Final Report

WERSA PROJECT STRAND 1 - Building administrative datasets and models

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Contents

Executive summary

Pension expenditure is one of the largest outgoings for almost all European countries' public budgets – as a result of the combination of generous first pillar pension formulae and the rapid onset of population ageing – and it has often been the first field of intervention when those European countries with high public debt are forced to act to reduce their indebtedness.

It is precisely under the pressure of the financial markets and the threat of a default that from the early 1990s the Italian pension system started a deep reform process aimed at recovering financial sustainability. The milestones of this process have been the progressive shifting from a very generous Defined Benefit regime (DB rule) to a (more actuarially fair) Notional Defined Contribution (NDC) one and an increase in the age and seniority requirements to access retirement benefits. However, the process has been very gradual and unstructured and many different interventions followed in quick succession, complementing or amending each other, ultimately being incapable of assuring the short- and medium-term sustainability of the system.

Consequently, when, in 2011, Italy found itself again on the brink of a deep financial crisis, a new incisive pension reform was needed. The pension reform announced in December 2011 (Law 214/2011) did not introduce great innovations, but basically applied the content of the previous reforms more rapidly and more strictly. Indeed, its key elements are:

- the immediate abolition of the early retirement option, which allowed workers to retire up to five years before reaching the old age requirement;
- the application of the NDC benefit computation mechanism to all workers for seniority accrued since 2012;
- a strict link between the increase in life expectancy and age and seniority requirements;
- the (further) homogenization of requisites between genders–the old-age retirement age for women will be harmonized to that for men by 2018 – and between working schemes.

The impact of the reform in terms of reduction in pension expenditures has been noteworthy (according to the official projections of the Ministry of Finance, the pension expenditure will be reduced by about 20 GDP percentage points in the period 2012–2050) and the measure has had undoubtedly success in recovering the trust of the financial markets and preventing default. However, the reform met with strong opposition from large groups of the population not only because of the evident harsh effects on those individuals who at the time of the introduction were near to retirement, but also because of the incomplete and misleading understandings that many individuals had of the aims and effects of the reform as a whole. The economic literature has already highlighted the key role of correct information in determining the success of a reform, as the lack of sufficient knowledge of the aims and content of a reform can not only prevent its acceptance, but also induce behaviors capable of neutralizing (in part or as a whole) its positive effects.

In this context, our research for the WeRSA project aims to dispel some wrong common perceptions and unfounded beliefs and to inform correctly (from a scientific point of view) about the content and the effects of the reform. In particular, in this strand we investigate the consequences of the last pension reform in terms of adequacy of pensions and of inter- and intra- generational distribution of resources, and the expected reactions of individuals in terms of savings, consumption and labour supply.

The two core studies of the report make use of two microsimulation models. To evaluate the effects of the pension reform on the adequacy and redistributive impact of the pension system we have used CeRPSIM, a dynamic microsimulation model built in 2005 at CeRP-Collegio Carlo Alberto by Margherita Borella and Flavia Coda Moscarola. Since then it has been continuously updated with innovations in the legislative framework and the evolution of the economic and socio-demographic scenarios. CeRPSIM is now in its third release and, in the context of the WeRSA project, it has been updated to consider the main labour and

pension policy reforms occurred in Italy starting from the 1990s, including the last major reform introduced in December 2011. CeRPSIM makes it possible to simulate the effect of reforms as they are phased in or one at a time as they are "*at regime*". It is a relatively simple simulation model featuring in particular a detailed modelization of the pension rules characterizing the main social security schemes of Italian workers in time and a realistic estimation of the labour income profiles.

