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How much flexibility do we need?

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Abstract Short-term contracts have been deployed rapidly across Europe since the mid 90s. The objective of this paper is to investigate both theoretically and empirically the effects of short-term contracts on individual welfare. By comparing the economy pre and post-reforms, we study the evolution of firms' and workers' dynamics, we identify the determinants behind the firms' decision to hire short-term, and we quantify the change in welfare for different categories of workers. We find that more productive workers fare better, while junior and less productive workers pay the cost of higher turnover and lower wages, confirming the presence of a dual economy. The study of potential policy interventions allows us to conclude that the longer the short-term contracts, the better the labor market outcomes. In addition, the comparison of the models pre and post-reforms with an American-style economy with a unique flexible contract, seems to suggest that flexibility has positive effects on the labor market for junior workers, but not necessarily on the one for senior workers.

1 Introduction

The recent economic downturn has caused a remarkable increase in unemployment rates both in North America and Europe. Throughout the recent economic history, high unemployment rates have been on the economic reform agenda of nearly all countries. In particular, young workers face considerably higher unemployment rates than prime-age workers. This has further increased the urgent need to identify solutions for increasing employment among this demographic group. The Bureau of Labor Statistics reported that "[..] in US historically one out of every eight young workers was unemployed, a rate of unemployment more than two and a half times that of prime-age workers". In Europe the numbers appear even

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more dramatic. Short-term employment contracts, characterized by flexible employment features, were thought to be the solution, and have been deployed rapidly in particular across the rigid EU economies. Featuring short duration, lower costs, and more straightforward hiring procedures, they are designed to be an agile instrument to increase labor market flexibility and, in turn, to reduce unemployment. In this respect, Italy represents an excellent case study because of the abrupt increase in the share of short-term contracts in the mid-nineties, followed by a sharp decrease in the unemployment rate, in particular among young workers.

The objective of this paper is to perform a welfare analysis, by comparing the average income of different groups of individuals before and after the introduction of short term contracts. The analysis of the changes registered in the labor market since the mid 1990s is the basis for developing two search models, which explain the workers and firms behavior when different types of contracts are available. The calibration of the models allows us to draw conclusions regarding the income change and to evaluate the effects of several policy interventions.

In agreement with the findings of Tealdi (2010), we use data from Bank of Italy and the National Social Security Institute to show that people hired short-term tend to be young, female, inexperienced, less educated, and poorly qualified. The data indicate the existence of a substantial wage "premium" for workers hired permanently, which is present even when differences in education level, gender, age, working sector, geographical location, and occupation are taken into account. We show that labor force participation and employment are higher for older workers after the reforms. However, lower unemployment rates among young workers come as a consequence of lower labor force participation.

We design two search model in the spirit of Diamond (1982), Mortensen (1984), and Pissarides (2000), which we extend by allowing workers' heterogeneity, social security contribution, and differentiated contracts. The first model describes a pre-reforms economy, characterized solely by permanent contracts and no possibility of firing; the second model describes a post-reforms economy, featuring the availability of short-term contracts, which implies a higher degree of flexibility. In this set up, workers are heterogeneous with respect to productivity. We consider two labor markets, one for for *junior* workers, at the early stage of their working career and whose productivity is not yet observed, and one for *senior* workers, who have already accumulated work experience and whose productivity is observed. In the pre-reforms economy, the inability for firms to fire workers causes the labor market to be rather rigid and determines the creation of a pool of permanently employed workers, with both high and low level of productivity. This pooling is reflected in the wage, which is a weighted average of the productivity of the two categories. In the post-reforms economy, given the availability of short, cheaper, and more flexible short-term contracts, it is more profitable for firms to hire *junior* workers for a short period of time, when they first join the labor force. They might experience several sequences of short-term employment and unem-

ployment before their productivity is observed. Only when they are revealed to be more productive, the firm maximizes its profit by upgrading them to a permanent contract. Less productive workers will keep working short-term, alternating spells of unemployment and temporary work.

The models are able to replicate closely the changes regarding the Italian labor market composition. Performing the calibration of both models, we recreate the working careers of different groups of workers and we compute their average income. We find that, on average, workers spend more time within the labor force after the reforms. In addition, we detect a substantial increase in wages and in income among more productive *senior* workers. In contrast, *junior* workers as well as less productive experienced workers are worse off in the post-reforms economy. In particular, less productive workers are the ones paying the cost of lower wages and higher turnover. By considering the entire working career of the individuals of both productivity levels, we find that after the reforms the present value lifetime income is lower for less productive workers, but higher for more productive workers.

There are several strands of literature related to this paper.

First of all, this study is linked to papers, which empirically analyze short-term employment contracts and their impact on European labor markets. Berton et al. (2007) and Guell and Petrongolo (2007) study the way short-term contracts have changed the pattern dynamics across states and contracts. Specifically, their objective is to identify the role of short-term contracts: as screening device or as an instrument for firms to reduce costs. Their results show that both in Italy and in Spain short-term contracts are used for both purposes. In addition, Pfeifer (2009) shows that in Germany short-term contracts are utilized by firms to adjust the workforce according to business cycle fluctuations. Berton (2008) investigates whether short-term contracts have been effective in reducing the high rate of long-term unemployment in Italy. His findings provide a negative answer; however, Guell (2000) finds that in Spain the rate at which workers leave unemployment is higher after the reforms. Regarding the effect of short-term contracts on employment, Giannelli et al. (2009) show that in Italy short-term contracts did not help increase the length of the first employment spell and they are associated with high uncertainty. However, Aguirregabiria and Alonso-Borrego (2009) state that in Spain short-term contracts had a positive effect on employment and job turnover. This paper complements the existing literature, by providing a complete analysis of the changes in the labor market since the mid-nineties in Italy, when short-term contracts were introduced. This paper provides a thorough description of the characteristics of workers hired on a short-term basis and the evolution of labor force composition, transition patterns, and wages for different categories of workers.

From a theoretical point of view, a number of papers develop models to study the effect of short-term contracts on the labor market and, in particular, on employment and unemployment (Hopenhayn and Rogerson (1993), Cao et al. (2011), Berton and Garibaldi (2006), Boeri (2011), Wasmer (1999)). Specif-

ically, Barbieri and Scherer (2009) and Nunziata and Staffolani (2001) show that the total employment rate did not increase in Italy as a consequence of the introduction of short-term contracts, but permanent employment has been replaced by temporary employment. Cahuc and Postel-Vinay (2002) find that the combination of short-term contracts and high firing costs causes high unemployment and reduced efficiency. Other papers focus on the effect of short-term contracts on job turnover (Bentolila et al. (2010), Bentolila et al. (1994), Serrano (1998), Bentolila and Saint-Paul (1992), Cabrales and Hopenhayn (1997)). If on one side the conclusion on the effect of short-term contracts on employment is controversial, the main agreeable finding is that job turnover has increased significantly after the introduction of temporary contracts. In contradiction with the empirical literature, which support the hypothesis that short-term contracts are used as a screening mechanism, as a way to reduce costs, and as a buffer during business cycles slowdowns, Portugal and Varejao (2003) and Faccini (2008) find that the main reason why firms use short-term contracts is to screen workers to fill permanent positions. However, among the cited articles, only the paper by Cahuc and Postel-Vinay (2002) studies the effects on welfare, defined as the measure of the economy's total output net of the recruiting cost. In the literature, there is no paper which performs an individual welfare analysis to understand which are the categories of workers who are benefiting and which ones are penalized. This paper represents the first attempt to quantify the change in individual welfare due to the introduction of short-term contracts for different groups of workers.

The theoretical framework designed by Blanchard and Landier (2002) is the one that most closely resembles the models described in this paper. The authors use a search model to investigate whether the introduction of short-term employment contracts, common mostly among young workers, reduced the income of workers of age 20-24 in France. We extend their set up in several directions. First of all, we consider two different typologies of contracts, permanent, characterized by unlimited duration, and short-term, whose termination is established at stipulation. Second, we design an economy pre-reforms, when only permanent contracts are available, and an economy post-reforms, when both permanent and short-term contracts are present. This allows us to compare the economy pre and post reforms, to illustrate the allocation mechanism of workers into different contract typologies, and to quantify the change in income. Moreover, by including the whole sample of workers (not only young), we are able to draw welfare conclusions among individuals who belong to different age groups. In addition, we extend the search model of Mortensen and Pissarides (1994) used by Blanchard and Landier (2002) to allow for heterogeneity on the side of the workers, social security fees to be paid by the firm to guarantee benefits for the workers, and differentiated contracts to analyze the driving forces behind the decisions of firms to choose permanent versus short-term contracts.

This paper is organized as follows: Section 2 provides an overview of the regulatory framework characterizing the Italian labor market in the last two decades. Section 3 describes the data sources and

presents a summary of the results of the empirical analysis regarding changes in labor force composition, transitions, and wages performed by Tealdi (2010). Section 4 describes the search models. Section 5 presents the calibration approach to test the models. According to the findings, in Section 6 we provide conclusions regarding the change in welfare for different categories of workers, we perform the sensitivity analysis, and we discuss the effects of potential policy changes. The last section (Section 7) concludes the paper and discusses future research.

2 Changes in the Italian Labor Market Regulatory Framework

Since 1995 many reforms have been approved in Italy[1] with the specific intent of increasing labor market flexibility. To achieve this goal, short-term employment contracts have been introduced as a versatile instrument. Specifically, the objectives of the interventions, in accordance with the European guidelines, can be summarized in the following key points: increasing labor force participation, boosting employment, and reducing unemployment, particularly among young people. Indeed, in the nineties, the Italian labor market statistics regarding employment, unemployment, and labor force participation were much worse compared to other European countries. The labor force participation rate was one of the lowest in Europe, particularly among women (44% compared to the average 54% among the EU countries[2]); young and long term unemployment rates were very high (31% and 70% respectively compared to the average 16% and 44% among the EU countries)[3] and the employment rate was quite low, particularly among women (36% compared to the average 49% among the EU countries[4]). The Italian government promptly implemented new reforms to help, particularly, the weakest groups of workers: women, young, unemployed and low educated. Due to the nature of short-term contracts and due to government subsidies their costs were much lower compared to permanent contracts. These features would have allowed firms to manage their workforce in a more flexible way according to specific needs, and would have reduced the cost burden pending on the employers, triggering a more competitive market.

In Italy short-term contracts were already present in the 60s, but they were underutilized until 1995, when for the first time new forms of limited length contracts were independently regulated. Before 1995, only two types of quasi substitute short-term contracts were available: apprenticeship and CFL (vocational contracts). Together they represented less than 10% of the total number of contracts. Their objective was dual. Not only they were a flexible labor instrument for firms, but they also included a

[1] See Tealdi (2011) for an extensive description of these reforms.

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

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

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

remarkable amount of training on the job for workers.[5] It is extremely important to clarify that for both contract types the age limit was strictly enforced, they were specifically designed for young people. The age threshold changed over time since their introduction, however individuals older than 34 years old could not be hired on any of the two short-term contracts.

Since 1995, gradually, many types of short-term contracts were regulated according to specific needs of firms in different sectors and industries[6]. The key novelty was that an age limit was not anymore listed among the eligibility criteria. The market responded positively to this set of reforms and the utilization of short-term contracts increased consistently over time. Specifically, the share of short-term employment raised from 7% in 1994 to over 13% in 2008[7].

Overall, the significant increase of the share of short-term contracts in Italy had strong effects on labor market outcomes and dynamics. In order to evaluate the impact of the reforms, we compare the labor market before 1995 and after 2003. In the following section, we describe the data, illustrate the empirical analysis, and present the results.

3 Empirical Evidence

In this section we investigate from an empirical point of view the changes registered in the Italian labor market after the reforms were implemented. Specifically, in order to provide a complete description, we analyze the variations in labor force composition, employment and unemployment rates, transitions across states, and wages. After describing the data sets, we provide a summary of the results computed using both reduced form and structural estimation techniques[8].

3.1 Data Sources

Our empirical analysis is based on two data sets offering complementary information.

The Survey on Household Income and Wealth (SHIW (1993-2008)) is a sample survey conducted by the Bank of Italy every two years. The data collection started in the sixties with the aim of gathering information on the incomes and savings of the Italian households. Today, SHIW is one of the most widely used sources of information on socio-demographic characteristics, labor force status, income, savings, and wealth of the Italian population. The sample used in the most recent surveys comprises

[5] They differed in the length of the contract and in the training required. The apprenticeship contract was in general longer and demanded more training. Controls for training were much stricter for apprenticeship and were organized at both national and local levels.

[6] The description of all contract types goes beyond the scope of this paper. For more details, please refer to Tealdi (2011).

[7] Source: OECD.

[8] For an extensive description of the empirical results and techniques, please refer to Tealdi (2010).

about 8,000 households (24,000 individuals), distributed over approximately 300 Italian municipalities. The target population of SHIW consists of the Italian resident population.

The Work Histories Italian Panel (WHIP (1985-2005)) is a database of individual work histories, based on the National Social Security Institute's administrative archives. The reference population consists of individuals, Italian and foreign, who have worked in Italy for the whole or only part of their working career. A large representative sample has been extracted from this population. Overall the sample consists of a dynamic population of about 700,000 people. For each of these individuals the main episodes of their working careers are observed. The complete list of observations includes information on working contracts, retirement spells, social benefits, and workers, jobs and firms characteristics. The data do not include information on public sector workers or freelancers (lawyers or notaries), who have an independent security fund. The period of observation spans from 1985 to 2004.

Looking at the data, we can notice that in Italy the number of people hired short-term increased significantly in the last two decades. Indeed, in 2003 the number of short-term employees was more than 20 times bigger than the number of people hired short-term in 1995[9]. In Figure 1 we observe the number of short-term contracts as a share of the total contracts in Italy since 1985. While in 1993 the share was approximately 8%, in 2004 it equals approximately 25% of total contracts. Given the significant increase in the utilization of short-term contracts, we proceed by investigating their impact on the labor market. In the following section, we show the evidence observed in the data, which can be summarize in four categories: the characteristics of the workers hired short-term; the labor force composition; the wage difference across types of contracts; and the transitions across states.

3.2 Characteristics of the workers hired short-term

To investigate the characteristics of workers hired short-term, we focus on the age and gender of the workers, education level, and occupation. Table 1 shows that short-term contracts are more common among young individuals. Their utilization declines with age; approximately 41% of individuals from 15 to 24 year old and approximately 20% of the individuals who belong to the 25-34 year old age group are employed short-term. However, only 12% of workers who belong to the 35-44 year old age group and 8% of workers older than 45 year old are hired on a short-term contract in 2006. Moreover, since 1995 the share of older people hired on a short-term basis has been consistently increasing (Figure 2).

Gender appears to be an important feature to discriminate between short-term and permanent positions. The share of females hired on a temporary contract is higher compared to the share of males: approximately 15% of total females compared to 13% of total males are hired short-term.

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

Less educated people are also more likely to be hired on short-term contracts. In particular 50% of individuals with no education and approximately 22% of individuals with primary education are hired temporary. Among other categories, the most likely to be hired short-term are the ones with a junior-high degree or a 3-year college degree (15%), followed by those with a post graduate degree (13%).

We also observe the distribution of contracts across occupation. Most of the consultants are by definition hired on a short-term basis. Among others, blue collar workers and teachers are the categories of people more likely to be hired short-term, while white collar workers and managers are mainly hired permanently.

Controlling for these individual characteristics, we perform a probit regression (Table 2). Female workers have approximately 6% higher chances to be hired short-term. By age groups, it appears that belonging to the 15- 24 year old age group strongly increases the likelihood of having a temporary job (+17%). Moreover, young people in their thirties[10] are more likely to be hired short-term; their chances are approximately 6% higher than older age groups. Both high levels and low levels of education play 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 (25-34 year old age group) is positive and significant. This confirms the findings of Barbieri and Scherer (2009), who show that recent college graduates are very likely to be offered a short-term contract when they first step into the labor market. Finally, in terms of occupation, we find that managers as well as white collar workers and teachers have higher chances to be hired permanently compared to blue collar workers.

To summarize, we find that people who are more likely to be hired short-term are females, young, low qualified, and in general poorly educated. In addition, we can also identify a group of highly educated people who belong to the 25-34 year old age group who have a greater chance to be hired short-term.

3.3 Labor force composition

The second goal is to analyze the changes in labor force composition and transitions of people between states (employment, unemployment, and out of the labor force) after the introduction of short-term contracts. We perform the statistical analysis by age groups to investigate the presence of cohort effects. The analysis is conducted over the period 1991-2006 for five age categories: 15-24 year old, 25-34 year old, 35-44 year old, 45-54 year old, and 55-64 year old (Figure 3).

[10] Those who belong to the 25-34 year old age group.

The 15-24 year old age group is characterized by a gradual, but constant decrease in unemployment starting from 1997. Figure 3(a) suggests that the lower unemployment rate is explained only by the increasing flow of workers outside the labor force. The employment rate remains constant over time.[11].

The 25-34 year old and 35-44 year old age groups is analyzed together because of their similar trend. For both cohorts the employment to population ratio slightly increases. Unemployment is approximately constant and labor force participation slightly decreases. However, these movements are not very pronounced[12](see Figure 3(b) and 3(c)).

Among the 45-54 year old age group, employment and labor force participation grow significantly (by more than 10%) after 1997, while unemployment is approximately constant (see Figure 3(d)). The patterns among the 55-64 year old age group appear similar but delayed[13] (Figure 3(e)). Therefore, we detect among these two cohorts a significant flow of individuals moving from out of the labor force directly into employment.

In summary, it appears that the age group showing more dynamics is the 45-54 year old age group. Even though the unemployment to population ratio does not show a negative trend, many individuals, who were previously (before 1995) either not working or looking for jobs, are employed after 1995. This investigation becomes more interesting when we identify the people who were outside the labor force before and after the reforms.

