

[29] Average rate across 19 European countries. Year: 1990. Source: OECD.

[30] According to some scholars (Aimo, 2006; Cappellari et al., 2012), the relaxation of these rules and the liberalization of short-term contracts created a sort of confusion among employers regarding the actual requirements for adoption. Specifically, it was not clear whether employers could use short-term contract also for activities which are not of temporary nature. Moreover, in case of court disputes, the applicability relied too much on the interpretations of the judges, causing delays and disincentives for the adoption of the

2001, the law regulating short-term contracts provided a very specific list of circumstances under which firms could use those contracts, for example seasonal jobs or replacement of workers on sick leave. The new law liberalized the contract by abolishing the detailed list of specific reasons and allowing their utilization for reasons of a technical, organizational, production or replacement nature. In 2003, Law-30/2003, known as *Legge Biagi*, introduced new additional forms of atypical contracts (such as job on call and job sharing) and introduced several modifications to the vocational training contract. However, the main novelty was the relaxation of the rules for the utilisation of apprenticeship contracts. Specifically, the age eligibility was extended and the possibility to perform on the job training within the firm (instead of outsourcing it to specific external institutions) was introduced. These changes were made in order to make the apprenticeship contract more flexible and therefore more appealing for firms, promoting their utilisation.

The market responded positively to this set of reforms and the share of short-term employment increased significantly. In particular, in 2003 the number of short-term employees was more than 20 times bigger than in 1995.[31] While in 1993 the number of short-term contracts as a share of total contracts was approximately 8%, in 2004 it equals approximately 25% of total contracts. Overall, the significant increase in the share of short-term contracts in Italy had strong effects on labour market outcomes and dynamics. It is therefore important to evaluate the impact of the reforms on several aspects of the labour market.

7.1.1. The Worker's Value Functions in the Benchmark Model (Pre-Reforms)

Let W_Y^E denote the expected present value of utility for a *junior* worker currently employed and W_Y^U the present value of utility for a *junior* worker unemployed. Let then W_O^j with $j \in \{N, E\}$ denote the expected present value of utility for an employed *senior* worker

contracts and therefore distorting the objective of the law.

[31] Indeed, 1004 individuals were hired short-term in 1995, while 14505 individuals were hired short-term in 2003. Source: *Work Histories Italian Panel* (WHIP).

in a *new* or *existing* match and W_O^U be the present value of utility for a *senior* worker unemployed.

The present discounted values of utility of unemployed *junior* and *senior* workers satisfy the following equations:

$$rW_Y^U = b + \mu_y[W_Y^E - W_Y^U], \tag{21}$$

$$rW_O^U = b + \mu_o \int_{\underline{y}}^{\overline{y}} \left[\max(W_O^N(y), W_O^U) - W_O^U\right]. \tag{22}$$

The first term on the right-hand side of both equation is the unemployment benefit, while the second is the probability to form a match with an employer times the change in value from unemployment to employment. Notice that for *senior* workers (Eq. 22), if the productivity level is below the threshold y^n, the worker does not get the job and stays unemployed.

The present discounted value of utility of employed *junior* and *senior* workers reads as:

$$rW_Y^E = w_y + \delta[W_Y^U - W_Y^E] + \lambda \int_{\underline{y}}^{\overline{y}} \left[\max(W_O^E(y), W_O^U) - W_Y^E\right], \tag{23}$$

$$rW_O^E(y) = w_o^E(y) + \delta[W_O^U - W_O^E(y)] + s^p[W_O^{OLF} - W_O^E(y)], \tag{24}$$

$$rW_O^N(y) = w_o^N(y) + \delta[W_O^U - W_O^N(y)] + s^p[W_O^{OLF} - W_O^N(y)], \tag{25}$$

where

$$rW_Y^{OLF} = 0,$$

$$(r+d)W_O^{OLF} = \pi.$$

The *junior* worker receives the wage associated with his productivity level y_0 until his pro-

ductivity is revealed at rate λ; at that point, he can either move to a *senior* position or join the unemployment pool, if his productivity level turns out to be below the threshold y^e. Moreover, the match may be destroyed at rate δ and his utility may change from employment to unemployment (Eq. 23). The *senior* worker receives the wage associated with the productivity level y until he retires, at rate s, in which case he exits the labour force or until a shock hits the match and the worker's utility changes from employment to unemployment.