Our simulations find that the reform of 2011 increased the average retirement age by two to three years for all the cohorts considered, with younger cohorts in general facing a higher increase. The greatest increase in the average retirement age occurs among women currently retiring (i.e. those born in 1955 in our simulations), for whom not only the early retirement option has disappeared but also the old-age requirement has been gradually increased in order to match the requirement for men by 2018. On the adequacy side, we find that average replacement rates from the first pillar increase for all cohorts and groups considered. The largest increase in the replacement rate following each year of retirement postponement occurs among the youngest, purely NDC, cohorts, a consequence of the actuarial adjustment of the benefits in the NDC system. The reform of 2011 also affects intergenerational redistribution as measured by the ratio of the present value of benefits and the present value of the contributions paid (benefit-to-tax ratio, or Present Value Ratio, PVR). This ratio, before the reform, was ranging between 1.5 and 3 for the generation born in 1955; as a result of the reform these values are reduced, although remaining well above one. As expected, younger cohorts display an average PVR very close to one, due to the implementation of the NDC system.

The comparison of the Italian situation with a representative sample of OECD countries reveals some additional noteworthy features. First of all, some population groups, namely low-income workers, women and the self-employed, show greater vulnerability. This is particularly evident for Italy, but is also found in all the other OECD countries analysed. In fact, workers belonging to these groups are more likely than their counterparts to receive a future pension that will be: (i) lower than the pensions received by current retirees; (ii) below the poverty threshold. Secondly, future generations in Italy will be not only more at risk of not reaching the country-specific replacement rate once they have retired (a feature in common with all the other analysed countries), but they will also attain on average lower pensions than current retirees (something not observed in the other countries). Thirdly, even under the optimistic assumption of a complete adhesion of all private-sector employees and self-employed workers to the pension funds, the role of the second pillar in determining the total pension income would be limited to 12%, a share which is lower than all the other analysed countries, with the sole exception of France.

Evaluations of the effects of the pension system on savings behaviour rely on ITALISSIMO: a structural overlapping-generations model simulating the circumstances of a population cross-section through time matched to contemporary survey data for Italy. The focus of the model is the analysis of saving and labour supply decisions in the context of uncertainty over the life cycle. We present the results from three policy simulations:

    a)   imposing relatively strict age and monetary minimum conditions for accessing pensions
    b)   the elimination of all access conditions, with the exception of a relatively low minimum age
    c)   a substantial reduction in the mandatory pension contribution rate.

Apart from the specific findings discussed within the report, some cross-cutting emerging themes can be identified:

- The nature of pension benefits has changed over the years. These are increasingly no longer seen a as 'right' or 'reward' in recognition of service at the end of a long career, but rather as an individual investment that one actively saves and plans for. This change of logic underpins the shift from DB to DC schemes. Our simulations make the *financial* nature of pension saving choices evident. In all the cases considered, changes in pension policy affect individuals' wider portfolio choices in terms of

liquidity and alternative pension savings. This suggests that policies focusing on the private pension pillar cannot avoid considering the nature of the public pension pillar as well as that of other alternative saving options.

- Having time to prepare for a policy allows for quantitatively and qualitatively different responses. Allowing a minimum period of lag between announcement and implementation may therefore attenuate the adverse effects of reforms.

Finally, this report also offers the opportunity to showcase the sort of analyses possible with ITALISSIMO and highlight the importance of accounting for second order behavioural effects.

Among the potential reactions of individuals to the reforms, in an ancillary work we have additionally considered absenteeism. As far as we know this dimension is still unexplored in the literature, but our results highlight that individuals, women in particular, can use it as a last resort solution to keep on working when obliged by the pension reform and having cope with heavy informal caregiving duties. Both economic and epidemiological literature has shown that perceived high strain at work and lack of social infrastructures are good predictors of sick-leave. The latter is particularly relevant in (Mediterranean) countries where facilities for children and long-term care services are relatively scarce and women are frequently asked to fill the gap. In the analysis based on data from an administrative data set provided by the Italian Social Security Institute (INPS), the so-called *Estratti conto* archive, we do find evidence of a substantial response of Italian women to changes in pension rules. However, the response differs on the basis of their past sick-leave record. Women who in 2011 had already experienced a sick-leave spell and were forced by the pension reform to postpone retirement appear to increase their sick-leave spells proportionally to the number of years of delay imposed to them by the reform. Women who did not have a sick-leave spell in 2011 behaved in the same manner, but less intensively and only if they are grandmothers, i.e. presumably in charge of caregiving duties towards their grandchildren.