In 1995 more than two thirds of the individuals out of the labor force who belonged to the 45-54 year old age group were female homemakers (housewives). This percentage is significantly lower in 2006. Given that the unemployment rate for this cohort is approximately unchanged and that labor force participation and employment rate increased by the same percentage from 1995 to 2006, we may detect a supply effect. However, in order to identify any trend among females, we need to isolate it from the trend of increased female labor force participation across Europe in the last two decades. Looking at Figure 4, we notice that an increasing trend was present since the end of the seventies, but after 1997 the fraction of females in the labor force grows at a faster rate. Focusing on the labor force participation for females older than 45 years old, we can recognize a similar and even more pronounced pattern.

[11] These movements can be due to the fact that over the last fifteen years education has become more and more valued and a larger number of young people attend college. This trend has been enhanced by the implementation of policies targeting the achievement of higher levels of education. One of this reforms increased the age for compulsory education to sixteen years old (previously fourteen). Another important legislation approved in 1999 introduced a new and shorter college degree, consisting of only three years of undergraduate classes (compared to the previous degree consisting of five years).

[12] Approximately 5%.

[13] A pension reform in 1992 extended the pension age from 55 to 60 for women and from 60 to 65 for men. Another reform in 1995 changed the way pensions are calculated, moving from salary-based to contribution-based payments. Moreover it allowed retirement at 57 if welfare contributions have been paid for at least 35 years. Later reforms changed the retirement age for both women and men, but they became affective only in 2008.

3.4 Wages across types of contracts

It is also very important to analyze how wages differ across types of contracts to capture any discrimination effect. Data show that workers hired short-term tend to have lower income[14]. Figure 5 shows the distribution of annual income across contracts types. Short-term contracts offer much lower income compared to permanent contracts[15]. This figure takes into account two main aspects: first, the lower salaries associated with short-term contracts; second, the spells of unemployment that may occur between two (or more) spells of employment.

However, since this evidence may be attributed to individual characteristics, in particular to tenure, as described in section 3.2, we investigate the way this income distribution changes by age groups. We notice that across all ages workers on average tend to earn lower salaries when they are hired on short-term contracts compared to permanent contracts (Figure 6). The distribution of income is wider for older cohorts, but the short-term negative effect on income is persistent.

To test for the presence of a wage "premium" when working on a permanent basis, we perform an OLS regression. We consider as regressors characteristics of the workers, the employers, and the jobs. To account for economic and social differences between the North and the South of Italy, we control for the geographical location of the worker. Moreover, we consider the age of the workers and, particularly, we focus on the difference in wages between younger and older workers. We are as well interested in the effect of the education level of the workers on the earnings level. Regarding the job characteristics, we control for the occupation, the type of contract, and the size of the firm.

As expected, being hired on a permanent position rather than a short-term position remarkably increases the wage level received by the worker (Table 3). There is a "premium" for working permanently which is strongly significant even when controlling for individual, firm, and job characteristics. Since it can not be explained by observable characteristics, we conclude that it is likely to be intrinsically hidden in some unobservable factors carried by workers who are hired permanently.

3.5 Transitions across contracts

The analysis of the changes in the transitions across contracts after the introduction of short-term contracts is essential to understand the new workers' dynamics. Specifically, it is critical to understand the reasons behind the decision of the firms to make use of short-term contracts, as emphasized by Portugal and Varejao (2003). To reach this objective, we consider the transitions across three states:

[14] 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. However, in general, there are no regulations regarding wages for other types of short-term contracts.

[15] Note that a short-term employee may not work full time for the entire year, but only for few months.

non-employment[16], short-term employment, and permanent employment. We investigate how these transitions changed since 1995 due to the labor market reforms.

First, we consider the pool of workers hired short-term in January 1995. Table 4 shows that 40% of these workers hired short-term were at their first job experience. Among the individuals with previous working experience, two thirds were not employed before the short-term spell. At expiration of the short-term contract, 40% of the experienced (30% of the inexperienced respectively) moved to a permanent position. Only 10% of the experienced (13% respectively) moved afterwards to another temporary job. The remaining moved to a non-employment position.

We repeat the same analysis for the group of workers hired on a short-term basis in January 2003. Only 3% of the workers were at their first work experience. Among the experienced workers, approximately 90% were coming from another short-term position. Almost half of the workers signed afterwards another short-term contract and one third moved to non employment. The remaining moved to a permanent position.

Overall, from 1995 to 2003 we detect an important change towards the utilization of short-term contracts. We can state that the percentage of people at their first experience was much higher in 1995 (40%) than in 2003 (3%). Moreover, among people with previous experience, only 15% were coming from another short-term contract in 1995, while in 2003 the percentage went up to 88%. Transitions toward permanent positions were also much more frequent in 1995: 31% of workers in their first job and 39% of more experienced workers transited toward a lifetime job. In 2003 they are down respectively to 10% and 23%. We should also mention that after some job spells, the percentage of workers moving towards non employment is lower in 2003 (30%) compared to 1995 (50%) because of the higher utilization of short-term contracts.

To summarize, we detect an increased worker turnover after the introduction of short-term contracts. The most significant changes are observed in the increased flows of workers from short-term contract to short-term contract and from short-term contract to non-employment. Less significant, but relevant is the increased transition from non-employment to short-term employment.

With the empirical findings described above in mind, in the following section we will design a model which is able to capture the changes in the workers and firms behavior and replicate the evidence found in the data. Without a theoretical framework, we will not be able to infer causality and to draw conclusions regarding the change in welfare for different categories of workers.

[16] In the data we do not observe whether the workers are unemployed or out of the labor force when they are not working.

4 The Search Model

In this section we design a search and matching labor market model. In light of the evidence provided above, we embed in the model the observed stylized facts. Specifically, we account for the fact that workers hired short-term are mostly young, poorly qualified, and poorly educated. Moreover, we include the evidence that sequences of short-term contracts became very common and the associated wages are lower compared to the wages associated to permanent contracts. Finally, we take into consideration the increased labor force participation rate among older workers, which is significant even after taking into account the growing female labor force participation trend. The calibration of the model will help drawing conclusions regarding the change in welfare for different categories of workers and it will help inferring predictions for future policy interventions.

We adapt the standard Mortensen and Pissarides (1994) search model to the environment described above, introducing workers heterogeneity, allowing for differentiated contracts, and including social security costs. The motivation behind the inclusion of heterogeneity among workers in the model is the presence of a significant wage "premium" associated with permanent contracts which is not explained by any of the observable characteristics seen in the data. The introduction of differentiated contracts will help explain the criteria by which each contract is offered to different categories of workers. The social security fees reflect the differences in costs associated with different types of contract. We describe the model before the reforms, when only permanent contracts are available, and after the reforms, when both permanent and short-term contracts are available. Workers are in one of the three states: out of the labor force, unemployed, or permanently employed.

4.1 The Set up

The set up is described by a set of parameters, which define the dynamics and mechanisms of the model (Table 5). The model is characterized by the presence of a population of measure one. Every instant a measure k of individuals are born and each instant the same measure of individuals die. Hence, the size of the population is constant over time. When the individuals are born, they are *junior* and they are out of the labor force. At rate m, which is the parameter of a Poisson arrival process, they join the labor force as unemployed and start looking for jobs. There are two types of workers defined by their productivity level, H type, with higher level of productivity, and L type, with lower level of productivity. The share of H type workers is equal to p. The productivity of the workers is not revealed, hence firms are not able to discriminate among job seekers. For both types, the productivity level is the entry level productivity y_0.

When the worker is hit by a productivity shock at rate $\lambda > 0$, her productivity level changes. If she is H type, her productivity level jumps up significantly to y^H, where $y^H > y_0$. If she is L type , her productivity level increases by a small amount and equals y^L, where $y^P > y^L > y_0$. Whenever the productivity shock hits the worker, she becomes *senior*. The productivity of the worker belongs only to the information sets of the specific firm and the worker. When the worker is *senior* she may retire at a rate s and, after exiting the labor force state, she may die at rate d. We define b as the value of the unemployment benefits[17].

Firms hire both *junior* and *senior* workers. We assume that the waiting time until a shock hits the worker-firm match is distributed exponentially. Hence, the probability that the shock is realized is the density of the distribution and the parameter of the distribution is the rate at which the shock occurs. Firms without workers post vacancies at cost c and they fill the vacancies with probability α, which is the parameter of a Poisson arrival process. In equilibrium, job creation is governed by profit maximization by taking into account expected revenues and costs of a new match. Negative shocks arrive to existing matches at the Poisson rate q. When this happens, the productivity of the job is reduced to zero and the match is dissolved.

Firms and workers come together via a matching function $M(u, v)$ where u is the rate of unemployment and v is the vacancy rate. This function is twice differentiable and increasing in its arguments. It exhibits constant returns to scale. The flow of matches for a vacancy can be defined as $M(u, v)/v = \alpha(\theta)$ which is a differentiable decreasing function, where θ is the tightness of the labor market defined by v/u. The flow of matches for an unemployed worker can be defined as $M(u, v)/u = \mu(\theta)$, which is an increasing function[18].

All realized job matches yield a surplus. If the worker and the firm separate, each part will have to go through a costly search process in order to meet its next partner. The surplus of the match is shared between the parities. Following the approach of Blanchard and Portugal (2001), we assume that the surplus is divided in fixed proportions between the firm and the worker through an asymmetric Nash Bargaining process[19], where β represents the worker's share. Hence, workers and firms do not bargain the wage each instant, but only each time a new contract is signed, even between the same parities, before the beginning of the match. The wage they agreed upon changes only when the conditions of the contract are altered.

We use X_Y and X_O to denote any variable X respectively for *junior* (Young) and *senior* (Old) workers. We define J^V as the value function for a firm which opens a vacancy and J^E as the value

[17] The eligibility criteria for unemployment benefits are quite strict and explicitly require continuous work experience.
[18] Standard Inada conditions apply.
[19] A possible alternative would be the solution proposed by Rubinstein (1982) to the infinite-horizon bargaining with alternating offers.

function for a filled position. From the point of view of the worker, we denote W^U as the value function of an unemployed worker, W^E as the value function for an employed worker, and W^{OLF} as the value function for a worker who is out of the labor force.

4.2 The Benchmark Model

In the basic set up, only permanent contracts are available and firing is not allowed. Hence, whenever a firm decides to hire a worker, the firm opens a new vacancy. Whenever the firm finds a good match, the firm offers the worker a permanent contract (the only type of contract available). When the firm hires a *junior* worker, the productivity level of the worker (H type or L type) is not revealed. At this stage, the productivity level of the worker is the entry level productivity y_0. At rate λ the worker's productivity is revealed and the worker becomes *senior*. Independently on the worker's type, the firm is obliged to keep the worker within the workforce, since firing is not allowed. At rate q a random shock may hit the match and drive the surplus of the match to zero (match destruction). Workers may retire at rate s^p,[20] and leave the labor force pool. In this case, the firm opens a new vacancy.

4.2.1 The Firm's Problem

In this setup there are two types of vacancies: a vacancy for *senior* and a vacancy for *junior* workers. When the firm posts a vacancy, the Bellmann equations for the firm are:

$$rJ_Y^V = -c_y^p + \alpha_y^p[J_Y^E - J_Y^V] \tag{1}$$

$$rJ_O^V = -c_o^p + \alpha_o^p[(pJ_O^{EH} + (1-p)J_O^{EL}) - J_O^V] \tag{2}$$

In equation 1 we can observe that whenever the firm opens a vacancy for *junior* workers, the firm pays a cost c_y^p. The vacancy is filled at rate α_y^p. The parities bargain the current wage and the wage the worker will earn when she will become *senior*. If the opened vacancy is for *senior* workers, the firm pays a cost c_o^p and the vacancy is filled at rate α_o^p with a H type or a L type worker (Eq. 2). The parities bargain the current wage.

When the vacancy is filled with *junior* or *senior*, either H type or L type workers, the firm Bellman equations are respectively:

$$rJ_Y^E = y_0 - w_y - \tau_y^p + \lambda[p(J_O^{EH} - J_Y^E) + (1-p)(J_O^{EL} - J_Y^E)] + q(J_Y^V - J_Y^E) \tag{3}$$

$$rJ_O^{EH} = y^P - w_o - \tau_o^p + q(J_O^V - J_O^{EH}) + s^p(J_O^V - J_O^{EH}) \tag{4}$$

$$rJ_O^{EL} = y^L - w_o - \tau_o^p + q(J_O^V - J_O^{EL}) + s^p(J_O^V - J_O^{EL}) \tag{5}$$

[20] The subscript p denotes the permanent feature of the contract.

In Eq. 36, we can notice that when the *junior* worker is hired, her productivity is the entry level productivity y_0 and the firm pays her the wage w_y. Moreover, the firm pays social security and welfare fees equal to τ_y^p for her benefits. At rate λ the firm learns the worker's type. With probability p, she is H type, with productivity level $y^P > y_0$; with probability $(1-p)$, she is L type, with productivity level y^L, where $y^P > y^L > y_0$. In both cases, the firm is obliged to keep the worker within the workforce, since firing is not allowed. At rate q the match is destroyed and the firm opens a new vacancy.

When the worker is *senior*, as shown in Eq. 37 and Eq. 38, her salary is equal to w_o, as bargained at the stipulation of the contract. Moreover, the firm pays the social security and welfare fee τ_o^p for the worker's benefits. The match may be destroyed if the worker decides to retire at rate s^p or if the negative shock q hits the match. In both situations, the firm opens a new vacancy.

4.2.2 The Worker's Value Functions

We can define the value of being unemployed for *junior* and *senior* workers as

$$rW_Y^{UH} = \mu_y[W_Y^{EH} - W_Y^{UH}] \tag{6}$$

$$rW_Y^{UL} = \mu_y[W_Y^{EL} - W_Y^{UL}] \tag{7}$$

$$rW_O^{UH} = b + \mu_o[W_O^{EH} - W_O^{UH}] \tag{8}$$

$$rW_O^{UL} = b + \mu_o[W_O^{EL} - W_O^{UL}] \tag{9}$$

Senior unemployed workers of different productivity levels are eligible for unemployment benefits b. Since firms are not able to discriminate between the more and less productive (H type versus L type) *senior* workers by looking at their working histories, workers of both types have the chance to be re-hired after their match is dissolved at rate μ_o (See Eq. 34 and Eq. 35).

Junior workers are not eligible for unemployment benefits. This assumption is justified by the strict requirements in terms of continuous working careers for the eligibility to unemployment benefits[21]. At rate μ_y the unemployed *junior* worker finds a new permanent job (See Eq. 32 and Eq. 33).

The value of being employed for *junior* and *senior* workers of both types is

$$rW_Y^{EH} = w_y + \lambda[W_O^{EH} - W_Y^{EH}] + q[\max\{W_Y^{UH}, W_Y^{OLF}\} - W_Y^{EH}] \tag{10}$$

$$rW_Y^{EL} = w_y + \lambda[W_O^{EL} - W_Y^{EL}] + q[\max\{W_Y^{UL}, W_Y^{OLF}\} - W_Y^{EL}] \tag{11}$$

$$rW_O^{EH} = w_o + q[\max\{W_O^{UH}, W_O^{OLF}\} - W_O^{EH}] + s^p[W_O^{OLF} - W_O^{EH}] \tag{12}$$

$$rW_O^{EL} = w_o + q[\max\{W_O^{UL}, W_O^{OLF}\} - W_O^{EL}] + s^p[W_O^{OLF} - W_O^{EL}] \tag{13}$$

[21] In Italy to be eligible for full unemployment benefits the worker should have worked for at least 12 months during the 24 months before joining the unemployment pool.

where

$$rW_Y^{OLF} = 0$$
$$(r+d)W_O^{OLF} = \pi$$

As shown in Eq. 36 and Eq. 37, a *junior* worker gets a salary equal to w_y. Her productivity is revealed to the firm at rate λ: she maybe more productive H type or less productive L type. At rate q the match is hit by a negative shock and destroyed. The worker decides whether to exit the labor force or join the unemployment pool by solving an optimization problem. Since as *junior* and unemployed the worker has chances to find a job (and hence she faces a positive utility), while the utility of being out of the labor force is zero, she chooses the former.

A *senior* worker gets a salary w_o while employed (Eq. 38 and Eq. 39). There are two events by which a *senior* employed worker may lose her job: if the match is destroyed at rate q or if she retires at rate s^p. If the match gets destroyed when the worker is *senior*, the worker has to solve a utility maximization problem. She may decide to join the unemployment pool, from which she can exit by finding a new job at rate μ_o, or she may decide to retire. The former option gives her a positive utility b and the chance to be hired again, while the latter option gives her a utility equal to π[22]. Since the first option gives her an higher utility, she joins the unemployment pool. If the firm-worker match is hit by a retiring shock s^p, the worker leaves the labor force pool and she may die at rate d.

4.2.3 Wage Determination and Equilibrium Conditions

Solving the problem above from the point of view of the firms and the workers, we obtain the equilibrium equations for the firms and for the workers.

The firm's problem becomes:

$$J_O^{EH} = \frac{y - w_o - \tau_o^p}{(r+q+s^p)}$$
$$J_O^{EL} = \frac{y_0 - w_o - \tau_o^p}{(r+q+s^p)}$$
$$J_Y^{E} = \frac{y_0 - w_y - \tau_y^p}{(r+\lambda+q)} + \frac{\lambda p}{(r+\lambda+q)} J_O^{EH} + \frac{\lambda(1-p)}{(r+\lambda+q)} J_O^{EL}$$

The worker's value functions become:

[22] We can think of it as a pension payment.

$$W_Y^{EH} = \frac{w_y}{(r+\lambda+q)} + \frac{\lambda}{(r+\lambda+q)} W_O^{EH} + \frac{q}{(r+\lambda+q)} \frac{\mu_y}{(\mu_y+r)} W_Y^{EH}$$
$$W_Y^{EL} = \frac{w_y}{(r+\lambda+q)} + \frac{\lambda}{(r+\lambda+q)} W_O^{EL} + \frac{q}{(r+\lambda+q)} \frac{\mu_y}{(\mu_y+r)} W_Y^{EL}$$
$$W_O^{EH} = \frac{w_o}{(r+q+s^p)} + \frac{q}{(r+q+s^p)} W_O^{UH} + \frac{s^p}{(r+q+s^p)} W_O^{OLF}$$
$$W_O^{EL} = \frac{w_o}{(r+q+s^p)} + \frac{q}{(r+q+s^p)} W_O^{UL} + \frac{s^p}{(r+q+s^p)} W_O^{OLF}$$

The mechanism by which the labor market works is described in Figure 7.