7.1.2. Equilibrium conditions in the Benchmark Model (Pre-Reforms)

Let y^e be the productivity threshold above which a *junior* worker who is turning *senior* is offered a permanent contract. If the productivity of the worker happens to be below the threshold ($y < y^e$), the worker is fired and the firm pays the firing cost F. In case of *senior* workers hired from unemployment, for a value of productivity equal to y^n, the firm is indifferent whether to offer a permanent position or to keep a vacancy without incurring in any cost.

$$y^e = (r+s)W_O^U - (r+s)F - sW_O^{OLF}, \tag{26}$$

$$y^n = (r+s)W_O^U + \delta F - sW_O^{OLF}. \tag{27}$$

7.1.3. The Worker's Value Functions in the Model with Short-term Contracts

From the workers' point of view, we can define the value of being unemployed for *junior* and *senior* workers as:

$$rW_Y^U = b + \mu_y \max\{(W_Y^P, W_Y^S) - W_Y^U), \tag{28}$$

$$rW_O^U = b + \mu_o \int_{\underline{y}}^{\overline{y}} \max\left[(W_O^{NP}(y), W_O^S(y), W_O^U) - W_O^U\right] \, dH. \tag{29}$$

The Bellman equations for employed *junior* and *senior* workers are:

$$rW_Y^P = w_y + \lambda \int_{\underline{y}}^{\overline{y}} \max\left[(W_O^{OP}(y), W_O^U(y)\right] - W_O^U \, dH + \delta[W_Y^U - W_Y^S], \tag{30}$$

$$rW_Y^S = w_y + \lambda \int_{\underline{y}}^{\overline{y}} \max\left[(W_O^{OP}(y), W_O^S(y)\right] - W_O^U \, dH + t[W_Y^U - W_Y^S], \tag{31}$$

$$rW_O^{NP} = w_o^{np} + \delta[W_O^U - W_O^{NP}] + s^p[W_O^{OLF} - W_O^{NP}], \tag{32}$$

$$rW_O^{OP} = w_o^{op} + \delta[W_O^U - W_O^{OP}] + s^p[W_O^{OLF} - W_O^{OP}], \tag{33}$$

$$rW_O^S = w_o^s + t[W_O^U - W_O^S] + s^p[W_O^{OLF} - W_O^S], \tag{34}$$

where

$$rW_Y^{OLF} = 0, \tag{35}$$

$$(r+d)W_O^{FL} = \pi + \gamma(W_O^{UL} - W_O^{FL}), \tag{36}$$

$$(r+d)W_O^{FH} = \pi. \tag{37}$$

7.1.4. Equilibrium Conditions in the Model with Short-term Contracts

In case of *senior* workers, we compute the optimal threshold level y^e above which a *junior* worker who is turning *senior* is offered a permanent contract. If the productivity of the worker happens to be below the threshold y^e, the worker is kept within the short-term contract until expiration (at rate t) and fired then at zero cost. In case of *senior* workers hired from unemployment, two are the optimal thresholds levels of productivity for the firms. For values of productivity above y^{nh}, the worker is hired on a permanent basis; for values of productivity between y^{nh} and y^{nl}, the worker is hired on a short-term contract, and below the threshold y^{nl}, for the firm is optimal to keep a vacancy. Indeed in case of very productive workers, for the firm is optimal to offer a permanent contract since the destruction rate is lower and the surplus is higher. In case of low productivity workers, since the surplus of the match is negative, the firm prefers to keep the vacancy open. Finally, for workers with intermediate productivity level, the optimal strategy is to offer a short-term contract, which is cheaper.

$$y^e = (r+s^p)W_O^U - s^p W_O^{OLF} + \frac{(r+t+s^p)(\beta(r+s^p)+\delta)F}{(1-\beta)(t-\delta)}, \tag{38}$$

$$y^{nh} = (r+s^p)W_O^U - s^p W_O^{OLF} + \frac{(r+t+s^p)\delta F}{(t-\delta)}, \tag{39}$$

$$y^{nl} = (r+s^s)W_O^U - s^s W_O^{OLF}. \tag{40}$$

7.2. Sensitivity analysis

We analyse in this section the robustness of the results to perturbations of few key parameters such as the match-destruction shock δ and the rate at which the productivity is revealed, λ (Table 10).