As anticipated, the reaction of individuals to the pension reform ultimately depends on the understanding of individuals about the content of the reform. Indeed, we conclude our report with two chapters focused on the evolution of the expectations about retirement among individuals and their reliability. For this scope we exploit the information of the Survey of Households Income and Wealth (SHIW) from 2000 to 2012. First we focus on the variation of the individuals' expectation as a consequence of the 2011 reform using the SHIW panel. We find that between 2010 and 2012 about one third of sampled workers did not change their expectations about retirement age, while more than half had increased them. A residual 10 per cent revised their expectations downwards, probably due to a better knowledge of their personal pension situation. On average dependent workers have increased the value of the expected retirement age between 2010 and 2012 at a little less than two years, while the same expectation has increased by about 1.3 years for self-employees. The higher revision in the expectations has occurred among women and for the 1970–1979 cohort. In addition, the variation in the expectations about retirement is lower for more highly educated individuals than those with lower education levels, a result that can derive from the fact that more highly educated people are normally also more informed and more financially literate and consequently, they have more facility in understanding correctly the implications of the new norms introduced.

Second, adopting a more comprehensive and articulated perspective, we use the information referring to the expectations on both the future level of the replacement ratio (i.e. the ratio between the first pension benefit and the last wage) and of the retirement age and their variations in time since the early 2000s to estimate the expected level of the future public pension benefit for workers in the SHIW survey. This information allows us to compute the 'pension error', defined as the difference between the expected value and the 'statutory' value of the pension benefit, the second variable defined as the pension benefit level computed, at the expected retirement age, on the basis of the pension rule that was in force in the year of the survey. We find that in time there has been a shift from a general overestimation of the generosity of the future pension

towards a greater tendency to underestimate it, particularly because many do not realize that the retirement age will continuously be postponed with increasing life expectancy. At the end of a turbulent period of reforms, many workers still are not able to predict correctly the level of their pension benefit or their correct retirement age, in particular in the last few years, also due to the effects of the economic crisis. However, individuals seem to react to the expected reduction in the social security wealth by increasing private wealth, confirming the existence of a significant degree of substitutability between the two types of wealth.

From these findings three main policy implications can be derived. The first one is the need for better information about the motivations, the aims and the effects of the pension reforms. This will help in boosting the acceptance of the reforms and debunk some false perceptions about their effects. In addition, it will allow individuals to implement the most effective compensating behaviours, as, for example, in terms of private wealth accumulation or decumulation or of adhesion to second pillar pension schemes.

The second is the need for ad hoc policy interventions towards all the categories of workers – primarily women, self-employed and young people–who, having more discontinuities and poor careers will also end up, under the NDC rule, with lower pension benefits when retired.

The third is the need for a careful evaluation of the impact of the second round effects of the policies implemented. Indeed, individuals can react to the introduction of reforms by assuming behaviours that can result in reducing their positive impact. In particular, if older women are in charge of heavy caregiving duties towards children or the elderly because of a shortcoming of the welfare system on these fields, and the pension reform obliges them to postpone retirement; they can react by resorting to more sick-leave absences. Matching welfare policies are then required to help them to cope better with both their working and caregiving duties.

1. Introduction

Evidence-based analyses of the effects of policy reforms are not only interesting for academics, but also central for the action of modern European policy-makers. There are two main requirements for pursuing such an objective: good data and good models.

In this report we focus on pension reform and in particular we try to explore the effects of the last pension reform in Italy from different perspectives: adequacy, inter- and intra-generational distributive impact, effects on consumption and saving behaviour, and the reactions of individuals in terms of labour supply.

To answer our research questions we used two different microsimulation models: CeRPSIM3 and ITALISSIMO. CeRPSIM3 is the third release of an existing microsimulation model, updated to the most recent normative and socio-demographic evolution. ITALISSIMO is a structural overlapping-generations model simulating the circumstances of a population cross-section through time matched to contemporary survey data for Italy. The focus of the model is the analysis of saving and labour supply decisions in the context of uncertainty over the life cycle. Despite the different objectives and structures, the models obviously refer to the same normative framework and use the same survey and administrative data. The latter provided, explicitly for this project, by the Italian Social Security Institute (INPS) and by the Commissione di Vigilanza sui Fondi Pensione (COVIP).