We can use these expressions to compute the values of the wages received by *junior* and *senior* workers. We assume that the wages are determined using a Nash Bilateral Bargaining mechanism and we define β as the fraction of surplus enjoyed by the workers.

In this economy two are the wage levels: one for *junior* workers and one for *senior* workers. Workers and firms decide upon the current and future wage levels when they first meet and the permanent contract is signed. Firms are willing to pay to the workers, once they get *senior*, the weighted average of the productivity of H type and L type workers. The weights are given by the proportion of workers belonging to each type. Indeed, when the firms sign the contract, they do not observe the workers' productivity levels.

The sharing rules for the determination of the wage per each workers' category are described by the following equations:

$$\beta[J_Y^E - J_Y^V] = (1-\beta)[p(W_Y^{EH} - W_Y^{UH}) + (1-p)(W_Y^{EL} - W_Y^{UL})]$$
$$\beta[p(J_O^{EH} - J_O^V) + (1-p)(J_O^{EL} - J_O^V)]$$
$$= (1-\beta)[p(W_O^{EH} - W_O^{UH}) + (1-p)(W_O^{EL} - W_O^{UL})]$$

The free entry conditions imply that on both markets (for *senior* and *junior* workers) the values of the vacancies are equal to zero. In steady state, to guarantee the stability of the system, the measure of newborns is equal to the measure of people who die. Moreover, the share of *junior* and *senior* people is constant over time. By maximizing the total surplus, we compute the wage setting condition for *senior* and *junior* workers.

The equilibrium wage for *senior* workers turns out to be:

$$w_o = \beta[py^H + (1-p)y^L - \tau_o^p] + (1-\beta)(r+s^p)(pW_O^{UH} + (1-p)W_O^{UL})$$
$$- (1-\beta)[s^p]W_O^{OLF}$$

The equilibrium wage for *junior* workers is:

$$w_y = \beta[y_0 - \tau_y^p] + (1-\beta)(r+\lambda)[pW_Y^{UH} + (1-p)W_Y^{UL}]$$
$$- (1-\beta)\lambda[pW_O^{UH} + (1-p)W_O^{UL}]$$

Rearranging and plugging in the expressions for each value function, we can write the wages as functions of the parameters of the model. We define θ as the tightness of the market per each segment[23].

$$w_o = \beta[py^H + (1-p)y^L - \tau_o^p] + \left(\frac{r+s^p}{r}\right)((1-\beta)b + \beta c_o^p \theta_o^p) - (1-\beta)[s^p]\left(\frac{\pi}{r+d}\right) \quad (14)$$

$$w_y = \beta[y_0 - \tau_y^p] + \frac{(r+\lambda)}{r}\beta c_y^p \theta_y^p - \frac{\lambda}{r}((1-\beta)b + \beta c_o^p \theta_o^p) \quad (15)$$

From Eq. 40, we can notice that the wage level for *senior* workers turns out to be a weighted average of the productivity of the two types of workers, H type and L type. In fact, since the firm is not able to discriminate between more and less productive workers, a pooling equilibrium of the two types of workers drives the average wage to lower levels. More productive workers are consequently penalized by the presence of less productive workers.

4.3 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 either short-term or permanently. The main feature of the new type of contract is the limited duration, which is established when the contract is stipulated. When a firm opens a vacancy for *junior* workers, the firm may decide whether to offer a permanent or a short-term contract. Short-term contracts are characterized by a more flexible structure: they allow the firms to pay no firing costs at expiration, they are cheaper in terms of social security and welfare fees, and they are associated with a more straightforward bureaucratic process. However, in general, sequences of short-term contracts are not allowed. Whenever the short-term contract expires, at rate t, firms have to decide whether to hire the workers permanently or whether to keep them short-term and re-bargain their wage.

[23] $\theta_o^p = \frac{\mu_o}{\alpha_o^p}$ and $\theta_y^p = \frac{\mu_y}{\alpha_y^p}$.

4.3.1 The Firm's Problem

Keeping the same notations as described in section 4.1, we compute the Bellman equations for the firm. There are three types of vacancies: for *junior* workers, for *senior* more productive H type workers and for *senior* less productive L type workers. The Bellman equations for a firm with open vacancies are:

$$rJ_Y^V = \max\{-c_{2y}^s + \alpha_{2y}^s[J_Y^{ES} - J_Y^V], -c_{2y}^p + \alpha_{2y}^p[J_Y^{EP} - J_Y^V]\} \tag{16}$$

$$rJ_O^{VH} = \max\{-c_{2o}^s + \alpha_{2o}^s[J_Y^{ESH} - J_O^{VH}], -c_{2o}^p + \alpha_{2o}^p[J_O^{EPH} - J_O^{VH}] \tag{17}$$

$$rJ_O^{VL} = \max\{-c_{2o}^s + \alpha_{2o}^s[J_O^{ESL} - J_O^{VL}], -c_{2o}^p + \alpha_{2o}^p[J_O^{EPL} - J_O^{VL}]\} \tag{18}$$

In Eq. 16, Eq. 17, and Eq. 18, we can notice that the firm solves a maximization problem every time it opens a vacancy either for *junior* workers or *senior* workers. The firm may decide to offer a permanent contract or a short-term contract. The first carries the disadvantages to be associated with higher social security and welfare fees and to be long-term. The second one is more flexible in terms of duration and cheaper in terms of costs. In fact, if the contract offered to a *junior* worker is short-term, the vacancy cost is c_{2y}^s[24], while if it is permanent the cost is c_{2y}^p[25], where $c_{2y}^p > c_{2y}^s$. In a similar way, for a *senior* worker, the vacancy cost associated to a short-term contract is c_{2o}^s[26], while the vacancy cost associated to a permanent contract for a *senior* is c_{2o}^p, where $c_{2o}^p > c_{2o}^s$[27].

The vacancies offering a short-term contract to *junior* and *senior* workers are filled respectively at rate α_{2y}^s and at rate α_{2o}^s. The rates at which vacancies offering a permanent contract are filled are α_{2y}^p and α_{2o}^p respectively for *junior* and *senior* workers.

[24] The superscript s refers to short term contracts, while the subscript y refers to *junior*(young).

[25] The superscript p refers to permanent contracts.

[26] The subscript o refers to *senior* (old).

[27] The cost of opening a vacancy is always higher for permanent positions compared to short-term positions since we assume that firms will spend more resources selecting a worker knowing that it will not be possible to fire her.

Whenever the firms have filled positions, the Bellman equations are:

$$
\begin{aligned}
rJ_Y^{EP} &= y_0 - w_y - \tau_y^p + \lambda[p(J_O^{EPH} - J_Y^{EP}) + (1-p)(J_O^{EPL} - J_Y^{EP})] + q[J_Y^V - J_Y^{EP}] \\
rJ_Y^{ES} &= y_0 - w_y - \tau_y^s + \lambda[p(\max\{J_O^{EPH}, J_O^{ESH}\} - J_Y^{ES}) + (1-p)(\max\{J_O^{EPL}, J_O^{ESL}\} - J_Y^{ES})] \\
&\quad + q[J_Y^V - J_Y^{ES}] + t[J_Y^V - J_Y^{ES}] \\
rJ_O^{EPH} &= y^H - w_o^H - \tau_o^p + (q + s^p)[J_O^{VH} - J_O^{EPH}] \\
rJ_O^{ESH} &= y^H - w_o^H - \tau_o^s + (q + t + s^s)[J_O^{VH} - J_O^{ESH}] \\
rJ_O^{EPL} &= y^L - w_o^L - \tau_o^p + (q + s^p)[J_O^{VL} - J_O^{EPL}] \\
rJ_O^{ESL} &= y^L - w_o^L - \tau_o^s + (q + t + s^s)[J_O^{VL} - J_O^{ESL}]
\end{aligned}
$$

Junior workers have a productivity level equal to y_0 and they get paid w_y. Moreover the firm is required to pay social security and welfare fees τ_y^p for the worker's benefits, if the worker is hired permanently, or τ_y^s, if the worker is hired short-term. If a negative shock q hits the match, the match is destroyed and the firm opens a new vacancy. If the worker is hired short-term, at rate t her contract may expire and the firm opens a new vacancy. At rate λ the worker's productivity is revealed and the worker becomes *senior*. In this instant, if the worker is hired short-term, the firm decides whether to hire the worker permanently or on a short-term basis.

Senior H type workers have a productivity level equal to y^P. The firms pay them a salary equal to w_o^H and cover the social security and welfare cost τ_o^p or τ_o^s, respectively if she is hired permanently or short-term. The match is over if the worker retires or the match is hit by a negative destructive shock. Note that the probability that the worker retires (or leaves the labor force) is higher if the worker is hired short-term, that is $s^s > s^p$. In addition, if the worker is hired short-term, the match may terminate at rate t when the contract expires. In all these circumstances, the firm opens a new vacancy.

Senior L type workers have a productivity level equal to y^L. The firms pay them a salary equal to w_o^L and cover the social security and welfare cost τ_o^p or τ_o^s, respectively if she is hired permanently or short-term. As for H type workers, the match is destroyed if the worker retires or the match is hit by a negative destructive shock. In addition, if the worker is hired short-term, the match terminates at rate t and the firm opens a new vacancy.

In equilibrium it is always more profitable for the firm to offer a short-term contract to *junior* workers and to less productive L type workers. The driving forces behind these choices are different according to each category: for *junior* workers the driving force is the possibility to fire them at no cost if they are revealed to be less productive; for L type workers the driving forces are the cheaper vacancy and social

security and welfare fees. H type workers are offered permanent contracts in equilibrium. Once the firm finds out that the worker is more productive, it is more profitable for the firm to keep the worker within the workforce long-term.

4.3.2 The Worker's Value Funtions

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

$$rW_Y^{UH} = \mu_{2y}(W_Y^{EH} - W_Y^{UH}) \tag{19}$$

$$rW_Y^{UL} = \mu_{2y}(W_Y^{EL} - W_Y^{UL}) \tag{20}$$

$$rW_O^{UH} = b^H + \mu_{2o}^H(W_O^{EH} - W_O^{UH}) \tag{21}$$

$$rW_O^{UL} = b^L + \mu_{2o}^L(W_O^{EL} - W_O^{UL}) \tag{22}$$

Whenever a *junior* worker is unemployed (Eq. 19 and 20), she is not eligible for unemployment benefits[28] and she finds a job at rate μ_{2y}. *Senior* H type workers have higher opportunity costs since they are eligible for unemployment benefits b^H and their chance to find a job is μ_{2o}^H (Eq. 21). *Senior* L type workers are eligible for lower unemployment benefits b^L since they do not have a continuous working history ($b^H > b^L$). For simplicity, we normalize b^L=0. Whenever hit by a destructive shock, L type workers, even though less productive, are not exiting the labor force since at rate μ_{2o}^L they may find a new job (Eq. 22). Since, it is optimal for the firm to offer L type workers short-term contracts, L type workers spend their life going through cycles of unemployment and short-term employment until they exit the labor force (discouraged) at rate s^s,[29].

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

$$rW_Y^{EH} = w_y + \lambda[W_O^{EH} - W_Y^{EH}] + t[W_Y^{UH} - W_Y^{EH}] + q[W_Y^{UH} - W_Y^{EH}]$$

$$rW_Y^{EL} = w_y + \lambda[W_O^{EL} - W_Y^{EL}] + t[W_Y^{UL} - W_Y^{EL}] + q[W_Y^{UL} - W_Y^{EL}]$$

$$rW_O^{EH} = w_o^H + q[W_O^{UH} - W_O^{EH}] + s^p[W_O^{OLFH} - W_O^{EH}]$$

$$rW_O^{EL} = w_o^L + q[W_O^{UL} - W_O^{EL}] + t[W_O^{UL} - W_O^{EL}] + s^s[W_O^{OLFL} - W_O^{EL}]$$

[28] For the same reasons as described in Section 6.4.2.

[29] s refers to short-term contract.

where

$$
\begin{aligned}
rW_Y^{OLF} &= 0 \\
(r+d)W_O^{OLFL} &= \pi + \gamma(W_O^{UL} - W_O^{OLF}) \\
(r+d)W_O^{OLFH} &= \pi
\end{aligned}
$$

Junior workers are always offered short-term contracts, since it is more profitable for the firms. When a *junior* worker is hired, she receives a wage equal to w_y. At rate λ the firm gets to know the worker's type. When the productivity of the worker is revealed she becomes *senior*. If she turns out to be H type, the firm offers her a permanent contract and the two parities re-bargain the wage. If she turns out to be L type, the firm decides whether to offer a permanent or a short-term contract. In equilibrium it is optimal for firms to offer short-term contracts to L type and permanent contract to H type workers. Hence, when L type workers lose their jobs, they have the chance to be hired again at rate μ_o^L on short-term contracts. If the short-term contract expires before the productivity of the worker is revealed, the worker joins the unemployment pool. At rate q the match is destroyed and the worker is unemployed. When workers of both types are *senior*, they may exit the labor force at rate s^p and s^s if they are hired permanently or short-term respectively[30]. Once workers exit the labor force, they may die at rate d. In addition, if they are L type , they may join the labor force again at rate γ as unemployed[31].

In this framework, there is no more pooling between H type and L type workers and they do not compete for the same types of contracts. Each of the two categories, when *senior*, target a specific segment of the market and each type bargains independently its own wage (see Figure 8). The separating equilibrium allows more productive workers to enjoy higher wages, which reflect their productivity level. Less productive workers receive lower wages and are bound to endure sequences of short-term employment and unemployment. *Junior* workers also experience several sequences of short-term employment and unemployment before becoming *senior*.

4.3.3 Equilibrium Conditions and Wage Determination

Solving the problem described above for workers and firms, we are able to solve the system of equations for both firms and workers.

[30] We assume that $s^s > s^p$ since workers hired short-term can exit the labor force either because they want to retire or because they are discouraged.

[31] This option is introduced into the model to capture the flows of workers hired short-term which transit in and out of the labor force, as seen in the data.

The firm's problem becomes:

$$J_O^{EPH} = \frac{y^P - w_o^H - \tau_o^p}{(r+q+s^p)}$$
$$J_O^{ESL} = \frac{y^L - w_o^L - \tau_o^s}{(r+q+t+s^s)}$$
$$J_Y^{ES} = \frac{y_0 - w_y - \tau_y^s}{(r+t+q+\lambda)} + \frac{\lambda}{(r+t+q+\lambda)}(pJ_O^{EPH} + (1-p)J_O^{ESL})$$

The worker's value functions become:

$$W_O^{EH} = \frac{w_o^H}{(r+q+s^p)} + \frac{q}{(r+q+s^p)}W_O^{UH} + \frac{s^p}{(r+q+s^p)}W_O^{OLF}$$
$$W_O^{EL} = \frac{w_o^L}{(r+q+t+s^s)} + \frac{(q+t)}{(r+q+t+s^s)}W_O^{UL} + \frac{s^s}{(r+q+t+s^s)}W_O^{OLF}$$
$$W_Y^{EH} = \frac{w_y}{(r+q+\lambda+t)} + \frac{\lambda}{(r+q+\lambda+t)}W_O^{EH} + \frac{(q+t)}{(r+q+\lambda+t)}W_Y^{UH}$$
$$W_Y^{EL} = \frac{w_y}{(r+q+\lambda+t)} + \frac{\lambda}{(r+q+\lambda+t)}W_O^{EL} + \frac{(q+t)}{(r+q+\lambda+t)}W_Y^{UL}$$

Using the expressions above, we can solve for the wage levels received by *junior* and *senior* workers. We assume that the wage is determined using a Nash Bilateral Bargaining mechanism and we define β to be the fraction of the surplus enjoyed by the workers.

In this economy there are three wage levels, one for each type of worker: *junior* and *senior*, H type and L type.

The following sharing rules apply to each specific category of workers:

$$\beta[J_O^{EPH} - J_O^{VH}] = (1-\beta)[W_O^{EH} - W_O^{UH}]$$
$$\beta[J_O^{ESL} - J_O^{VL}] = (1-\beta)[W_O^{EL} - W_O^{UL}]$$
$$\beta[J_Y^{ES} - J_Y^{V}] = (1-\beta)[p(W_Y^{EH} - W_Y^{UH}) + (1-p)(W_Y^{EL} - W_Y^{UL})]$$

The free entry conditions imply that the value of the vacancies for each segment of the market is equal to zero. Solving for the equilibrium wages, we get the wage setting condition for each type of worker.