We consider the way labour force statistics change when we perturb the parameter of

the match-destruction shock for workers hired on a permanent contract, δ. We allow the parameter to vary in a range from 0.005 to 0.01. The change in the parameter's value affects all workers pre-reforms and *senior* workers post-reforms. Table 10 shows that as δ increases, unemployment increases for all workers, while employment decreases. While changes are negligible for workers in the pre-reforms economy, *senior* workers post-reforms are the ones who are mostly affected. Overall, the statistics are not too sensitive to variation of δ.

Then, we analyse the changes registered in the labour force statistics when we vary λ in a range from 0.04 to 0.06. *Junior* workers pre-reforms and post-reforms are affected by the perturbation of this parameter and the statistics are quite sensitive to the changes. Particularly, employment and labour force participation are the ones which are subject to higher fluctuations. As λ increases, employment decreases and unemployment increases. Labour force participation overall decreases significantly.

Then, we perturbate the parameter k, which represents the elasticity of the matching function with respect to unemployment (Table 11). All workers pre-reforms and post-reforms are affected. We allow k^y to vary between 0.05 and 0.25, and k^o to vary from 0.2 to 0.4. While employment increases, both unemployment and labour force participation decrease as k increases. However, for all workers the magnitude of the changes is quite small. Therefore, results are quite robust to the changes of the elasticity of the matching function with respect to unemployment.

7.3. The Model with lower firings costs for junior workers

The model is the same as the benchmark model, except for the different firing costs across categories of workers. In this setup, we assume that only permanent contracts are available and firing costs $F > 0$ need to be paid by the firm in case of dismissal of *senior* workers,

while firing costs $F_0 < F$ need to be paid by the firm in case of dismissal of *junior* workers.[32]

The firm's Bellman equations for a filled position read:

$$rJ_Y^E = y_0 - w_y + \delta[J_Y^V - F_0 - J_Y^E] + \lambda \int_{\underline{y}}^{\overline{y}} \left[\max(J_O^E(y), J_O^V - F_0) - J_Y^E\right] \, dH, \quad (41)$$

$$rJ_O^j(y) = y - w_o^j(y) + \delta[J_O^V - J_O^j(y) - F] + s^p[J_O^V - J_O^j(y)]. \quad (42)$$

Let y_p^e be the productivity threshold above which a *junior* worker who is turning *senior* is offered a permanent contract. If the productivity of the worker happens to be below the threshold ($y < y_p^e$), the worker is fired and the firm pays the firing cost F_0. In case of *senior* workers hired from unemployment, for a value of productivity equal to y_p^n, the firm is indifferent whether to offer a permanent contract or to keep a vacancy without incurring in any cost.

$$y_p^e = (r+s)W_O^U - sW_O^{OLF} - \frac{1}{(1-\beta)}[(r+s+\delta)F_0 - \beta(r+s)F - \delta F], \quad (43)$$

$$y_p^n = (r+s)W_O^U + \delta F - sW_O^{OLF}. \quad (44)$$

7.4. Extension: the Search Model with Match Specific Productivity

We consider an extension of the previous model in which we relax the assumption that the productivity of the workers is permanent. While the productivity of *junior* workers still remains the entry level productivity y_0, we allow the productivity of *senior* workers to have two components: a fixed component, y, and a match specific component, ϵ. The fixed component characterises the productivity of the workers, who are high productivity

[32]Following 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, they can be considered as equivalent to a separation tax.

$(y = y^H)$ with probability p and low productivity $(y = y^L)$ with probability $(1 - p)$, where $y^H > y^L$. The match specific component ϵ is a mean zero random variable, which is drawn every time a *senior* worker meets a firm, and identifies the goodness of the match. This assumption overcomes the dichotomous simplification of the previous model (post-reforms) where in equilibrium high productivity workers will always be hired on a permanent basis, while low productivity workers will always fall into cycles of short-term employment and unemployment. In this new scenario, *senior* low productivity workers may still have a chance to be hired on a permanent contract, if they find a good match, i.e., the newly drawn ϵ is high enough to compensate for the low y. While the equilibrium of the pre-reforms economy is unchanged, in the post-reforms economy only the labour market for *junior* individuals is not affected by the new assumptions. All *senior* workers may now be hired on any of the two contracts, according to the goodness of the fit. Specifically, both low and high productivity workers may experience several cycles of short-term employment and unemployment before finding eventually a good match; however in expectation the waiting time until stability is shorter for high productivity workers. The wages reflect the higher total productivity (aggregate and idiosyncratic) associated with permanent compared to short-term contracts. By calibrating this version of the model, we get similar results with respect to *junior* workers: they are worse off in the post-reforms economy. Indeed, they experience sequences of short-term employment associated with a low salary and unemployment. On the other hand, high productivity workers are better off when short-term contracts are available, confirming the results of the previous model, since they might spend some time as temporary workers, but they will eventually find a good match and enjoy a higher wage. Finally, in this scenario the welfare of low productivity workers crucially depends on the reservation productivity of low productivity workers, and ultimately on the productivity gap between high and low productivity workers. If the gap is quite important, the probability that low productivity workers find a good match is low and therefore on average they will be worse off. On the