The analysis is completed by three ancillary works highlighting respectively the reactions of women in private-sector employment to the postponement in retirement induced by the reforms, the change in individuals' expectations as a consequence of the latest reform, and the degree of comprehension that individuals have of the latest pension reforms.

This work is the result of fruitful collaboration by academic researchers from CeRP-Collegio Carlo Alberto, University of Bologna, and NIESR who worked on the models, and public institutions such as INPS and COVIP that provided the data and the details about the normative framework. It also profited from an interesting collaboration with the OECD team in charge of the publication of the annual Pension Outlook for the cross-country comparative exercise. This work indeed represented a unique occasion, with few precedents in Italy, of knowledge exchange among different research teams developing complementary microsimulation models and of close interaction between modellers and data suppliers.

The report is structured as follows. Chapter 2 provides a description of the normative framework. Chapter 3 introduces the two microsimulation models providing a reasoned review of the pension microsimulation models available for Italy. Chapter 4 describes CeRPSIM3 and reports the results of the simulations run. Chapter 5 runs a comparative exercise that highlights the relative position of Italy in terms of adequacy of the pension benefits with respect to a representative sample of OECD countries. Chapter 6 describes ITALISSIMO and the results of three policy experiments aiming to capture first- and second-order effects of policies devoted to changes in retirement ages and the share of the public component in the pension saving. Chapter 7, 8 and 9 report the above mentioned ancillary works. Section 10 concludes with the main policy implications of the work.[1]

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[1] The name of the author of each chapter is reported under the chapter's title. Flavia Coda Moscarola acted as principal investigator.

2. The normative framework

Author: Margherita Borella[•]

In this chapter, with the aim of providing a detailed normative framework in which to place our analysis, we describe the pension rules in force immediately before the 2011 reform, and then we illustrate the reform. We focus on the first pillar as the 2011 reform only impinged on that pillar. A description of the second-pillar pension system–which is still highly underdeveloped in Italy – is deferred to chapter 5, where the second pillar pensions are also accounted for when analysing the adequacy of the pension income at retirement in a comparative perspective with other representative OECD countries.

The chapter is organized as follows. In section 2.1 we describe the pension rules in place immediately before the 2011 reform, while in section 2.2 we illustrate the reform.

2.1 The first pillar before the 2011 reform

Before 1992 the pension system was characterized by a Defined Benefit (DB) pension formula, based on the last few years of earnings, combined with soft eligibility rules, without any actuarial correction for age at retirement. The first reform, which took place in 1992, set new – and more stringent – eligibility requirements while preserving the DB system. After the transition phase, pensionable earnings at regime would be based on the worker's entire earnings history and revalued at the nominal GDP growth rate. No actuarial correction for age at retirement was provided for, but the pension indexation mechanism was downgraded from wages to prices. Such an indexation mechanism has been since maintained by all subsequent reforms.

A second major reform approved in 1995 scheduled a new (and long) transition towards an NDC formula. The NDC formula harks back to actuarial fairness principles. Benefits are commensurate with the amount of payroll taxes paid capitalized at an interest rate equal to the rate of growth of GDP and annuitized according to life expectancy at retirement. Access to retirement was initially quite flexible, as individuals were allowed to retire in the 57–65 age range, subject only to the constraint of having a pension higher than 1.2 times the social allowance. The reforms of 1992 and 1995 thus opened a long transition period which will end in 2030. Until then, in fact, the rules for accessing retirement pension and calculating the pension benefit will evolve differently for different generations of workers. In particular, one can distinguish three groups:

1 - workers who had accumulated at least 18 years of service at the end of 1995: the pension for these workers is calculated with the DB rules as modified by the 1992 reform. The age requirements for retirement have also been raised, as will be discussed shortly. Hence a Modified Defined Benefit (MDB) applies to these workers;

2 - workers who started to contribute to the pension system before 1995 but had accumulated less than 18 years of contributions at the end of 1995: for these workers the pension is calculated with a pro-rata (PR) system. The first part of the pension covers the seniority accrued up to the end of 1995 and is calculated with

the DB formula. The second part of the pension instead refers to seniority accrued after 1995 and is calculated with the NDC formula.