The equilibrium wage for H type *senior* workers is:

$$w_o^H = \beta[y^H - \tau_o^p] + (1-\beta)(r+s^p)W_O^{UH} - (1-\beta)s^pW_O^{OLF}$$

The wage setting condition for L type *senior* workers is:

$$w_o^L = \beta[y^L - \tau_o^s] + (1-\beta)(r+s^s)W_O^{UL} - (1-\beta)s^s W_O^{OLF}$$

Finally, the wage setting condition for *junior* workers is:

$$\begin{aligned} w_y = \beta[y_0 - \tau_y^s] + (1-\beta)(r+\lambda)[pW_Y^{UH} + (1-p)W_Y^{UL}] \\ - (1-\beta)\lambda[pW_O^{UH} + (1-p)W_O^{UL}] \end{aligned}$$

Rearranging and plugging in the corresponding expressions per each value function, we obtain the wage levels for the three categories of workers as functions of the parameters of the model. We define θ as the tightness of the market per each specific segment[32].

$$w_o^H = \beta[y^P - \tau_o^p] + \frac{(r+s^p)}{r}((1-\beta)b^H + \beta c_{2o}^p \theta_{2o}^p) - (1-\beta)s^p\left(\frac{\pi}{r+d}\right) \tag{23}$$

$$w_o^L = \beta[y^L - \tau_o^s] + \left[1 + \frac{(r+d-\gamma)s^s}{(r+d)r}\right](\beta c_{2o}^s \theta_{2o}^s) - (1-\beta)s^s\left(\frac{\pi}{r+d}\right) \tag{24}$$

$$w_y = \beta[y_0 - \tau_y^s] + \frac{(r+\lambda)}{r}(\beta c_{2y}^s)\theta_{2y}^s - \frac{\lambda}{r}\Big[p((1-\beta)b^H + \beta c_{2o}^p \theta_{2o}^p) + (1-p)(1-\beta)(c_{2o}^s \theta_{2o}^s)\Big] \tag{25}$$

We can notice from Eq. 23 that the wage level of H type and L type workers is a function only of their productivity level of the more productive workers. Hence, it is higher in the post-reforms economy. Moreover, the wage level for workers is lower in the post-reforms economy, since it reflects their lower productivity level (Eq. 25).

5 Calibration

Solving the two models described in sections 6.4 and 4.3, we can compute the labor force statistics for *junior* and *senior* workers as a function of the parameters of the models. Using these expressions and assigning values to the parameters, our goal is to match the rates observed in the data. The final objective is to compute the change in welfare after the introduction of short-term contracts.

In order to analyze the consequences of the transition from a system of solely permanent contracts to a system where permanent and short-term contracts coexist, we perform the calibration of the two

[32] $\theta_{2o}^p = \frac{\mu_{2o}^h}{\alpha_{2o}^p}$, $\theta_{2o}^s = \frac{\mu_{2o}^l}{\alpha_{2o}^s}$, $\theta_{2y}^s = \frac{\mu_{2y}}{\alpha_{2y}^s}$.

models, as describe in section 4.1. The comparison of macro aggregates and labor market rates, before and after the reforms, will help us quantify the changes in the lifetime income for different categories of people, as identified in the model.

Three are the main criteria used to select the parameters: consistency with the previous literature, matching with labor force statistics extracted from the data (SHIW and WHIP), and conformity with the Italian legislation.

Specifically, our objective is to match the rates of unemployment, employment, and labor force participation, as well as the average wages for different categories of workers in 1995 (before the reforms) and in 2006 (after the reforms). Parameters defining unemployment benefits, social security and welfare fees, and the average length of a short-term contract, are chosen both according to the Italian legislation and the empirical evidence for Italy in the period 1993-1995 and 1996-2006, which correspond to the steady-states of the models.

A summary of the parameter values can be found in Table 6.

Following Blanchard and Landier (2002), we consider the length of a month as the unit time period and we set the interest rate r =0.01. We set the parameter which defines the bargaining power of the worker β =0.4.

Since we do not observe in the data the productivity level of the worker, it is difficult to assign a precise value to p, the share of high-productive workers. To face this problem, we allow the model to identify the two categories of workers, more productive H type and less productive L type . We consider those workers who were able to transit from a short-term contract to a permanent contract after their *junior* phase as more productive H type. According to the empirical evidence found in the Italian data, we assign to p the value of 0.85.

In terms of labor costs we conform to the the Italian legislation. The average social security and welfare fee associated with permanent contracts and paid by the firm (which is defined as τ^p in the model) in Italy amounts to approximately 33% of the worker's salary. On average, the percentage is lower for short-term contracts: a number of incentives drive the rates, which differ according to the type of short-term contract, to levels ranging from 10% to 25% of the worker's salary (in the model denoted by τ_o^s and τ_y^s, respectively for *senior* and *junior* workers). The vacancy cost, represented by c, is set approximately equal to 60% of the average monthly productivity (as seen in Hagedorn and Manovski (2006)).

Elsby et al. (2009) estimate monthly inflow and outflow rates from unemployment for several OECD countries. According to their estimation, we set q, the parameter which represents the match-destruction shock, equal to 0.8%. Viviano (2003) and Sylos-Labini (2005) report transition probabilities from un-

employment to employment in Italy. The parameter μ defined in the models as the job finding rate is calibrated as average of the transition probabilities reported in the above-mentioned literature.

In Italy unemployment benefits are classified according to two types: the full benefit and the reduced benefit. The full benefit carries very strict requirements and lasts for a maximum of eight months. It provides the worker with 60% of the salary for the first six months, which is reduced to 50% in the following two months. The reduced benefit carries less requirements and lasts for a maximum of six months. It provides the workers with 35% of the salary for the first four months, which is increased to 40% in the following two months. The corresponding parameter in the model is b and is set equal to 50% of the worker's salary.

Regarding the average length of a short-term contract, 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.

The most difficult parameter to calibrate is the monthly probability of a productivity change on an entry level job. Given the rigid structure of the Italian labor market, we set the value of the parameter to a relatively low level, specifically 4%. The sensitivity analysis performed in the next section will explore the robustness of this value.

6 Findings

This section is divided into three parts: first, we describe the model steady states before and after the reforms; second, we perform the sensitivity analysis; and finally, we analyze the effects of policy changes.

6.1 Steady-state analysis

Using the parameter values describe in Section 5, we can match the percentages of employment, unemployment, and labor force participation for more productive (H type), less productive (L type), *senior*, and *junior* workers, before and after the reforms. The model is able to replicate well the values computed using the SHIW data for the year 1995 and 2006. The results are shown in Table 7 and Table 8, respectively for *senior* and *junior* workers.

In terms of *junior* workers, the model can reproduce an approximately unchanged labor force composition. In fact, both in the data and in the model, the employment rate registers an increase of few percentage points. Moreover, while the labor force participation rate is constant, the unemployment rate decreases at the same rate as the employment rate increases. The main point to be stressed is the change in the type of contract *junior* workers are hired on. Before the reforms *junior* workers were permanently

hired, while after the reforms they are mostly hired short-term. In terms of *senior* workers, by calibrating the model we can recreate the sharp increase in the labor force participation rate as seen in the data, which is almost completely absorbed by the increase in the employment rate.

In terms of wages, *junior* workers face a slight increase in the received salary. For *senior* workers, we observe contrasting trends. The salary of productive H type workers is much higher after the reforms; the salary of unproductive L type workers is lower. The formers are the only ones hired permanently and this separation allows them to enjoy a wage "premium". In fact, the pooling with unproductive workers, as seen in the equilibrium pre-reforms, is no longer part of the system. Less productive workers (L type), who were hired permanently before the reforms, are hired short-term after the reforms and they face lower wages.

Using the parameter values described above, we compute the average working income accumulated while in the labor force by *junior* workers as well as more productive (H type) and less productive (L type) workers. In addition, we compute the average time the workers spend in the labor force. Assuming linear preferences as in the standard Mortensen-Pissarides search model[33], we compute the present discounted value of income for the three categories of workers.

The average working income accumulated by *junior* workers during their career has slightly increased after the reforms (Table 9). In addition, on average, *junior* workers spend more time in the labor force (including both periods of employment and unemployment). In the pre-reforms economy they would spend 0.7 months as unemployed and 20 months as employed before becoming *senior*. In the post reforms economy they still spend 20 months in employment, but they alternate periods of unemployment, which sum up to a total of approximately 6 months. Even though the wage level of *junior* workers post-reforms is similar to the wage level pre-reforms, it takes longer for their productivity to be revealed and as a result, the present discounted value of their income is lower.

Among *senior* workers, more productive workers fare better (Table 9). Their average income accumulated while in the labor force is much higher after the reforms. Not only they are in the labor force for a longer period of time, but they are the only ones hired permanently (separating equilibria). They spend slightly less time in unemployment and more time in employment after the reforms. In the pre-reforms economy, they were penalized by the pooling of more and less productive workers within the same contract type since their wage was pulled down by the presence of less productive workers. In the post-reforms economy, their monthly salary reflects their high productivity level and the present discounted value of their income is higher.

Less productive *senior* workers are worse off after the reforms (Table 9). They have higher chances to be employed in the post-reforms economy, but they have no chance to be hired permanently. They

[33] This assumption could be relaxed by assuming other more sophisticated types of preferences.

alternate spells of short-term employment and unemployment and they face a lower salary. In the pre-reforms economy, considering the total time spent in the labor force, they would spend approximately 20 months in unemployment, while in the post-reforms economy this amount is up to 75 months. The average income accumulated during their working career is lower. Even though they spend less time in the labor force, their average working income is too little to improve their economic condition. Consequently, the present discounted value of their average income in the post-reforms economy is lower.

To complete the analysis, we consider the present discounted value of the working income accumulated by workers during the whole lifetime. We do not separate the working career in the *junior* and *senior* phases, but we consider the whole career, since the instant the workers join the labor force until they retire. We compute the statistics for more (H type) and less (L type) productive workers. The average working income accumulated by more productive workers (H type) is higher after the reforms (Table 10). Moreover, they tend to spend more time in the labor force. Combining these two results, we compute the present discounted value of income, which turns out to be higher after the reforms. On the other hand, the average working income accumulated by less productive workers (L type) is lower after the reforms (Table 10). Overall, they spend less time in the labor force. As a result, the present discounted value of the lifetime income turns out to be lower after the reforms. This result is not surprising. Less productive workers, indeed, are worse off both when *junior* and when *senior*. This is due to the higher turnover experienced during their entire career and the lower wages they face when *senior*. More productive workers, instead, enjoy much higher wages when *senior* and this allows them to compensate for their losses occurred when *junior*.

6.2 Sensitivity analysis

We analyze in this section the robustness of the results to perturbations of few key parameters such as the match-destruction shock q and the rate at which the productivity is revealed, λ.

We consider first the way labor force statistics change when we perturb the parameter of the match-destruction shock for workers hired on a permanent contract, q^p. We allow the parameter to vary in a range from 0.003 to 0.005. The change in the parameter's value affects all workers pre-reforms and *senior* workers post-reforms. The values are kept small because the rate includes only the quitting and not the firing rate[34]. In Table 11 we can notice that as q^p increases, unemployment increases while employment decreases. The changes are more significant among *senior* workers. Overall, however, the values for employment, unemployment, and labor force participation are not too sensitive to variation of q^p.

[34] In the model we assume there is no possibility to fire permanently-hired workers.

We consider then the perturbation of the parameter of the match-destruction shock for workers hired on a short-term contract, q^s. We allow the parameter to vary between 0.001 and 0.003. The change affects all the workers post-reforms. As for q^p, the unemployment increases and the employment decrease, as q^s increases. However, the changes are minimal.

Finally, we analyze the changes registered in the labor force statistics when we vary λ in a range from 0.045 to 0.055. The statistics are sensitive to the perturbation of this parameter. Particularly, employment and labor force participation are the ones which are subject to higher fluctuations. As λ increases, employment decreases and unemployment increases. The labor force participation overall decreases significantly.

6.3 Policy changes

In this section we describe the quantitative effects of reforms on the distribution of employment and unemployment as well as on the welfare of different categories of workers. We study the effects of two government policy interventions: the increase in the length of short-term contracts (by varying the parameter t) and the inclusion of a firing possibility, while workers are hired permanently.

Our counterfactual analysis starts with the focus on the effects of a change in t, which represents the rate at which the short-term contract expires, which determines the length of the short-term contract. In the calibration section, we fixed the value for t at 0.1, which corresponds to a length of approximately ten months. In this section, we allow t to vary from 0.04 to 0.15, which corresponds to a range of duration between 2 years ($t = 0.04$) and 6 months ($t = 0.15$).

We study first the effect of this policy intervention on the labor force statistics: unemployment and employment ratio to population for different values of t among *junior* workers (Figure 14(a)). We can easily notice that as the length of the short-term contract decreases (the value of t increases), the unemployment ratio increases significantly and the employment ratio decreases. When the short-term contract is longer (the value of t is lower), the employment ratio is higher and the unemployment ratio is lower compared to an economy where short-term contracts are not available (such as the economy pre-reforms). Note that in the economy pre-reforms the unemployment to population ratio was approximately 18.2%. For values of t higher than 0.09, the unemployment to population ratio is lower than in the economy without short-term contracts. For the extreme case where t is 0.04, the unemployment to population ratio is down to 12.5% and the employment is up to approximately 40%.

Looking at the same statistics for *senior* workers (Figure 14(b)) we can notice a similar trend, even though the range of variation is less important. In fact, the unemployment to population ratio varies approximately from 4% for low levels of t to 7.5% for higher levels of t. Longer short-term contracts seem

to increase employment and reduce unemployment. Note that the unemployment to population ratio was 4.7% before the reforms. The unemployment numbers shown in Figure 14(b) are lower compared to the pre-reforms economy for values of t smaller than 0.05.

In Figure 15(a) the distribution of the present discounted value of income for *junior* workers is presented. The light gray line shows the value pre-reforms (approximately 18.9 thousands euro), while the dark gray bar shows the values post-reforms, when allowing for the variation of t. We can readily notice that the shorter the duration of the short-term contract (bigger t), the lower the welfare of *junior* workers. Only when t takes values smaller than 0.05 (the length of the contract is at least 1.5 years) the welfare of *junior* workers is approximately unchanged (or slightly higher) with respect of a previous situation where short-term contracts were not available. For any value of t higher than 0.05, the present discounted value of income of *junior* workers is much lower. In particular, looking at the other extreme (value of t equal to 0.15), we can notice that the present discounted value of income is down to approximately 17.8 thousands euro. Young workers are consequently worse off after the reforms.

The welfare for *senior* more productive H type workers after the reforms is not affected by the length of the short-term contract, since they are hired permanently. In Figure 15(b) the change in the present discounted value of income of *senior* less productive L type workers is shown. As per *junior* workers , the shorter the duration of the short-term contract (the bigger the value of t), the lower the welfare of *senior* L type workers. The value of income decreases rapidly as the length of the contract decreases. Even in the extreme situation when t takes the value of 0.04 (2 years length), the welfare of *senior* L type workers is lower compared to a previous situation where short-term contracts were not available. Overall, the present discounted value of income of *senior* L type workers is sensitive to the change in the length of the contract. For high value of t (short length of the contract) the present discounted value of income is approximately one third of the value before the implementation of the reforms. For low value of t (longer length of the contract) the present discounted value of income is approximately two third of the value before the reforms.

Figure 16 shows the change in the present discounted value of lifetime income. In this context, we are not splitting the working life of the individuals according to the accumulated working experience, but we consider the time span since the entrance in the labor force until retirement. We can notice that for both more productive H type workers and less productive L type workers the welfare decreases as the length of short-term contracts decreases. However, the magnitude of the change is much bigger for H type workers. The value of income for more productive H type workers is higher compared to an economy without short-term contracts and the income variation due to changes in t is negligible. The situation is not as positive for less productive L type workers. In fact, for any value of t, the income of less productive workers is lower compared to the income they would have in an economy with no

short-term contracts. Even in a situation were the duration of the short-term contract is longer (2 years, $t = 0.04$) the welfare of the less productive L type workers is still lower compared to an economy with no short-term contracts (approximately 104 compared to 138 thousands euro).

Finally, we analyze how the labor force statistics change when firms have the possibility to fire workers hired permanently. We introduce a new random shock distributed poisson with parameter γ in the economy post-reforms. We study how employment, unemployment, and labor force participation among more productive workers change for different values of the parameter γ. Figure 17 shows that the bigger the values of γ, the more the unemployment increases and the employment decreases. This result is not surprising. In the economy post-reforms, indeed, firms offer permanent contracts only to highly productive workers. Allowing firms to fire H type workers does not make them better off, since the screening of the workers has been done already, by making use of short-term contracts. Most important, the decision of the firms regarding which contract to offer is unchanged. Indeed, even by allowing the firm to fire permanently-hired workers, it is still more profitable for firms to offer short-term contracts to *junior* workers and less productive L type workers, because of the lower vacancy and social security and welfare costs.

In summary, we can conclude that policies which incentive the utilization of longer short-term contracts would be beneficial for both *junior* and *senior* workers. The longer duration of short-term contracts would have beneficial employment effects for all workers and would help reduce the unemployment to population ratio, particularly among *junior* workers. In addition, there would be beneficial effects also in terms of welfare. In fact, the present discounted value of income for both types of workers is an increasing function of the length of the contract. By increasing the short-term contract duration (up to 2 years), *junior* workers would enjoy an income level similar to the one they would experience without short-term contracts. More productive workers would face a significant welfare increase. Even though less productive workers would be worse off compared to a situation without short-term contracts, however the gap would not be as significant and they would enjoy an higher income[35]. Finally, we can conclude that by implementing a policy intervention which allows firms to fire permanent workers without reforming the labor market structure, the unemployment to population ration might increase significantly and the overall labor market outcome might deteriorate.

A more substantial policy change would involve a more radical reform of the labor market, according to the US model of high flexibility. In the US, there exists only one type of contract and firms are allowed to fire workers with few days of mandatory layoff notice, by paying very low firing costs. In the next section, we will analyze the consequences of introducing the American labor market system in the Italian economy. We keep the same notation as in section 4.1, we model the new dynamics (Figure 9),

[35] In the current situation, we assume that the average short-term contract duration is 10 months.

we compute the equilibrium, and we calibrate the model by keeping the same values as in the economy with short-term contracts.