contrary, if the productivity gap is not too big, low productivity workers have good chances to eventually find a good match after spending time on temporary employment despite their low aggregate productivity and therefore they will be able to enjoy a higher salary. They will be better off.[33]

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[33]Numerical simulations can be provided upon request.

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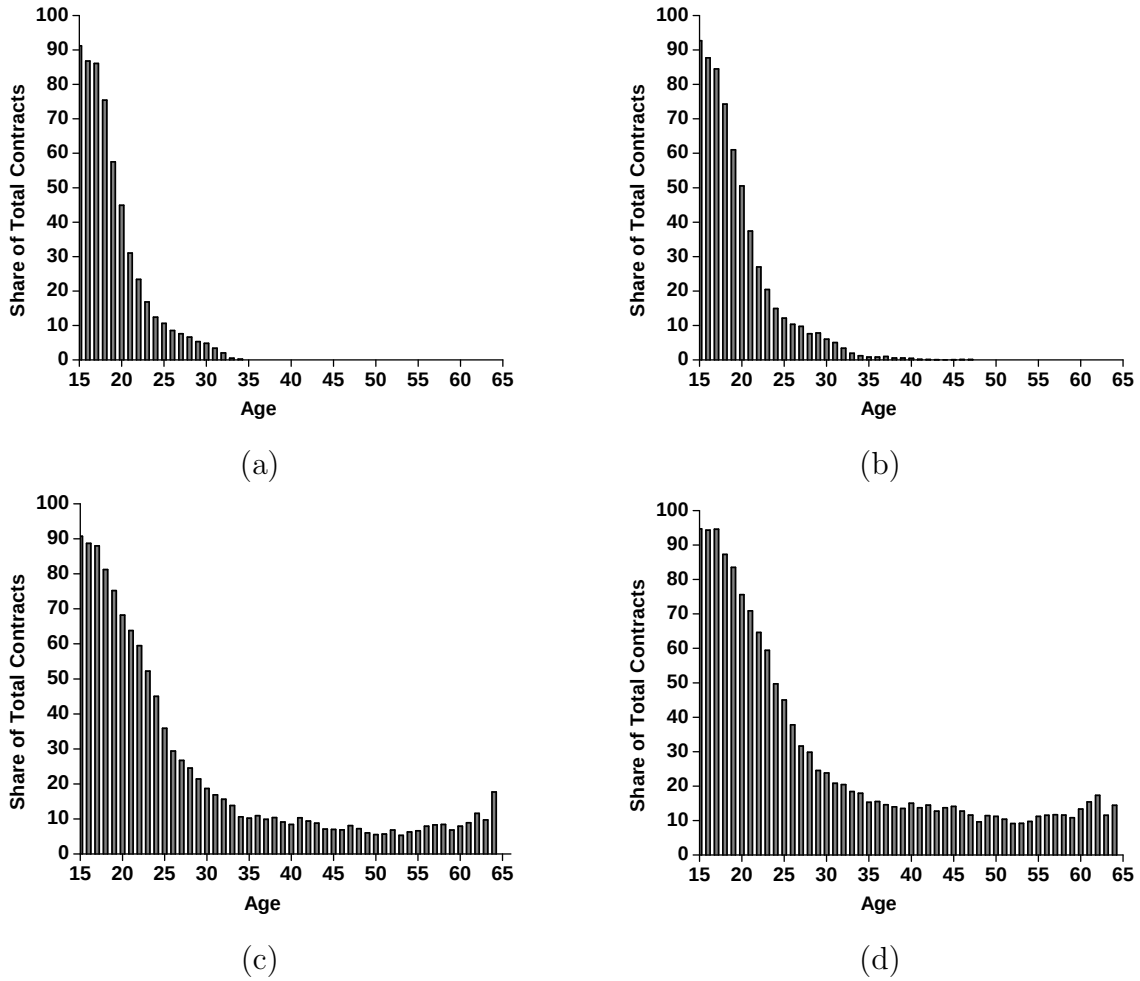

Figure 1: Short-term contracts age distribution in years (a) 1995, (b) 1997, (c) 2000, and (d) 2004.