3 - Workers who entered the labour market after 1 January 1 1996: to these workers the NDC system fully applies.

It is useful to describe the abovementioned pension formulae for the computation of the benefits, as the results of our analysis largely depend on them. In the MDB system, the benefit depends on pensionable income, that is, an average income earned at the end of the career. As a consequence of the reform of 1992, the benefit consists of two parts, in which pensionable income is computed taking the average over a longer period for seniority accrued after 1992. Apart from this complication, the MDB pension is a traditional defined benefit pension computed as:

$$P_{MDB} = \alpha * (c_1 W_1 + c_2 W_2)$$

Where W_1 and W_2 is pensionable income, that is, average income over the last five (W_1) or ten (W_2) years of the working career (ten to fifteen for the self-employed), revalued according to inflation (W_1) or nominal GDP growth (W_2), and c_1 and c_2 are the years of contribution accrued before and after 1992 respectively. The annual accrual rate α is equal to 2 per cent up to a certain threshold, gradually reduced for higher pensionable incomes.

The NDC pension, for all categories of workers, is computed as:

$$P_{NDC} = \left(\sum_{i=\underline{a}}^{\bar{a}} C_i * (1+g)^{\bar{a}-i} \right) \cdot \delta_{\bar{a}+1} \quad P_{NDC} = \left(\sum_{i=\underline{a}}^{\bar{a}} C_i * (1+g)^{\bar{a}-i} \right) \cdot \delta_{\bar{a}+1}$$

where C_i is the contribution paid by the worker at age i, g is the five years moving average of the nominal GDP growth rate, δ is an age-specific annuity rate, $\underline{a}$ is the age at which the worker entered the labour market and $\bar{a}$ is the individual's age in his or her final working year. In other words, the pension benefit in the NDC system is equal to the notional capital, that is, the sum of all contributions paid, revalued to a rate equal to the five years moving average of the nominal GDP growth rate, multiplied by an age-specific coefficient δ. The annuity rates δ are set by law as the inverse of the present value at retirement of a one unit annuity benefit, and are updated according to life expectancy. In section 3.3 we describe them in more detail.

The NDC pension formula fully applies to NDC workers, who entered the labour force after 1 January 1996. During the transition, that is, for workers already active in the labour force in 1995, the pension benefit will be computed with a *pro-rata* mechanism, that is, as a weighted average of the MDB and NDC payment, with the weights given by years of seniority accrued before and after 1 January 1996.

Due to the length of the transition, numerous legislative measures have gradually raised the requirements for access to retirement, but without changing the method of calculating the pension. The legislative decree of 30 August 2004, no. 243, the Law of 24 December 2007, no. 247, and the Law of 30 July 2010, no. 122, gradually raised the eligibility requirements for retirement. In particular, the 2007 reform introduced the system of 'quotas', according to which the right to retire accrues not only with 35 years of contributions, but also with the achievement of a 'quota' given by the sum of the age and seniority contribution gained by the worker. This eligibility mechanism applies regardless of the pension scheme, MDB, PR, or NDC, and was expected to increase over time until 2013. The 2007 law also restated the transformation coefficients for calculating the NDC pension benefit (in force since 2010), and expected them to be updated every three years on the basis of demographic tables and long-term trend of GDP measured by the Italian National Statistics Institute (ISTAT). Finally, the Law of 30 July 2010, no. 122, introduced a new 'deferral' system of

the time of retirement; with this mechanism the right to receive the pension benefits matures 12 (or 18, for the self-employed) months after meeting the requirements. Importantly, the same law also adopted an automatic update mechanism (every three years) of the age requirements for retirement, both for early retirement with the system of the 'quota' and for old-age retirement, so that these ages are linked to changes in life expectancy (while seniority requirements are kept constant). In Tables 2.1 and 2.2 we summarize the eligibility requirements in place immediately before the reform of 2011.