6.4 The Model with a Unique Flexible Contract (US model)

In this set up, only permanent contracts are available, as in the benchmark model, but firing is allowed at any stage of the worker's career. As before, whenever a firm decides to hire a worker, the firm opens a new vacancy. Whenever the firm finds a good match, the firm offers the worker a permanent contract (the only type of contract available). When the firm hires a *junior* worker, the worker's type (H type or L type) is not revealed. At this stage, the productivity level of the worker is the entry level productivity y_0. At rate λ the worker's productivity is revealed and the worker becomes *senior*. There are two situations in which a shock might hit the match and drive the surplus to zero (match destruction): the first, at rate q, captures the situation in which the worker decides to quit, while the second one, at rate δ, represents the firing action by the firm. This is the major novelty compared to the benchmark model: firms may fire the workers any time. Workers may retire at rate s^p,[36] and leave the labor force pool. In this case, the firm opens a new vacancy.

6.4.1 The Firm's Problem

Again there are three types of vacancies: a vacancy for *senior Htype* and $L-type$, and a vacancy for *junior* workers. When the firm posts a vacancy, the Bellmann equations for the firm are:

$$rJ_Y^V = -c_y^p + \alpha_y^p[J_Y^E - J_Y^V] \tag{26}$$

$$rJ_O^{VH} = -c_o^p + \alpha_o^p[J_O^{EH} - J_O^{VH}] \tag{27}$$

$$rJ_O^{VL} = -c_o^p + \alpha_o^p[J_O^{EL} - J_O^{VL}] \tag{28}$$

In equation 26, whenever the firm opens a vacancy for *junior* workers, the firm pays a cost c_y^p. The vacancy is filled at rate α_y^p. The parities bargain the current wage and the wage the worker will earn when she will become *senior*. If the opened vacancy is for *senior* workers, the firm pays a cost c_o^p and the vacancy is filled at rate α_o^p with a H type or a L type worker (Eq. 27). The parities bargain the current wage.

[36] The subscript p denotes the permanent feature of the contract.

When the vacancy is filled with *junior* or *senior*, either H type or L type workers, the firm Bellman equations are respectively:

$$rJ_Y^E = y_0 - w_y - \tau_y^p + \lambda[p(J_O^{EH} - J_Y^E) + (1-p)(J_O^{EL} - J_Y^E)] + (q+\delta)(J_Y^V - J_Y^E) \tag{29}$$

$$rJ_O^{EH} = y^P - w_o^H - \tau_o^p + (q+\delta)(J_O^{VH} - J_O^{EH}) + s^p(J_O^{VH} - J_O^{EH}) \tag{30}$$

$$rJ_O^{EL} = y^L - w_o^L - \tau_o^p + (q+\delta)(J_O^{VL} - J_O^{EL}) + s^p(J_O^{VL} - J_O^{EL}) \tag{31}$$

In Eq. 36, we can notice that when the *junior* worker is hired, her productivity is the entry level productivity y_0 and the firm pays her the wage w_y. Moreover, the firm pays social security and welfare fees equal to τ_y^p for her benefits. At rate λ the firm learns the worker's type. With probability p, she is H type, with productivity level $y^H > y_0$; with probability $(1-p)$, she is L type, with productivity level y^L, where $y^H > y^L > y_0$. In both cases, the firm keeps the worker within the workforce, since by bargaining the wage, the firm can still enjoy a positive surplus. At rate q the worker quits and the firm opens a new vacancy. At rate δ the firm fires the worker and the match is destroyed.

When the worker is *senior*, as shown in Eq. 37 and Eq. 38, her salary is equal to w_o, as bargained at the stipulation of the contract. Moreover, the firm pays the social security and welfare fee τ_o^p for the worker's benefits. The match may be destroyed if the worker decides to retire at rate s^p or if the negative shocks q and δ hit the match. In both situations, the firm opens a new vacancy.

6.4.2 The Worker's Value Functions

We can define the value of being unemployed for *junior* and *senior* workers as

$$rW_Y^{UH} = \mu_y[W_Y^{EH} - W_Y^{UH}] \tag{32}$$

$$rW_Y^{UL} = \mu_y[W_Y^{EL} - W_Y^{UL}] \tag{33}$$

$$rW_O^{UH} = b + \mu_o[W_O^{EH} - W_O^{UH}] \tag{34}$$

$$rW_O^{UL} = b + \mu_o[W_O^{EL} - W_O^{UL}] \tag{35}$$

Senior unemployed workers of different productivity levels are eligible for unemployment benefits b. Both more and less productive (H type and L type) *senior* workers have the chance to be re-hired after their match is dissolved at rate μ_o (See Eq. 34 and Eq. 35).

Junior workers find a new permanent job at rate μ_y (See Eq. 32 and Eq. 33). As in the previous models, they are not eligible for unemployment benefits.

The value of being employed for *junior* and *senior* workers of both types is

$$rW_Y^{EH} = w_y + \lambda[W_O^{EH} - W_Y^{EH}] + (q+\delta)[\max\{W_Y^{UH}, W_Y^{OLF}\} - W_Y^{EH}] \tag{36}$$

$$rW_Y^{EL} = w_y + \lambda[W_O^{EL} - W_Y^{EL}] + (q+\delta)[\max\{W_Y^{UL}, W_Y^{OLF}\} - W_Y^{EL}] \tag{37}$$

$$rW_O^{EH} = w_o^H + (q+\delta)[\max\{W_O^{UH}, W_O^{OLF}\} - W_O^{EH}] + s^p[W_O^{OLF} - W_O^{EH}] \tag{38}$$

$$rW_O^{EL} = w_o^L + (q+\delta)[\max\{W_O^{UL}, W_O^{OLF}\} - W_O^{EL}] + s^p[W_O^{OLF} - W_O^{EL}] \tag{39}$$

where

$$rW_Y^{OLF} = 0$$

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

As shown in Eq. 36 and Eq. 37, a *junior* worker gets a salary equal to w_y. Her productivity is revealed to the firm at rate λ: she maybe more productive H type or less productive L type. At rate q and δ the match is hit by a negative shock and destroyed. The worker decides whether to exit the labor force or join the unemployment pool by solving an optimization problem. Since as *junior* and unemployed the worker has chances to find a job (and hence she faces a positive utility), while the utility of being out of the labor force is zero, she chooses the former.

A *senior* worker gets a salary w_o^i $(i = H, L)$ while employed (Eq. 38 and Eq. 39). There are three events by which a *senior* employed worker may lose her job: if the match is destroyed at rate q or δ and if she retires at rate s^p. If the match gets destroyed when the worker is *senior*, the worker has to solve a utility maximization problem. She may decide to join the unemployment pool, from which she can exit by finding a new job at rate μ_o, or she may decide to retire. The former option gives her a positive utility b and the chance to be hired again, while the latter option gives her a utility equal to π[37]. Since the first option gives her an higher utility, she joins the unemployment pool. If the firm-worker match is hit by a retiring shock s^p, the worker leaves the labor force pool and she may die at rate d.

6.4.3 Wage Determination and Equilibrium Conditions

Solving the problem above from the point of view of the firms and the workers, we obtain the equilibrium equations for the firms and for the workers.

The firm's problem becomes:

[37] We can think of it as a pension payment.

$$J_O^{EH} = \frac{y - w_o^H - \tau_o^p}{(r+q+\delta+s^p)}$$
$$J_O^{EL} = \frac{y_0 - w_o^L - \tau_o^p}{(r+q+\delta+s^p)}$$
$$J_Y^{E} = \frac{y_0 - w_y - \tau_y^p}{(r+\lambda+q+\delta)} + \frac{\lambda p}{(r+\lambda+q+\delta)} J_O^{EH} + \frac{\lambda(1-p)}{(r+\lambda+q+\delta)} J_O^{EL}$$

The worker's value functions become:

$$W_Y^{EH} = \frac{w_y}{(r+\lambda+q+\delta)} + \frac{\lambda}{(r+\lambda+q+\delta)} W_O^{EH} + \frac{q+\delta}{(r+\lambda+q+\delta)} \frac{\mu_y}{(\mu_y+r)} W_Y^{EH}$$
$$W_Y^{EL} = \frac{w_y}{(r+\lambda+q+\delta)} + \frac{\lambda}{(r+\lambda+q+\delta)} W_O^{EL} + \frac{q+\delta}{(r+\lambda+q+\delta)} \frac{\mu_y}{(\mu_y+r)} W_Y^{EL}$$
$$W_O^{EH} = \frac{w_o^H}{(r+q+\delta+s^p)} + \frac{q+\delta}{(r+q+\delta+s^p)} W_O^{UH} + \frac{s^p}{(r+q+\delta+s^p)} W_O^{OLF}$$
$$W_O^{EL} = \frac{w_o^L}{(r+q+\delta+s^p)} + \frac{q+\delta}{(r+q+\delta+s^p)} W_O^{UL} + \frac{s^p}{(r+q+\delta+s^p)} W_O^{OLF}$$

The mechanism by which the labor market works is described in Figure 7.

We can use these expressions to compute the values of the wages received by *junior* and *senior* workers. We assume that the wages are determined using a Nash Bilateral Bargaining mechanism and we define β as the fraction of surplus enjoyed by the workers.

In this economy three are the wage levels: one for *junior* workers, one for *senior* more productive workers, and one for *senior* less productive workers. Workers and firms decide upon the current and future wage levels when they first meet and the permanent contract is signed.

The sharing rules for the determination of the wage per each workers' category are described by the following equations:

$$\beta[J_Y^E - J_Y^V] = (1-\beta)[p(W_Y^{EH} - W_Y^{UH}) + (1-p)(W_Y^{EL} - W_Y^{UL})]$$
$$\beta[(J_O^{EH} - J_O^{VH})] = (1-\beta)[(W_O^{EH} - W_O^{UH})]$$
$$\beta[(J_O^{EL} - J_O^{VL})] = (1-\beta)[(W_O^{EL} - W_O^{UL})]$$

The free entry conditions imply that on both markets (for *senior* and *junior* workers) the values of the vacancies are equal to zero. In steady state, to guarantee the stability of the system, the measure of newborns is equal to the measure of people who die. Moreover, the share of *junior* and *senior* people is

constant over time. By maximizing the total surplus, we compute the wage setting condition for *senior* and *junior* workers.

The equilibrium wage for H type *senior* workers is:

$$w_o^H = \beta[y^H - \tau_o^p] + (1-\beta)(r+s^p)W_O^{UH} - (1-\beta)s^p W_O^{OLF}$$

The wage setting condition for L type *senior* workers is:

$$w_o^L = \beta[y^L - \tau_o^p] + (1-\beta)(r+s^p)W_O^{UL} - (1-\beta)s^p W_O^{OLF}$$

Finally, the wage setting condition for *junior* workers is:

$$\begin{aligned} w_y = {} & \beta[y_0 - \tau_y^p] + (1-\beta)(r+\lambda)[pW_Y^{UH} + (1-p)W_Y^{UL}] \\ & - (1-\beta)\lambda[pW_O^{UH} + (1-p)W_O^{UL}] \end{aligned}$$

Rearranging and plugging in the expressions for each value function, we can write the wages as functions of the parameters of the model. We define θ as the tightness of the market per each segment[38].

$$w_o^H = \beta[y^H - \tau_o^p] + \left(\frac{r+s^p}{r}\right)((1-\beta)b + \beta c_o^p \theta_o^p) - (1-\beta)[s^p]\left(\frac{\pi}{r+d}\right) \tag{40}$$

$$w_o^L = \beta[y^L - \tau_o^p] + \left(\frac{r+s^p}{r}\right)((1-\beta)b + \beta c_o^p \theta_o^p) - (1-\beta)[s^p]\left(\frac{\pi}{r+d}\right) \tag{41}$$

$$w_y = \beta[y_0 - \tau_y^p] + \frac{(r+\lambda)}{r}\beta c_y^p \theta_y^p - \frac{\lambda}{r}((1-\beta)b + \beta c_o^p \theta_o^p) \tag{42}$$

6.5 Findings

After computing the equilibrium conditions, we proceed by calibrating the model. We use the same values as in the short-term environment to capture the increased flexibility of the system and the increased turnover, but we use the same values as in the pre-reforms economy to capture the characteristics of the social security system and the labor costs in Italy. Figure 10 illustrates the distribution of employment and unemployment for *junior workers* for different values of δ, the rate at which the match is destroyed (firing rate). We can notice that for any value of δ, the labor market situation for *junior* workers is better

[38] $\theta_o^p = \frac{\mu_o}{\alpha_o^p}$ and $\theta_y^p = \frac{\mu_y}{\alpha_y^p}$.

with the American system, compared to both economies, pre and post-reforms. The unemployment rate is lower and the employment rate higher. This is due to the flexibility of the system, which allows *junior* workers to find a job in a shorter period of time, after they are fired. If we look at the labor market of *senior* workers (Figure 11), the results are less convincing. For low values of δ, the unemployment rate is lower and the employment a rate is higher, compared to the economy pre-reforms. However, whenever the firing rate increases, both rates tend to converge towards each other, generating high unemployment and low employment. This final picture of the labor market describes a situation, which is worse compared to both pre and post reforms economies. We can therefore think that in an economic slowdown period, the ability for firms to fire workers without restrictions could easily generate a situation of high unemployment. However, the two figures presented here (Figure 10 and Figure 11), may suggest that the introduction of a unique labor market contract, which is very flexible for *junior* workers and less flexible for *senior* workers, might have beneficial effects on the Italian labor market. In Figure 12, we consider the total time spent in employment and unemployment by *junior* workers. We can notice that in the economy where the American model has been implemented, the workers spend less time in unemployment, compared to the economy post-reforms, even when the firing rate is quite high. Figure 12 presents a similar picture for *senior* workers. They spend the same amount of time in employment, as in the post-reforms economy, and overall they spend less time in unemployment. Most important, the dualism between more and less productive workers is eliminated since firms set the wages for different types of workers according to their productivity levels, by having the outside option to fire them.

7 Conclusion and Discussion

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

We present a set of stylized facts regarding the Italian labor market. First of all, we show that people hired short-term are mostly young, female, inexperienced, less educated, and poorly qualified. In addition, recent college graduates are also very likely to be hired on a short-term basis. We provide evidence that short-term contracts, which are associated with lower wages, often come in sequences. Finally, we show that labor force participation has increased particularly among older workers. To explain these patterns, we develop two standard Mortensen and Pissarides search models, pre and post-reforms, allowing for workers heterogeneity with respect to productivity and differentiated contracts, and introducing social security fees to be paid by the firm. We analyze the working career of individuals before the reforms, when only permanent contracts are available, and after the reforms, when permanent and short-term

contracts coexist. We identify both the lower costs and the higher flexibility associated with short-term contracts as driving forces behind the firm decision to hire workers on a temporary basis.

Using Italian data, we perform the calibration of the model in order to quantify the change in welfare for different categories of workers. We show that the model is able to replicate accurately the patterns observed in the data. By computing the present discounted value of income, we find that *junior* workers are worse off after the reforms. *Senior* workers, if more productive, enjoy higher wages and the benefits of permanent contracts. Less productive *senior* workers do not have the opportunity to be hired on a permanent basis in the post-reforms economy. Hence, they fall into cycles of unemployment and short-term employment, facing lower salaries and reduced benefits. Accounting for the lifetime income, we can additionally identify, in the post reforms era, a decrease in income for less productive individuals as well as an increase in income for more productive workers.

We then make use of the model to study the effects of labor market policy interventions, such as the perturbation of the short-term contracts duration and the possibility for firms to fire workers hired permanently. We find that longer short-term contracts would be beneficial for all types of workers. In particular, the welfare of all categories of workers would be higher compared to the current situation and the labor market statistics would improve. Not only the labor force participation would increase, but also employment would be higher and unemployment would shrink. The introduction of firing possibilities for permanently-hired workers would not be effective in improving labor market conditions. In this set up, short-term contracts are still the most profitable options for firms, both as a screening device for younger workers and as a buffer for less productive workers. Hence, the possibility to fire permanent workers has the only effect of increasing unemployment and decreasing employment. Our hypothesis is that in an economy where short-term and permanent contracts coexist, the possibility of firing permanent workers might not be sufficient to eliminate the existing duality. However, within this framework it is possible to test other policy interventions, such as the one suggested by some European economists to introduce a unique American-style contract, which allows firms to fire workers at no costs any time. Designing this new environment and computing the equilibrium, we can conclude that the American system would be beneficial for *junior* workers, but the effects are less clear for *senior* workers. This might suggests that a new reform, which introduces a unique contract, which is flexible for *junior* workers, but more rigid for *senior* workers could have positive effects on the whole labor market.

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References

Aguirregabiria, Victor and Cesar Alonso-Borrego (2009). "Labor Contracts and Flexibility: Evidence from a Labor Market Reform in Spain". In: *University of Chicago, Department of Economics*. URL: http://ssrn.com/abstract=156451ordoi:10.2139/ssrn.156451.

Barbieri, Paolo and Stefani Scherer (2009). "Labour Market Flexibilization and its Consequences in Italy". In: *European Sociological Review* 25 (6), pp. 677–692.

Bentolila, Samuel and Gilles Saint-Paul (1992). "The macroeconomic impact of flexible labour contracts: an application to Spain". In: *European Economic Review* 36 (5), pp. 1013–1047.

Bentolila, Samuel et al. (1994). "Labour Flexibility and Wages: Lessons from Spain". In: *Economic Policy* 9 (18), pp. 53–99.

Bentolila, Samuel et al. (2010). "Unemployment and Temporary Jobs in the Crisis: Comparing France and Spain". In: *Fundacin de Estudios de Economa Aplicada , Fundacin de Estudios de Economa Aplicada , Spain*.

Berton, Fabio (2008). "The (long) run out of unemployment: Are temporary jobs the shortest way?" In: *LABORatorio Revelli Working Papers*.

Berton, Fabio and Pietro Garibaldi (2006). "Workers and firm sorting into temporary jobs". In: *LABORatorio Revelli Working Papers*.

Berton, Fabio et al. (2007). "Temporary jobs: Port of entry, trap, or just unobserved heterogeneity?" In: *LABORatorio Revelli Working Papers*.