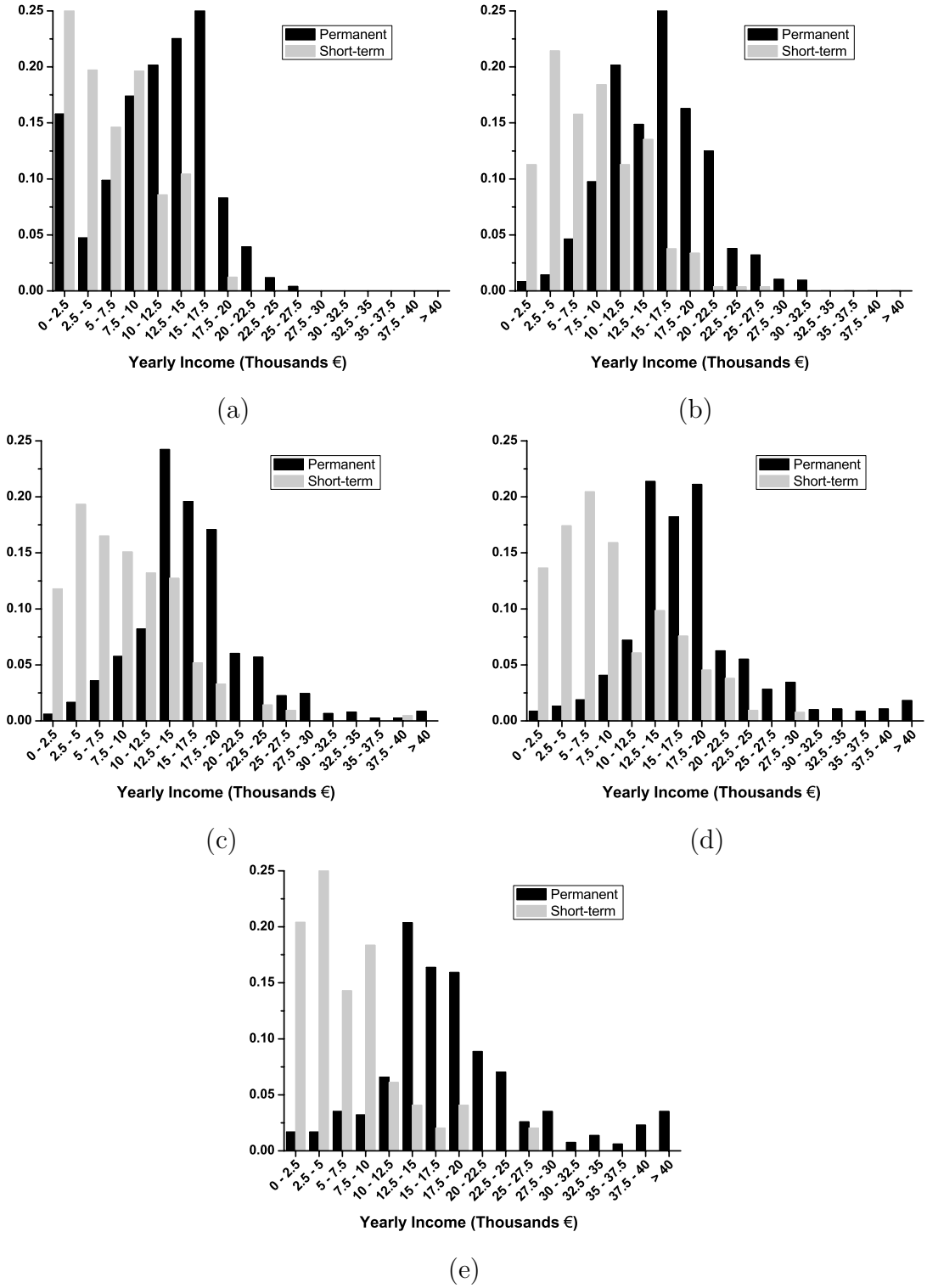

Figure 2: Distribution of yearly net income in Euro for workers in permanent and short-term contracts by age groups (a) 15-24, (b) 25-34, (c) 35-44, (d) 45-54, and (e) 55-64.

Table 1: Distribution of contracts (2006).