Table 2.1 – MDB and PR workers, eligibility requirements in 2011 (before the reform)

		Men	Women
Old age		65 years of age 20 years of contribution	60 years of age 20 years of contribution
Seniority		40 years of contribution	
Early retirement	Private-sector employees	Quota 96: with at least 60 years of age and 35 years of contribution	
	Self-employed	Quota 97: with at least 61 years of age and 35 years of contribution	

Note: all ages linked to life expectancy. Deferral time: 12/18 months (private-sector employees/self-employed)

Source: Authors' calculations

Table 2.2 – NDC workers, eligibility requirements in 2011 (before the reform)

		Men	Women
Old age		65 years of age 5 years of contribution	60 years of age 5 years of contribution
Seniority		40 years of contribution	
Early retirement	Private-sector employees	Quota 96: with at least 60 years of age and 35 years of contribution	
	Self-employed	Quota 97: with at least 61 years of age and 35 years of contribution	

Note: all ages linked to life expectancy. Deferral time: 12/18 months (private-sector employees/self-employed)

Source: Authors' calculations

2.2 The 2011 reform

The reform of 2011, namely the Decree-Law of 6 December 2011, no. 201, converted into Law of 22 December 2011, no. 214, further tightened the requirements for accessing retirement, while maintaining the important principle of the adjustment of all the age requirements to the evolution of life expectancy, and extending this principle to seniority requirements as well. In particular, since 2012 individuals can access retirement benefits through two channels only: the *old age* pension or the *seniority* pension, whereby the latter regulates the access to retirement benefit before the standard age, imposing obligations in terms of contribution paid.

This reform also accelerates the introduction of the contributory formula to compute the pension benefits for all workers, starting from seniority accrued from 1 January 2012 (with a PR system). While previous reforms were limited to reinforcing the requirements (age and years of contribution) to enter retirement, in fact, this reform intervenes on the method of calculating the benefit, extending the application of the PR method to all workers who, having completed at least 18 years of contributions in 1995, would have accrued a pension that was entirely retributive (MDB workers, in our terminology). In this way, the reform pursues the principle of the uniformity of treatment of workers. Benefits for MDB workers, in fact, had been preserved by all previous reforms, creating a sharp discontinuity of treatment with workers who, having accumulated less than 18 years of contributions in 1995, have their benefits computed with the pro-rata mechanism (PR workers). The oldest individuals in the latter group, in fact, will have roughly half the pension calculated by the MDB system and the NDC system – with the share of the NDC part increasing over time, as younger generations of workers reach retirement age. After the reform, MDB workers also will receive a pension calculated using the PR system, although for a much shorter period affecting very slightly the amount of their pension.

The law also changes the age and seniority requirements for accessing retirement, aiming to increase the average retirement age. In particular, as summarized in Table 2.3, the early retirement route based on the "quota" has been abolished, and the legal age requirement increased by one year, but at the same time the "deferral" of the first benefit is abolished. In addition, the new reform speeds up the convergence of the age of retirement for men and women in the private sector.[2] It is still possible to claim seniority pensions, with seniority requirement increased to 42 years and one month of contribution for men and to 41 years and one month for women.[3] All age and seniority requirements are linked to increases in life expectancy.

Table 2.3 – MDB and PR workers, eligibility criteria in 2012 (after the reform)

		Men	Women
Old age		66 years of age 20 years of contribution	62/63 years of age (private-sector employees/self-employed, reaching 66 in 2018) 20 years of contribution
Seniority		42 years	41 years
Early retirement	Abolished		

Note: all ages and seniority requirements linked to life expectancy. Deferral time: abolished

Source: Authors' calculations

The law also contains some mechanisms to smooth the transition to the new rules. For example, workers who had accrued, by the end of 2012, the requirements valid in 2011 for early retirement (60 years of age and 36 years of contributions, or 61 years of age and 35 years of contributions, i.e., quota 96) will be granted access to a retirement pension at the age of 64, that is two years earlier than the normal retirement pension.