Blanchard, Olivier and Augustin Landier (2002). "The Perverse Effects of Partial Labour Market Reform: Fixed-Term Contracts in France". In: *Economic Journal* 112 (480), pp. 214–244.

Blanchard, Olivier and Pedro Portugal (2001). "What Hides Behind an Unemployment Rate: Comparing Portuguese and U.S. Labor Markets". In: *American Economic Review* 91 (1), pp. 187–207.

Boeri, Tito (2011). "Institutional Reforms and Dualism in European Labor Markets". In: *Bocconi University Working Papers*.

Cabrales, Antonio and Hugo Hopenhayn (1997). "Labor-market flexibility and aggregate employment volatility". In: *Carnegie Rochester Conference Series on Public Policy* 46, 189 228.

Cahuc, Pierre and Fabien Postel-Vinay (2002). "Temporary Jobs, Employment Protection and Labor Market Performance". In: *Labour Economics* 9 (1), pp. 63–91.

Cao, Shutao et al. (2011). "Fixed-Term and Permanent Employment Contracts: Theory and Evidence". In: *Federal Reserve Bank of Atlanta Working Papers.*

Diamond, Peter (1982). "Wage Determination and Efficiency in Search Equilibrium". In: *The Review of Economic Studies* 42 (2), pp. 217–227.

Elsby, Michael et al. (2009). "Unemployment Dynamics in the OECD". In: *NBER Working Papers, No. 14617.*

Faccini, Renato (2008). "Reassessing Labor Market Reforms: Temporary Contracts as a Screening Device". In: *European University Institute Working Papers.*

Giannelli, Gianna et al. (2009). "Have labour market reforms at the turn of the millennium changed job durations of the new entrants? A comparative study for Germany and Italy". In: *LABORatorio Revelli Working Papers.*

Guell, Maia (2000). "The effects of fixed-term contracts on the duration distribution of unemployment: the Spanish case". In: *Princeton University Working papers.*

Guell, Maia and Barbara Petrongolo (2007). "How binding are legal limits? Transitions from temporary to permanent work in Spain". In: *Labour Economics* 14 (2), pp. 153–183.

Hagedorn, Marcus and Iourii Manovski (2006). "The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited". In: *University of Pennsylvania Working Papers.*

Hopenhayn, Hugo and Richard Rogerson (1993). "Job Turnover and Policy Evaluation: A General Equilibrium Analysis". In: *The Journal of Political Economy* 101 (5), pp. 915–938.

Mortensen, Dale (1984). "Job Search and Labor Market Analysis". In: *Handbook of Labor Economics* 11.

Mortensen, Dale and Christopher Pissarides (1994). "Job Creation and Job Destruction in the Theory of Unemployment". In: *The Review of Economic Studies* 61 (3), pp. 397–415.

Nunziata, Luca and Stefano Staffolani (2001). "On Short-term Contracts Regulations". In: *Universita' Politecnica delle Marche working papers.*

Pfeifer, Christian (2009). "Fixed-term Contracts and Employment Adjustment: An Empirical Test of the Core-Periphery Hypothesis Using German Establishment Data". In: *The Economic Record* 85 (268), pp. 92–107.

Pissarides, Christopher (2000). "Equilibrium Unemployment Theory". In: ed. by Oxford Blackwell.

Portugal, Pedro and Jose Varejao (2003). "Why Do Firms Use Fixed-Term Contracts?" In: *IZA Discussion Papers, No 4380.*

Rubinstein, Ariel (1982). "Perfect Equilibrium in a Bargaining Model". In: *Econometrica* 50 (1), pp. 397–415.

Serrano, Carlos (1998). "Worker turnover and job reallocation: the role of fixed-term contracts". In: *Oxford Economic Papers* 50 (4), pp. 709–725.

SHIW (1993-2008). "Survey on Household Income and Wealth. Bank of Italy". In: URL: `http://www.bancaditalia.it/statistiche/indcamp/bilfait;internal&action=_setlanguage.action?LANGUAGE=en`.

Sylos-Labini, Mauro (2005). "Job Search Methods and Outcomes for the Employed and Unemployed: An empirical investigation". In: *S.Anna School of Advanced Studies Working Papers*.

Tealdi, Cristina (2010). "Short-term Employment Contracts in Italy: Who is the Winner?" In: *Northwestern University Working papers*.

— (2011). "Typical and atypical employment contracts: the case of Italy". In: *Northwestern University Working papers*.

Viviano, Eliana (2003). "A structural matching model to analyze labour market dynamics". In: *University of Rome Working Papers*.

Wasmer, Etienne. (1999). "Competition for jobs in a growing economy and the emergence of dualism in employment". In: *Economic Journal* 109, pp. 349–371.

WHIP (1985-2005). "Work Histories Italian Panel. LABORatorio Revelli Centre for Employment Studies." In: URL: `http://www.laboratoriorevelli.it/whip`.

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 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
r	Interest rate
β	Worker's share of surplus
p	Share of H type workers
k	Measure of individuals born each instant
y_0	Productivity level of *junior* workers
y^P	Productivity level of H type *senior* workers
y^L	Productivity level of L type *senior* workers
b	Unemployment benefits
c_o^p	Vacancy cost for *senior* permanent workers
c_y^s	Vacancy cost for *junior* temporary workers
c_o^s	Vacancy cost for *senior* temporary workers
m	Rate at which *junior* individuals join the labor force
π	Utility out of the labor force
d	Rate at which people die
s^p	Rate at which permanent workers retire
s^s	Rate at which temporary workers retire
q^p	Rate at which the permanent match is destroyed
q^s	Rate at which the temporary match is destroyed
t	Rate at which the temporary contract expires
λ	Rate at which the productivity is revealed
γ	Rate at which the L type *senior* re-join the labor force
μ_y	Rate a *junior* receives a job offer
μ_o^H	Rate a H type *senior* receives a job offer
μ_o^L	Rate at which a L type *senior* receives a job offer
α_y^p	Rate at which a H type *senior* receives a job offer
α_y^s	Rate at which a firm offers H type *senior* receives a job offer
α_o^p	Rate at which a permanent vacancy for a H type *senior* is filled
α_o^s	Rate at which a temporary vacancy for a L type *senior* is filled
τ_o^p	Social security fees for *senior* permanent workers
τ_y^p	Social security fees for *junior* permanent workers
τ_o^s	Social security fees for *senior* temporary workers
τ_y^s	Social security fees for *junior* temporary workers

Table 6: Calibration parameter values

Parameter	Pre-reforms	Post-reforms
r	0.01	0.01
β	0.4	0.4
p	0.85	0.85
k	500	500
y_0	1500	1500
y	2500	2500
b	800	1000
c_o^p	1500	1500
c_y^s	—	1000
c_o^s	—	750
m	0.046	0.043
u	100	100
d	0.0058	0.0058
s^p	0.0036	0.0034
s^s	—	0.005
q^p	0.004	0.004
q^s	—	0.002
t	—	0.1
λ	0.05	0.05
γ	—	0.002
μ_y	0.11	0.3
μ_o^h	0.05	0.08
μ_o^l	—	0.25
α_y^p	0.06	—
α_y^s	—	0.13
α_o^p	0.25	0.14
α_o^s	—	0.11
τ_o^p	500	500
τ_y^p	300	—
τ_o^s	—	200
τ_y^s	—	100

Table 7: Labor market statistics for *senior* workers: data versus model

	Data		Model	
	Pre-reforms	Post-reforms	Pre-reforms	Post-reforms
Total employment rate	58.2%	65.0%	58.8%	64.8%
Permanent rate				
H type	—	—	49.9%	57.9%
L type	—	—	8.9%	—
Short-term rate				
L type	—	—	—	6.9%
Total unemployment rate	4.8%	5.4%	4.7%	5.5%
H type	—	—	4.7%	2.85%
L type	—	—	—	2.89%
Total out of labor force rate	37.0%	29.6%	36.5%	29.7%
Average wage (in €)				
H type	1570	2040	1520	2000
L type	1570	1370	1520	1406

Table 8: Labor market statistics for *junior* workers: data versus model

	Data		Model	
	Pre-reforms	Post-reforms	Pre-reforms	Post-reforms
Total employment rate	39.4%	39.0%	38.9%	38.4%
Permanent rate				
H type	—	—	33.1%	—
L type	—	—	5.9%	—
Short-term rate				
H type	—	—	—	32.6%
L type	—	—	—	5.8%
Total unemployment rate	18.5%	16.5%	18.8%	16.9%
H type	—	—	15.9%	14.4%
L type	—	—	2.8%	2.5%
Total out of labor force rate	42.3%	44.5%	42.3%	44.7%
Average wage (in €)	1050	1120	1010	1100

Table 9: Welfare changes by worker's types

	Pre-reforms	Post-reforms
Average working income while in the labor force (1000 €)		
Junior	21.1	21.7
Senior H type	453.0	625.0
Senior L type	453.0	278.3
Average time in the labor force (in months)		
Junior	20.7	26.8
Senior H type	300.0	308.8
Senior L type	300.0	283.2
Present value of total income while in the labor force (1000 €)		
Junior	19.0	18.4
Senior H type	133.6	175.8
Senior L type	133.6	52.4

Table 10: Lifetime income changes by worker's types

	Pre-reforms	Post-reforms
Average working income while in the labor force (1000 €)		
H type	440.7	247.4
L type	440.7	113.3
Average time in the labor force (in months)		
H type	307.4	327.0
L type	307.4	282.4
Present value of total income while in the labor force (1000 €)		
H type	136.7	188.9
L type	136.7	70.8

Table 11: Sensitivity analysis

	q^p			q^s			λ		
	0.003	0.004	0.005	0.001	0.002	0.003	0.045	0.05	0.055
Pre-reforms-*junior*									
Employment	39.06	38.92	38.79				41.46	38.93	36.69
Unemployment	18.48	18.77	19.05				17.98	18.76	19.45
Out of the Labor Force	42.36	42.31	42.16				40.56	42.31	43.87
Post-reforms-*junior*									
Employment				38.42	38.37	38.32	40.97	38.45	36.22
Unemployment				5.41	5.44	5.47	16.16	16.85	17.46
Out of the Labor Force				44.67	44.62	44.56	42.87	44.71	46.33
Pre-reforms-*senior*									
Employment	59.50	58.80	58.12						
Unemployment	3.57	4.70	5.81						
Out of the Labor Force	36.93	36.50	36.07						
Post-reforms-*senior*									
Employment	65.33	64.84	64.36	64.88	64.86	64.84			
Unemployment	4.75	5.47	6.17	5.41	5.44	5.47			
Out of the Labor Force	29.91	29.69	29.47	29.71	29.70	29.69			

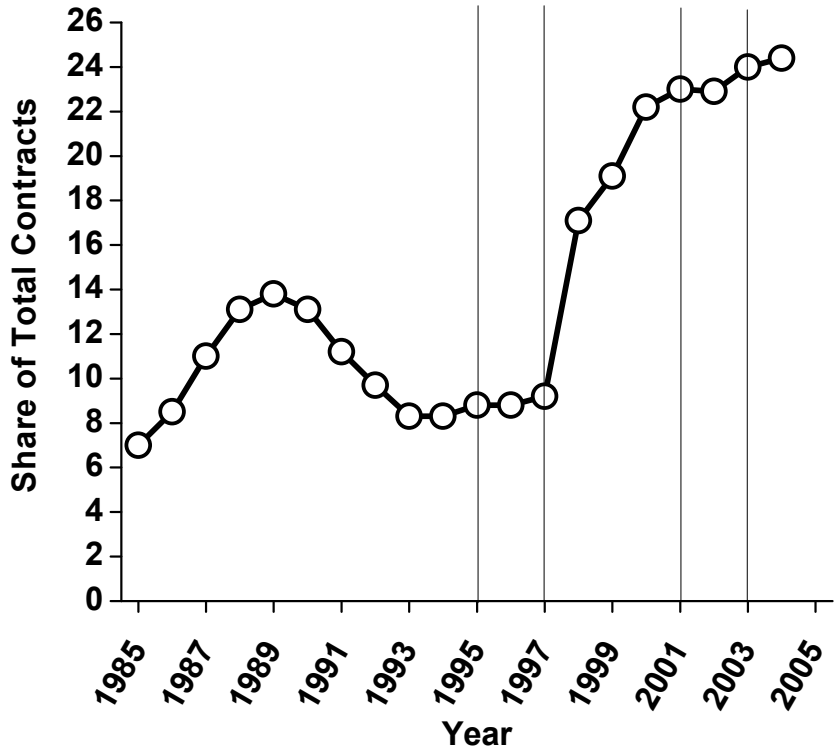


Fig. 1: Percentage of short-term contracts (as a share of total contracts). Vertical lines correspond to years of introduction of new reforms.

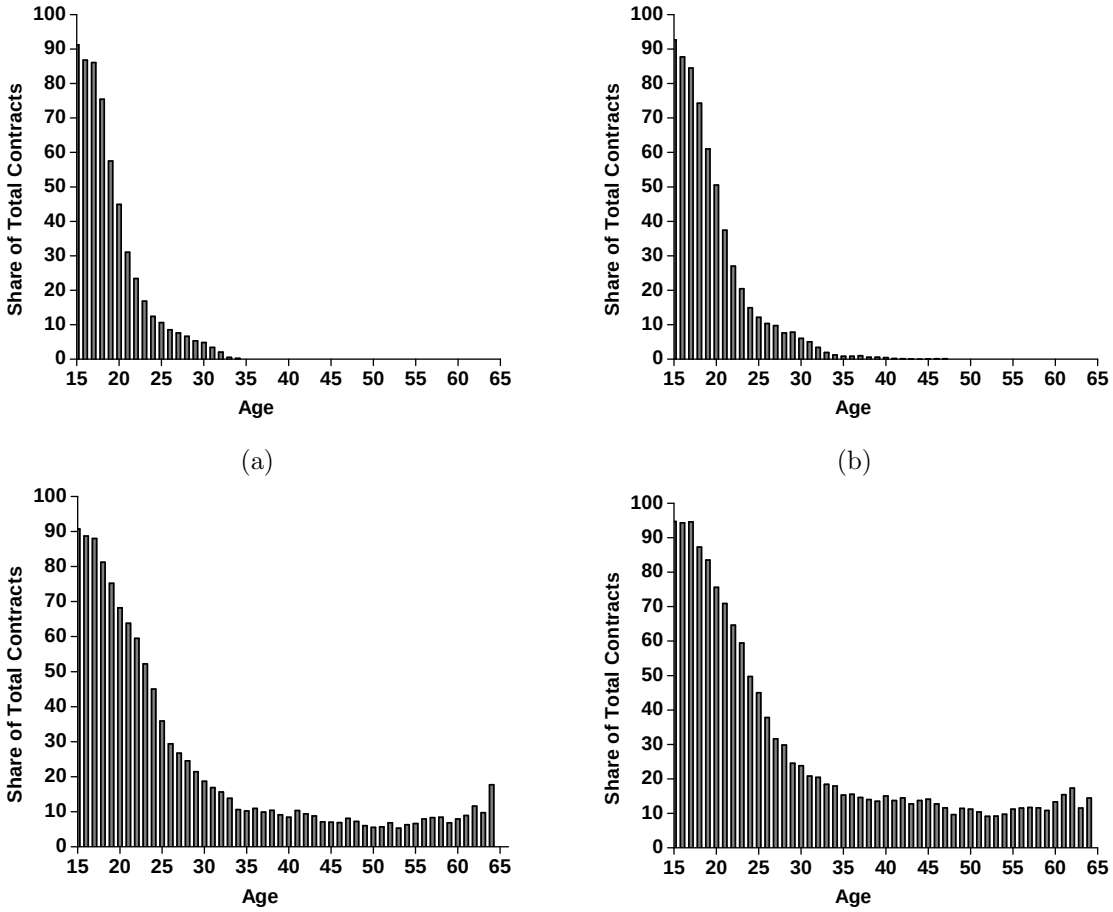
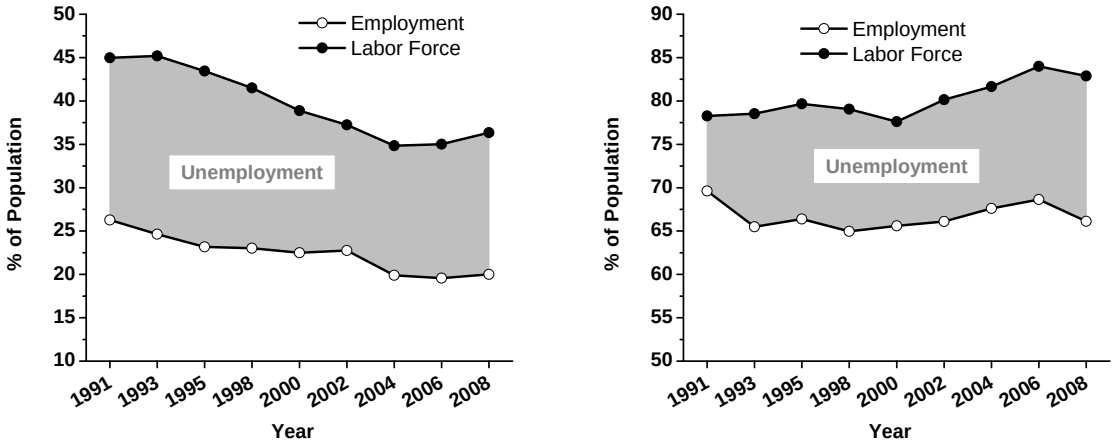
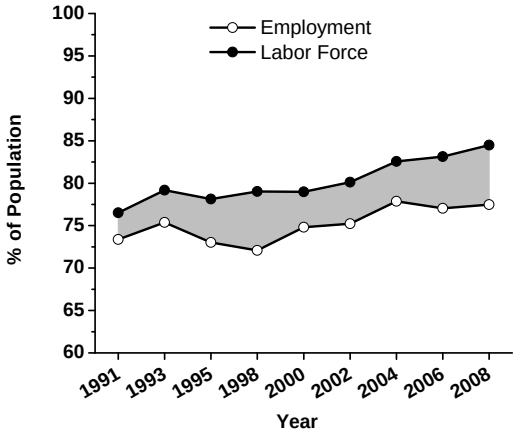


Fig. 2: Short-term contracts age distribution in years (a) 1995, (b) 1997, (c) 2000, and (d) 2004.