	Share of population (%)	Long term (%)	Short term (%)
Qualification			
Blue collar	49.06	82.34	15.05
White collar	35.59	92.05	7.95
Teacher	6.77	80.58	19.42
Junior manager	6.09	92.62	7.38
Senior manager	2.49	98.49	1.51
Age			
15 - 24	6.27	58.55	41.45
25 - 34	23.49	80.14	19.86
35 - 44	34.85	88.02	11.98
45 - 54	25.66	92.12	7.88
55 - 64	9.73	92.05	7.95
Gender			
Male	57.53	86.59	13.41
Female	42.47	84.65	15.35
Education			
No education	0.23	38.82	61.18
Primary	5.07	77.35	22.65
Junior high	33.39	84.26	15.74
Vocational	10.03	87.27	12.73
High school	37.80	87.57	12.43
3 year Bachelor's	1.73	84.97	15.03
5 year Bachelor's	11.45	87.62	12.38
Postgraduate	0.30	86.40	13.60
Geographical location			
North	53.90	88.98	11.02
Center	19.09	89.93	10.17
South	27.01	76.47	23.53

Table 2: Probit regression (2006).

	Short-term	Short-term	Short-term	Short-term	Short-term
Female	0.045***	0.047***	0.056***	0.061***	0.061***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
South	0.122***	0.121***	0.115***	0.109***	0.110***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Bachelor's	0.013	0.016			
	(0.011)	(0.012)			
Manager	-0.051***	-0.057***	-0.046***	-0.072***	-0.071***
	(0.009)	(0.009)	(0.011)	(0.006)	(0.006)
White Collar				-0.066**	-0.068***
				(0.007)	(0.007)
Teacher				-0.055***	-0.049***
				(0.008)	(0.009)
Age	-0.004***				
	(0.000)				
Age Group 15 - 24		0.191***	0.202***	0.184***	0.175***
		(0.022)	(0.023)	(0.022)	(0.022)
Age Group 25 - 34		0.068***	0.076***	0.070***	0.055***
		(0.010)	(0.070)	(0.010)	(0.010)
Master's			0.043	0.059	0.058
			(0.133)	(0.125)	(0.131)
5 Year Bachelor's			0.056***	0.072***	0.023
			(0.016)	(0.018)	(0.019)
3 Year Bachelor's			0.033	0.046	0.043
			(0.038)	(0.040)	(0.039)
Primary/Junior High			0.052***		0.011
			(0.008)		(0.009)
Primary				0.048***	0.042***
				(0.015)	(0.015)
No Education			0.260***	0.144***	0.136***
			(0.065)	(0.053)	(0.052)
Bachelor's * Age 25-34					0.121***
					(0.041)
Number of observations	6193	6055	6055	6055	6055

NOTES: "Short-term" takes value 1 if the contract is short-term and value 0 otherwise. Bachelor's 25 - 34 is an interaction variable, which captures the category of people with a Bachelor's or higher degree belonging to the 25 - 34 age group.
Standard errors in parenthesis.
** and *** denote significance at the 5% and 1% level respectively.

Table 3: Log wage regression (2006).

	Log wage	Log wage	Log wage	Log wage	Log wage
Permanent	0.223***	0.194***	0.194***	0.205***	0.205***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Male	0.271***	0.261***	0.253***	0.249***	0.249***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.101)
South	-0.122***	-0.113***	-0.100***	-0.094***	-0.094***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Bachelor's	0.235***	0.175***	0.176***	0.173***	
	(0.014)	(0.014)	(0.014)	(0.014)	
Manager		0.238***	0.232***	0.237***	0.235***
		(0.027)	(0.018)	(0.018)	(0.018)
Age	0.228***	0.893***	0.856***		
	(0.000)	(0.003)	(0.003)		
Age^2		-0.688***	-0.655***		
		(0.000)	(0.000)		
Size			0.084***	0.087***	0.087***
			(0.011)	(0.011)	(0.011)
Age Group 15 - 24				-0.167***	-0.167***
				(0.020)	(0.020)
Age Group 25 - 34				-0.141***	-0.140***
				(0.012)	(0.012)
Master's					0.050***
					(0.093)
5 Year Bachelor's					0.163***
					(0.015)
3 Year Bachelor's					0.052***
					(0.041)
Constant	6.314***	5.818***	5.830***	6.742***	6.742***
	(0.023)	(0.066)	(0.066)	(0.017)	(0.017)
Number of observations	5795	5696	5694	5694	5694
R^2	0.254	0.315	0.322	0.314	0.314

NOTES: *** denotes significance at the 1% level.