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[2] The old-age of retirement for women will equate to that for men in the year 2018, while before the reform convergence was due by the year 2026.

[3] Starting with the year 2017, the pension amount will be gradually reduced if the seniority pension is claimed before reaching the age of 62.

The reform of 2011 also confirms the possibility of early retirement for women, by opting for a benefit fully computed according to the NDC pension formula. This rule, already introduced by the reform of 2004 (art. 1, paragraph 9 of Law 243/2004), gives the possibility, until 31 December 2015, for female workers to get the early retirement pension with at least 35 years of contributions and a minimum age of 57, if employees, and 58, if self-employed, provided they opt for the calculation of the pension according to the rules of the contribution system.

The law also amends the rules for NDC workers, reintroducing some flexibility in retirement, however binding it to the passing of a minimum amount of the pension, as summarized in Table 2.4.

Table 2.4 – NDC workers, eligibility requirements in 2012 (after the reform)

	Men	Women
Old age	70 years of age (minimum seniority 5 years) Possibility of anticipated retirement at age 63 if pension entitlement is at least 2.8 times the social allowance, or at age 66 if it is at least 1.5 times the social allowance (minimum seniority 20 years).	
Seniority	42 years and 1 month	41 years and 1 month
Early retirement	Abolished	

Note: all ages and seniority requirements linked to life expectancy. Deferral time: abolished

Source: Authors' calculations

In 2012, the age for accessing retirement with the NDC system was between 63 and 70 years: the 'normal' old age requirement is 66 years. It is possible to access the 'anticipated' retirement, between 63 and 65 years of age, only if in possession of at least 20 years of contributions and if entitled to a benefit equal to at least 2.8 times the social allowance granted to the elderly Italian citizens in need.[4]

Starting from 66 years of age (what the law labels the 'normal' age of retirement) the conditions for accessing retirement are less stringent, requiring at least 20 years of actual contributions and an amount of pension equal to 1.5 times the social allowance. In the absence of these requirements, it is possible to claim a pension with only five years of contributions and without any constraint on the amount of the accrued pension at the age of 70 years. In addition, for NDC workers also it will be possible to claim seniority pensions with a minimum seniority of 42/41 years for men/women. All the age and seniority requirements set by the law are indexed to life expectancy.

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[4] In 2012, the annual (gross) amount of the social allowance was € 5577.00.

3. Literature review on microsimulation models focussed on pension systems

Author: Flavia Coda Moscarola[•]

Starting with the pioneer contributions of Orcutt (1957), microsimulation techniques and particularly dynamic microsimulation models (DMM) have been extensively used in policy analysis. Indeed, microsimulation is increasingly recognized as a key ingredient of a careful, evidence-based evaluation of the design of the tax benefit and social security policy reforms (Figari et al., 2014). Its main strength lies in being a tool able to generate synthetic micro-unit based data which may be used to answer "what-if" questions that otherwise could not be addressed (Li and O'Donoghue, 2013).

This section provides a brief literature review of the existing microsimulation models focussed on the pension system. This will help to highlight the innovative features and the specificities of the models developed in the WeRSA project.

Table 3.1 lists the existing pension microsimulation models by country and main objective, recalling and updating Li and O'Donoughue (2013).