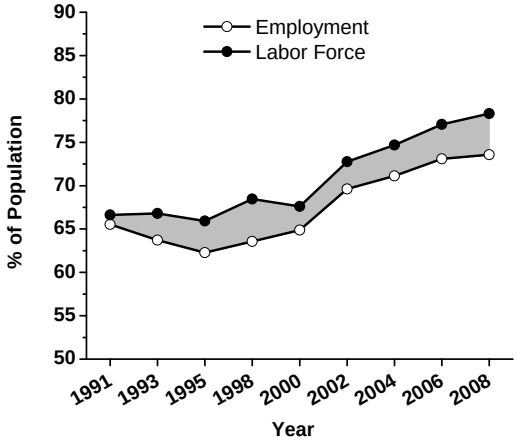


(a)

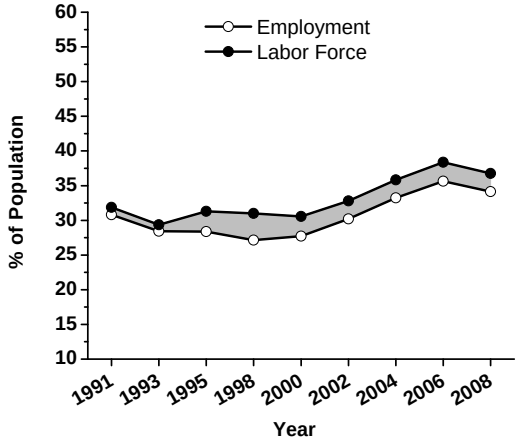
(b)



(c)



(d)



(e)

Fig. 3: Labor market statistics (employment, labor force, unemployment) across age groups (a) 15-24, (b) 25-34, (c) 35-44, (d) 45-54, and (e) 55-64.

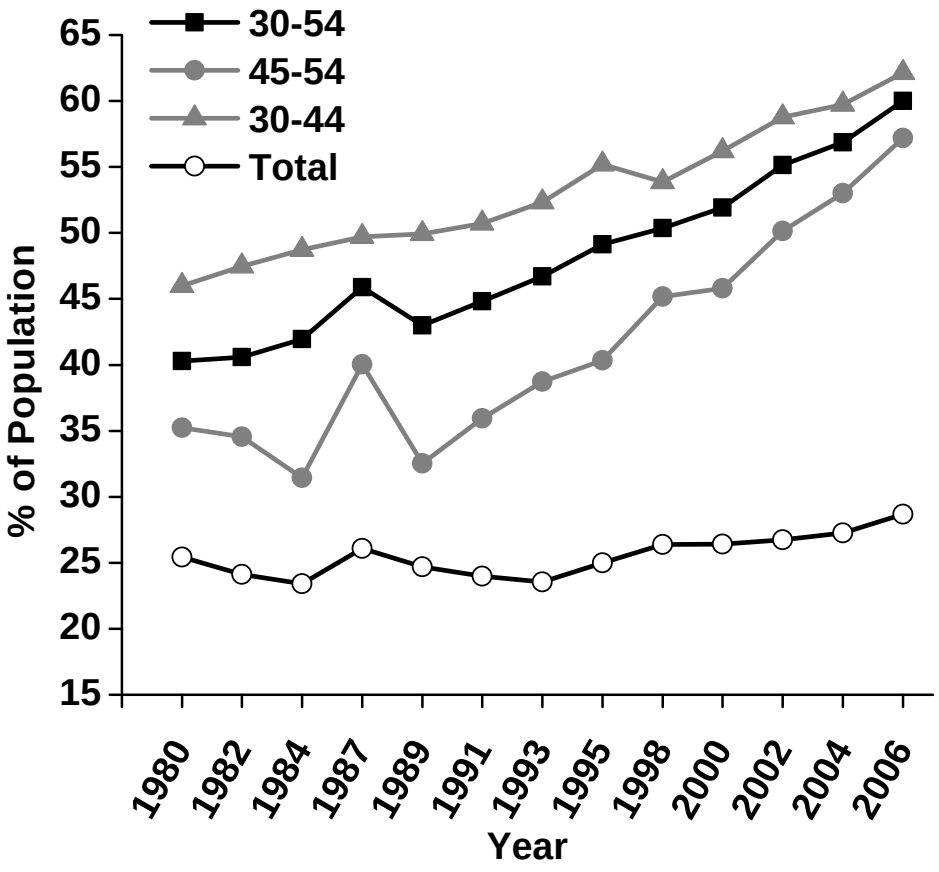


Fig. 4: Female employment rate as a % of age group population.

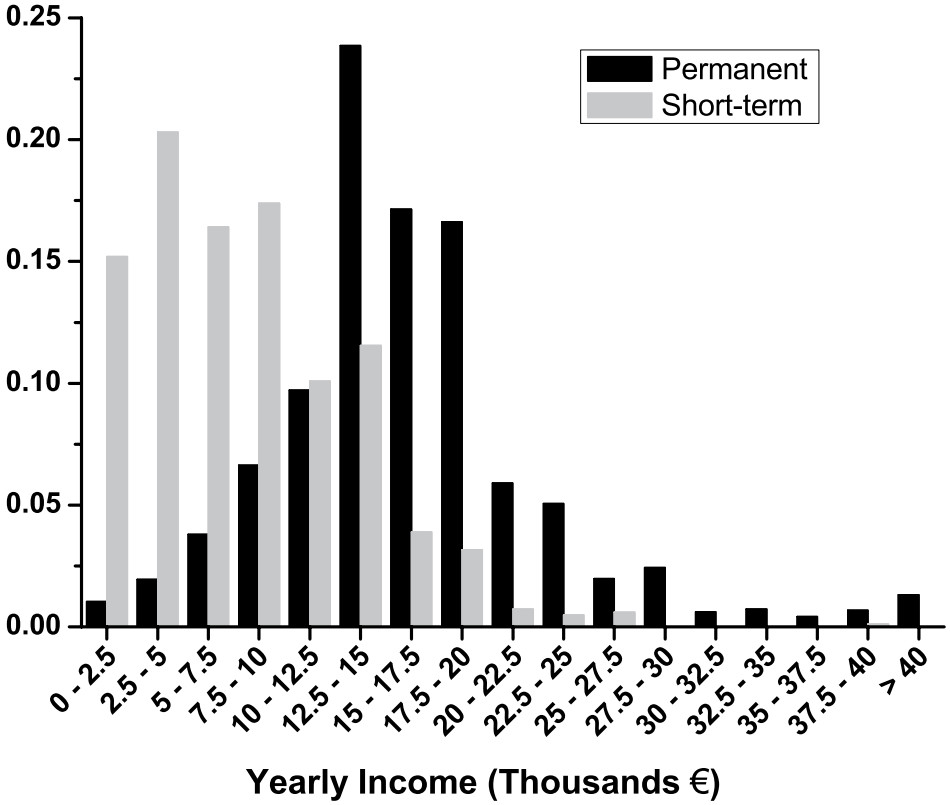


Fig. 5: Distribution of yearly net income in Euro for workers in permanent and short-term contracts.

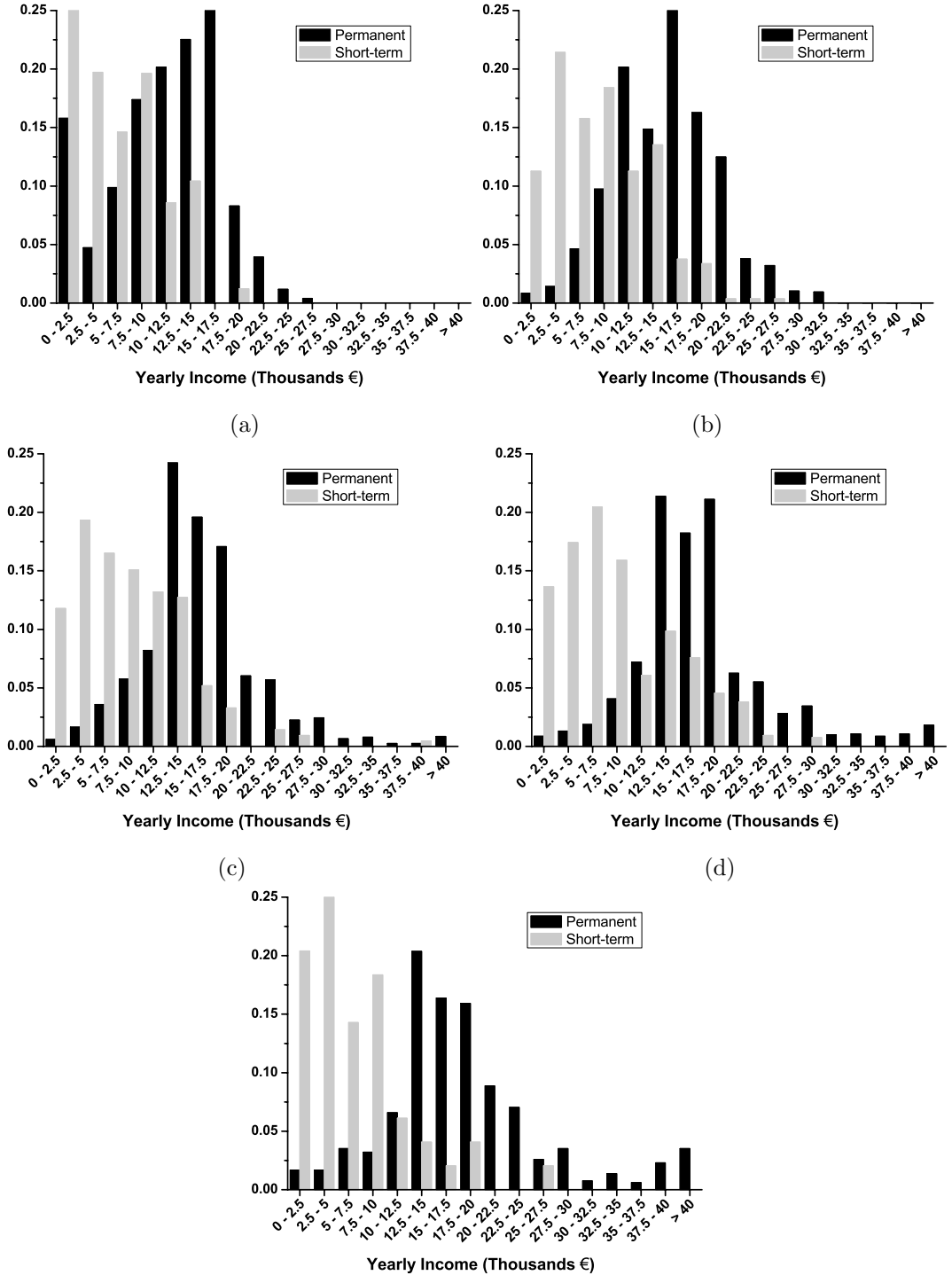


Fig. 6: Distribution of yearly net income in Euro for workers in permanent and short-term contracts by age groups (a) 15-24, (b) 25-34, (c) 35-44, (d) 45-54, and (e) 55-64.

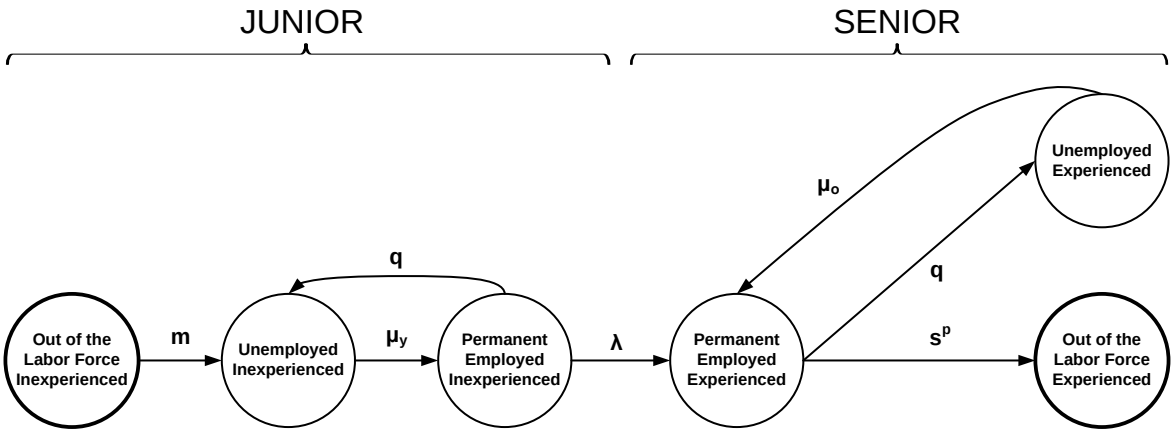


Fig. 7: The model pre-reforms.

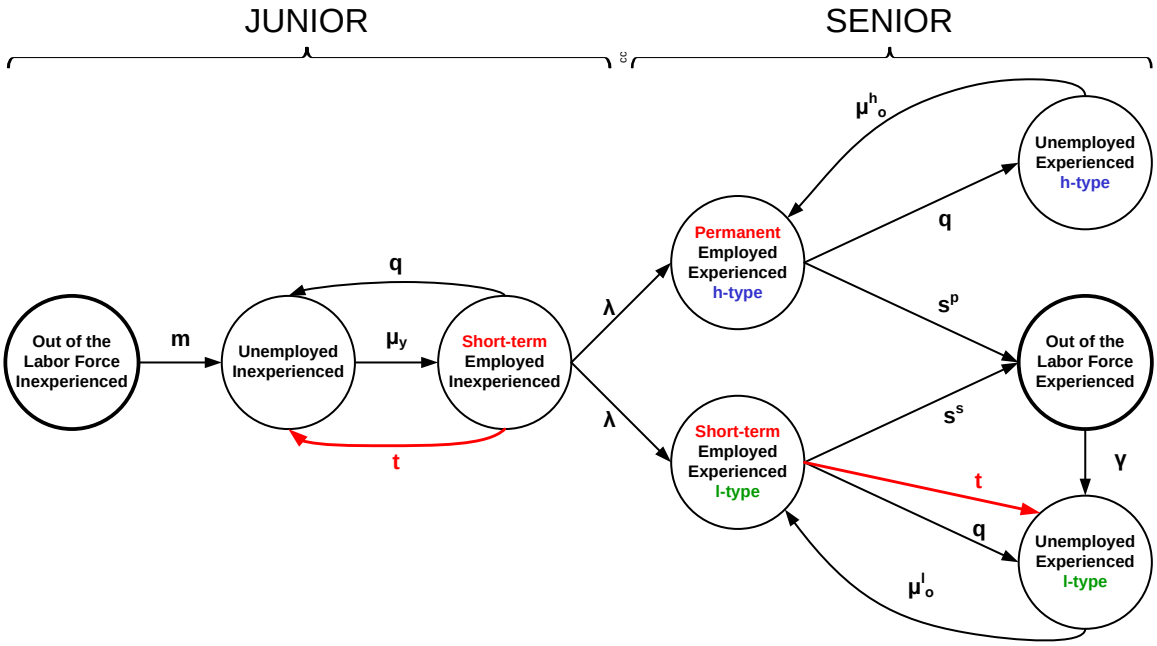


Fig. 8: The model post-reforms.

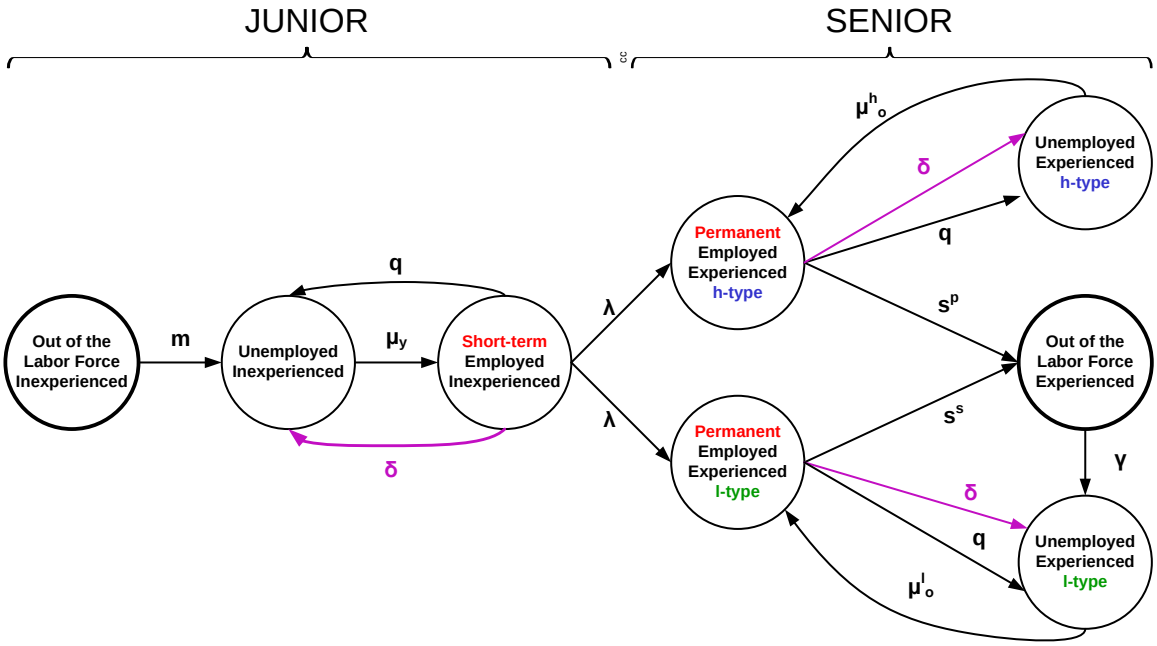


Fig. 9: The model with future reforms.