Table 4: Workers transiting from/to short-term contracts (as a % of workers hired on a short-term basis).

			1995	2000	2003
First job			0.3137	0.0391	0.0307
Panel A: Transitions to the short-term contract					
Non-employment			0.4702	0.0686	0.0754
Short-term	⇒	Short-term	0.0777	0.8384	0.8549
Long-term			0.1384	0.0539	0.0390
Panel B: Transitions from the short-term contract					
Short-term (first job)	⇒	Non-employment	0.4730	0.4037	0.4596
		Short-term	0.2952	0.4754	0.4350
		Long-term	0.2317	0.1209	0.1054
Short-term (not first job)	⇒	Non-employment	0.4804	0.2787	0.2977
		Short-term	0.2917	0.4635	0.4717
		Long-term	0.2279	0.2579	0.2307
Number of observations			1004	12467	14505

Table 5: Model parameters.

Parameter	Description
δ	Rate at which the permanent match is destroyed.
F	Firing costs.
c	Vacancy cost.
h_y	Matching efficiency for *junior* workers.
h_o	Matching efficiency for *senior* workers.
κ_y	Elasticity of the matching function w.r.t. unemployment for *junior* workers.
κ_o	Elasticity of the matching function w.r.t. unemployment for *senior* workers.
θ_y	Market tightness for *junior* workers.
θ_o	Market tightness for *senior* workers.
β	Worker's share of surplus.
λ	Rate at which the productivity is revealed.
s	Rate at which workers retire.
t	Rate at which temporary contracts expire.
b	Unemployment benefits.
r	Interest rate.
m	Rate at which *junior* individuals join the labour force.
d	Rate at which people die.
a	Lower bound of the distribution.
b	Upper bound of the productivity (uniform) distribution.
y_0	Productivity level of *junior* workers.
k	Measure of individuals born each instant.
π	Utility out of the labour force.

Table 6: Calibration parameter values.

Parameter	Pre-reforms	Source	Post-reforms
δ	0.0085	Pries and Rogerson (2005); Faccini (2014).	0.0085
F	5.10	Pries and Rogerson (2005); Faccini (2014); Boeri and Burda (2007).	5.10
c	0.15	Boeri and Burda (2007).	0.15
h_y	0.38	Peracchi and Viviano (2004).	0.38
h_o	0.22	Peracchi and Viviano (2004).	0.22
κ_y	0.15	Peracchi and Viviano (2004).	0.15
κ_o^p	0.29	Peracchi and Viviano (2004).	0.29
θ_y	0.25	Peracchi and Viviano (2004).	0.002
θ_o	0.55	Peracchi and Viviano (2004).	0.92
β	0.50	Petrongolo and Pissarides (2001).	0.50
λ	0.05	Blanchard and Landier (2002); Dolado et al. (2007).	0.05
s	0.018	Blanchard and Landier (2002); Ichino et al. (2013).	0.014
b	0.15	Dolado et al. (1996).	0.28
t		Cappellari et al. (2012)	0.1
r	0.004	To match statistics.	0.004
m	0.046	To match statistics.	0.046
d	0.03	To match statistics.	0.03
a	0	To match statistics.	0
b	5	To match statistics.	5
y_0	2.80	Normalized.	2.80
k	100	Normalized.	100
π	0.10	Normalized.	0.10

Table 7: EPL strictness and replacement ratio by country.

Country	EPL Strictness	Replacement Ratio
United States	0.7	0.50
United Kingdom	0.9	0.38
Denmark	1.5	0.90
Finland	2.1	0.63
Sweden	2.6	0.80
Germany	2.6	0.63
France	2.8	0.57
Spain	3.1	0.70
Italy	**3.4**	**0.20**
Portugal	3.7	0.65

Sources: OECD and Dolado et al. (1996).

Table 8: Labour market statistics: data versus model.

	Data		Model	
	Pre-reforms	Post-reforms	Pre-reforms	Post-reforms
Junior workers				
Employment rate	0.3940	0.3900	0.3910	0.3991
Unemployment rate	0.1850	0.1650	0.1840	0.1672
Out of labour force rate	0.4230	0.4450	0.4250	0.4338
Average wage (in e)	1,050	1,120	$1,053$	$1,050$
Senior workers				
Employment	0.5820	0.6500	0.5715	0.6555
Unemployment	0.0480	0.0540	0.0475	0.0605
Out of labour force	0.3700	0.2960	0.3810	0.2840
Average wage (in €)				
Permanent	1,570	2,040	1,689	2,025
Temporary	$--$	1,370	$--$	1,131

Table 9: Present discounted value of income by worker's types

	Pre-reforms	Post-reforms
Present value of income of employed workers		
Junior	54.70	27.99
Senior Permanent Ongoing	53.65	82.73
Senior Permanent New	52.30	79.59
Senior Temporary	−−	9.91
Present value of lifetime income		
Permanent	60.75	33.85
Temporary	−−	10.20

Table 10: Sensitivity analysis (job destruction and productivity shocks).

	δ					λ				
	0.0050	0.0060	0.0085	0.0090	0.01	0.04	0.045	0.05	0.055	0.06
Pre-reforms-*junior*										
Employment	0.3941	0.3929	0.3910	0.3891	0.3879	0.4428	0.4153	0.3910	0.3694	0.3500
Unemployment	0.1775	0.1801	0.1840	0.1879	0.1905	0.1722	0.1785	0.1840	0.1890	0.1934
Out of the labour Force	0.4284	0.4270	0.4250	0.4229	0.4216	0.3850	0.4062	0.4250	0.4416	0.4566
Post-reforms-*junior*										
Employment						0.4424	0.4196	0.3991	0.3804	0.3635
Unemployment						0.1730	0.1699	0.1672	0.1647	0.1624
Out of the labour Force						0.3847	0.4105	0.4338	0.4549	0.4741
Pre-reforms-*senior*										
Employment	0.5783	0.5756	0.5715	0.5675	0.5649					
Unemployment	0.0362	0.0407	0.0475	0.0541	0.0585					
Out of the labour Force	0.3855	0.3837	0.3810	0.3784	0.0585					
Post-reforms-*senior*										
Employment	0.6689	0.6637	0.6555	0.6466	0.6404					
Unemployment	0.0413	0.0487	0.060	0.0732	0.0821					
Out of the labour Force	0.2898	0.2876	0.2840	0.2802	0.2775					

Table 11: Sensitivity analysis (elasticity with respect to unemployment).

	k^y					k^o				
	0.05	0.10	0.15	0.20	0.25	0.20	0.25	0.30	0.35	0.40
Pre-reforms-*junior*										
Employment	0.3804	0.3856	0.3910	0.3954	0.3999					
Unemployment	0.2062	0.1953	0.1840	0.1749	0.1653					
Out of the labour Force	0.4134	0.4191	0.4250	0.4297	0.4347					
Post-reforms-*junior*										
Employment	0.3985	0.3988	0.3991	0.3993	0.3996					
Unemployment	0.1684	0.1678	0.1672	0.1667	0.1661					
Out of the labour Force	0.4331	0.4334	0.4338	0.4340	0.4343					
Pre-reforms-*senior*										
Employment						0.5699	0.5707	0.5715	0.5723	0.5731
Unemployment						0.0502	0.0488	0.0475	0.0461	0.0448
Out of the labour Force						0.3799	0.3805	0.3810	0.3816	0.3821
Post-reforms-*senior*										
Employment						0.6230	0.6413	0.6555	0.6662	0.6744
Unemployment						0.1070	0.0807	0.0605	0.0451	0.0334
Out of the labour Force						0.2700	0.2779	0.2840	0.2887	0.2922

Table 12: Policy intervention - Labour force statistics.

	Pre-reforms	Post-reforms	Increasing firing costs
Junior workers			
Employment rate	0.3910	0.3991	0.4382
Unemployment rate	0.1840	0.1672	0.0856
Out of the labour force rate	0.4250	0.4338	0.4763
Senior workers			
Employment rate	0.5715	0.6555	0.6552
Unemployment rate	0.0475	0.0605	0.0391
Out of the labour force rate	0.3810	0.2840	0.3057

Table 13: Policy intervention - Welfare.

	Pre-reforms	Post-reforms	Increasing firing costs
Present value of income			
Junior workers	54.70	27.99	64.72
Senior Permanent Ongoing	53.75	82.73	94.94
Senior Permanent New	52.30	79.59	92.72
Senior Temporary	−−	9.91	−−
Present value of lifetime income			
Permanent	60.75	33.85	91.64
Temporary	−−	10.20	−−