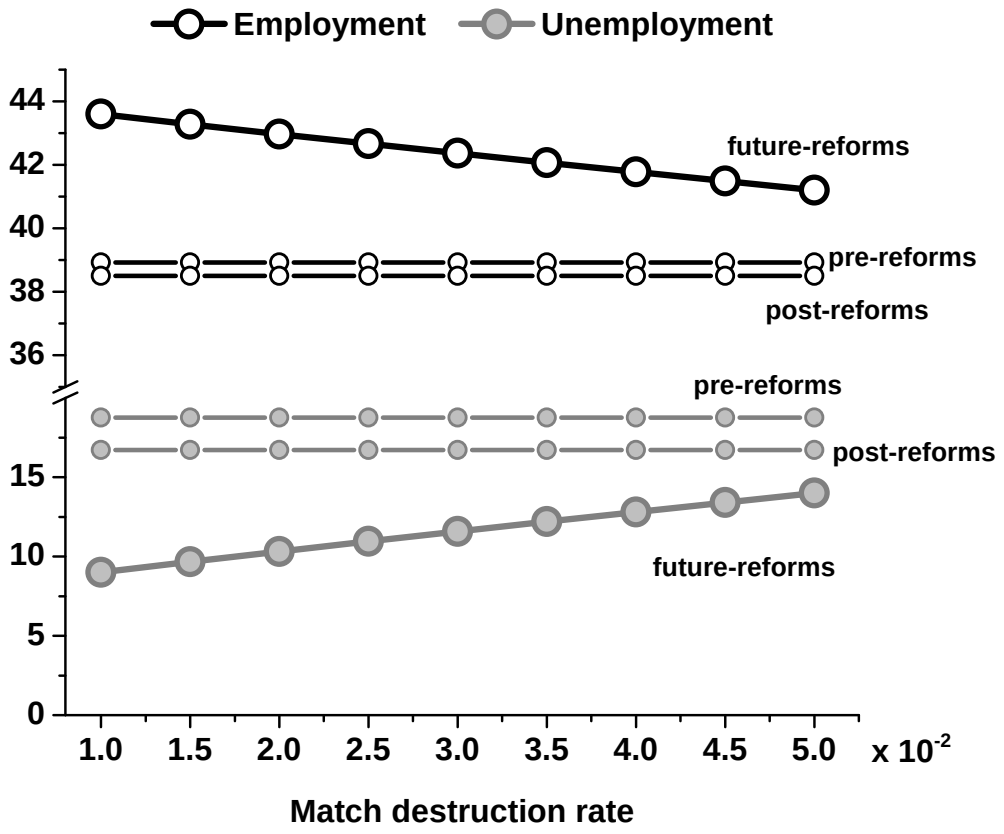


Fig. 10: Time spent in employment and unemployment before, after, and with future reforms by *senior* workers

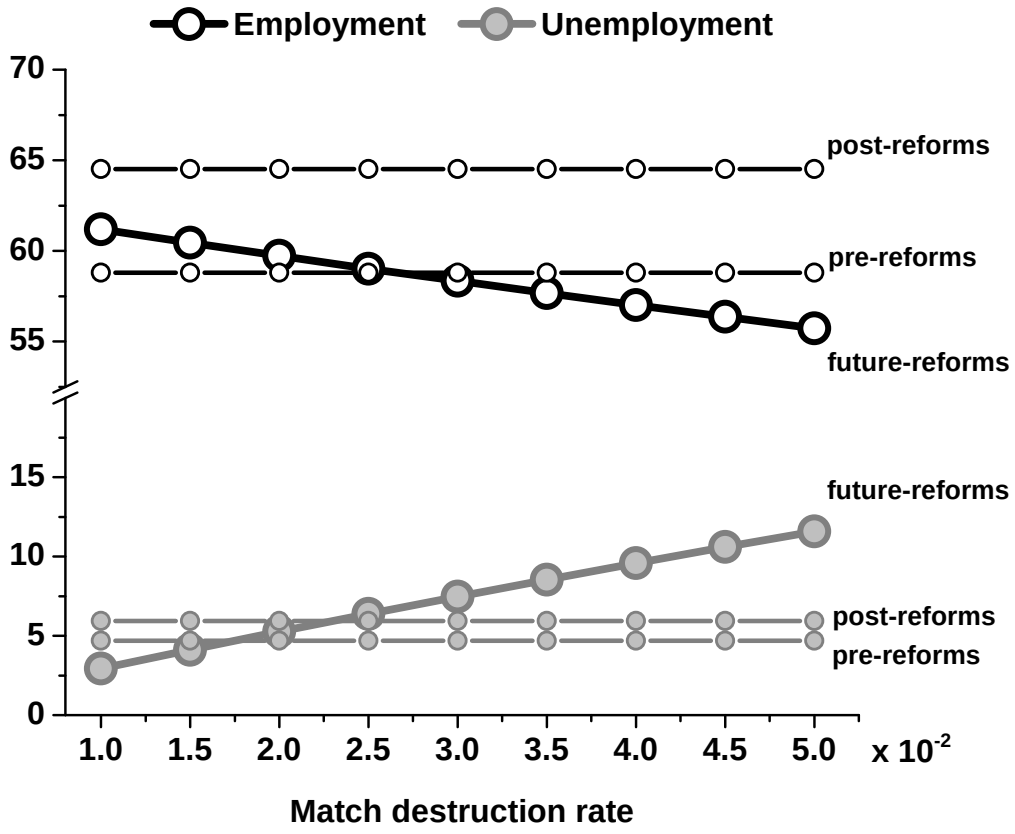


Fig. 11: Time spent in employment and unemployment before, after, and with future reforms by *senior* workers

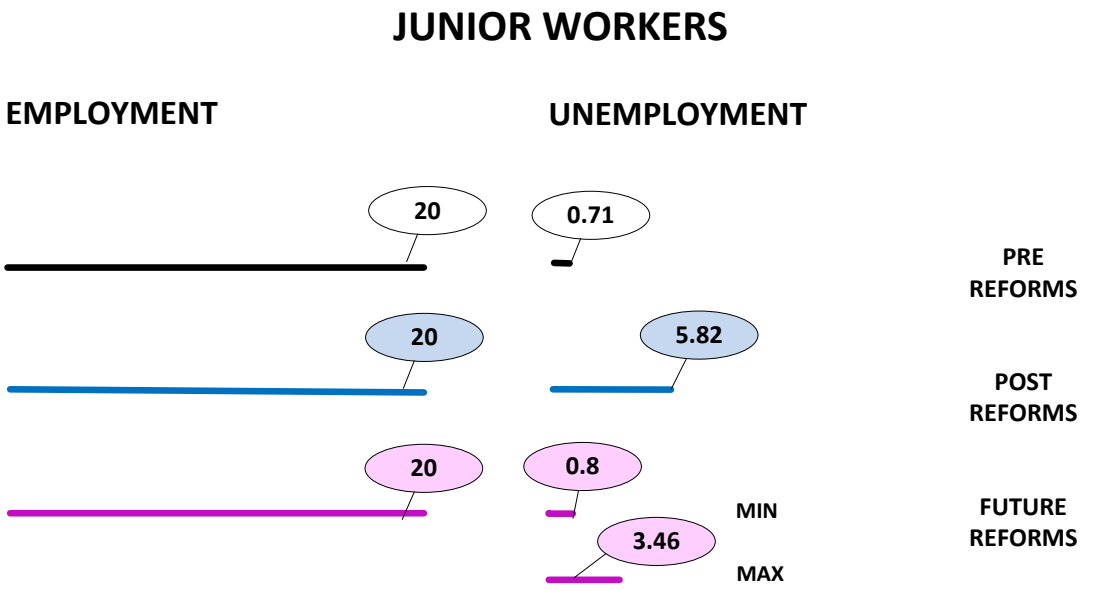


Fig. 12: Time spent in employment and unemployment before, after, and with future reforms by *junior* workers

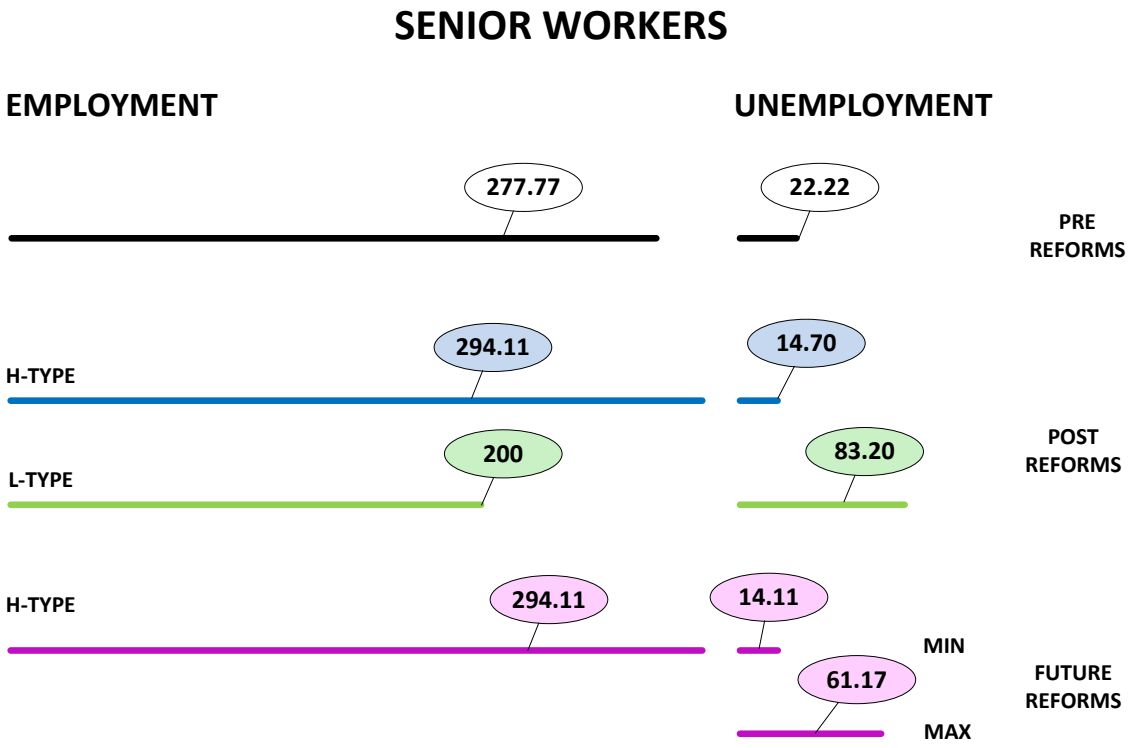
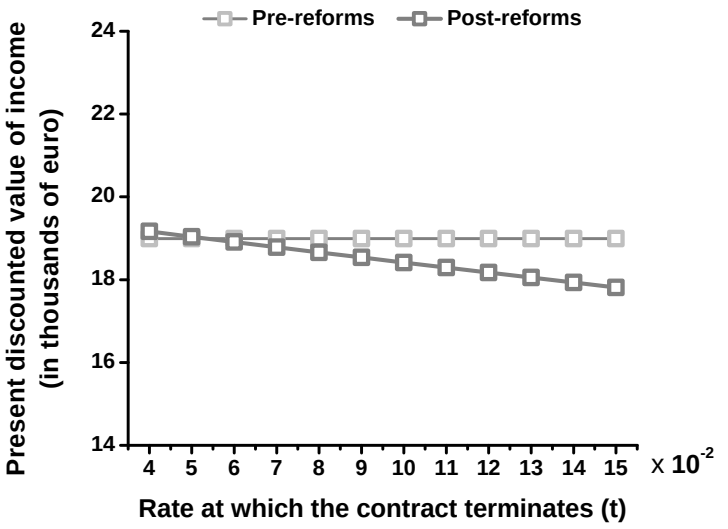


Fig. 13: Time spent in employment and unemployment before, after, and with future reforms by *senior* workers

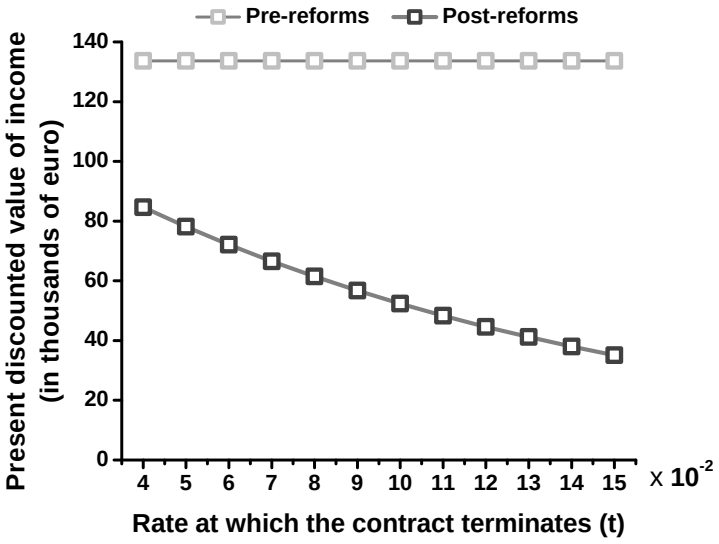
(a)

(b)

Fig. 14: Labor force statistics (employment and unemployment) as share of total population for (a) *junior* workers and (b) *senior* workers for different values of t.



(a)



(b)

Fig. 15: Present discounted value of income pre and post reforms for (a) *junior* workers and (b) *senior* L type workers for different values of t.

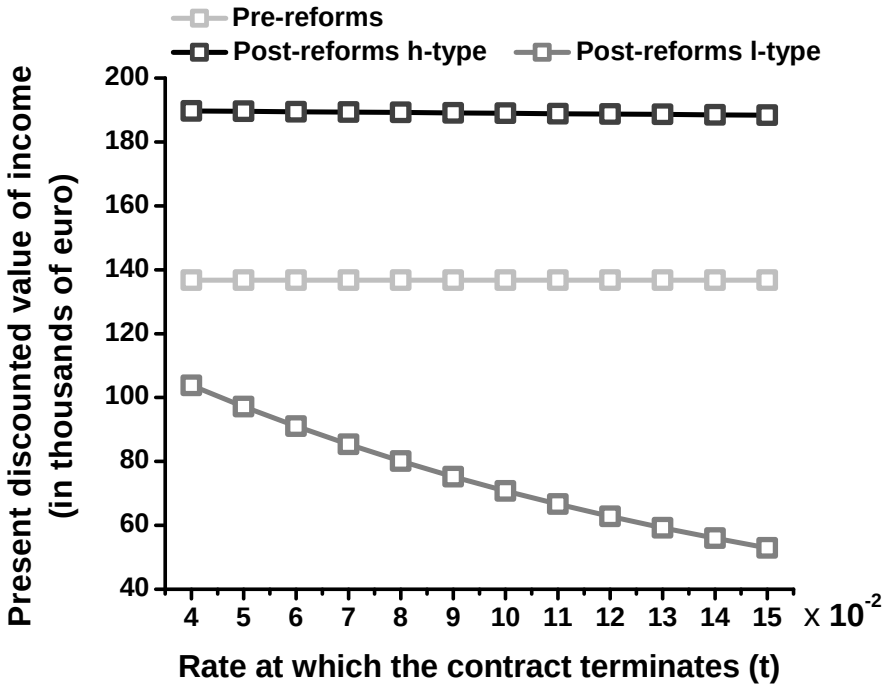


Fig. 16: Present discounted value of lifetime income for less productive (L) and more productive (H *type*) workers pre and post reforms for different values of t.

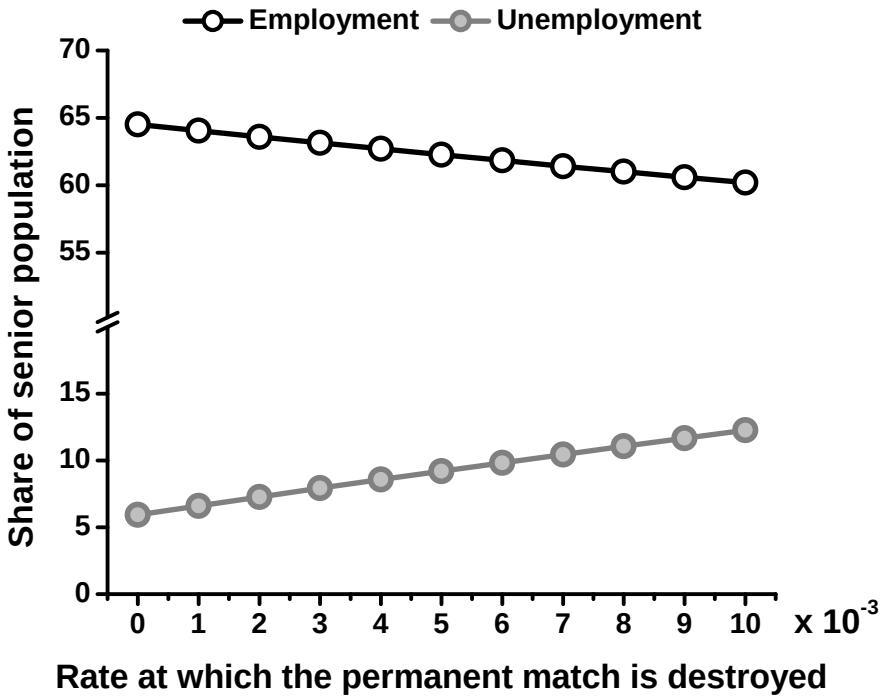


Fig. 17: Present discounted value of lifetime income for less productive (L) and more productive (H *type*) workers pre and post reforms for different values of t.