Table 3.1 – Overview of existing DMMs on pensions

Model	Country	Uses
DYNAMOD I & II	Australia	Models life course policies such as superannuation, age, pensions and education, long-term issues within the labour market, health, aged care and housing policy, future characteristics of the population and the projected impact of policy changes (Antcliff 1993; Antcliff et al., 1996; King et al., 1999a; King et al., 1999b)
Pensions Model	Belgium	Analyses and forecasts the medium term impact of a change to pension regulations (Joyeaux et al., 1996)
BRALAMMO	Brazil	Models the Brazilian labour market for pension welfare analysis (Zylberstajn et al., 2011)
DEMOGEN	Canada	Models distributional and financial impact of proposals to include homemakers in the Canadian pension plan (Wolfson, 1989)
DYNACAN	Canada	Models the Canada Pension Plan and its impact on the Canadian population (Morrison, 2000; Osberg and Lethbridge, 1996)
LifePaths	Canada	Models health care treatments, student loans, time-use, public pensions and generational accounts (Rowe and Wolfson, 2000)
Czech Republic Model	Czech Republic	Designed to analyse public pension system and potential reforms in the Czech Republic (Fialka et al., 2011)
DESTINIE I/II	France	Models public pensions and intergenerational transfers (Blanchet et al., 2009;

		Bonnet and Mahieu, 2000; Bonnet et al.,1999)
ELSI	Finland	Models the statutory pension scheme of Finland, with the objective of analysing different policy proposals related to the forthcoming (2017) pension reform (Tikanmäki et al., 2014).
MICSIM	Germany	Analyses German pension and tax reform (Merz et al., 2002)
MIDAS	Belgium, Germany, Italy	Analyses pension system and social security adequacy (Dekkers and Belloni, 2009)
Sfb3	Germany	Analyses pension reforms, the effect of shortening worker hours, distributional effects of education transfers (Galler and Wagner, 1986; Hain and Hellberger, 1986)
LIAM 1	Ireland	Evaluates potential reforms to the Irish pensions system in terms of changes to life-cycle incomes (O'Donoghue et al., 2009)
CAPP_DYN	Italy	Analyses the long term redistributive effects of pension reforms (Mazzaferro and Morciano, 2008–2012)
CeRPSIM	Italy	Analyses the distributional features embedded in the Italian Pension system during its transition from a Defined Benefit to a Notional Defined Contribution system (Borella and Coda Moscarola, 2010)
DYNAMITE	Italy	Models demographic and income dynamics and studies the effect of different features of the social security system (Ando and Nicoletti-Altimari, 2004)
LABORsim	Italy	Simulates the evolution of the labour force over future decades in Italy with a focus on pension system (Leombruni and Richiardi, 2006)
MIND	Italy	Simulates the redistributive effects of economic policies and fiscal and pension reforms (Vagliasindi et al., 2004)
TDYMM	Italy	Analyses the Italian labour market and pension system, with a focus on pension adequacy and related distributional effects (Caretta et al. 2013)
PENMOD	Japan	Public pension system analysis (Shiraishi, 2008)
NEDYMAS	Netherlands	Models intergenerational equity and pension reform, the redistributive impact of social security schemes in a lifetime framework (Nelissen, 1996; Nelissen, 1998)
SADNAP	Netherlands	Evaluates the financial and economic implications of the problem of ageing (Van Sonsbeek, 2009)
MOSART 1/2/3	Norway	Models the future cost of pensions, undertakes micro level projections of population, education, labour supply and public pensions, incorporates overlapping-generations models within a dynamic microsimulation framework (Andersson et al., 2009; Fredriksen, 1998)
DYPENSI (SIPEMM)	Slovenia	Dynamic Microsimulation Model with the focus on pension system simulation (Majcen, 2011)
IFSIM	Sweden	Studies intergenerational transfers and the interdependence between demography and the economy (Baroni et al., 2009)
Swedish Cohort	Sweden	Models the replacement of social insurance by personal savings accounts and the distribution of lifetime marginal effective tax rates (Fölster, 2001)
MiMESIS	Sweden	Evaluates Swedish Pension Reform (Mikula et al., 2003)
SESIM	Sweden	Analyses the consequences of population ageing and models budget and distributional impact of inter-temporal policy issues such as student grants, labour

		supply, savings decisions and pensions (Ericson and Hussenius, 1998; Ericson and Hussenius, 1999; Klevmarken and Lindgren, 2008; Klevmarken, 2010; Pylkkänen, 2001)
INFORM	UK	Developed for forecasting of benefit caseloads and combinations of receipt, designed to incorporate significant benefit reforms planned over the coming years, based entirely on administrative data (Gault, 2009)
IFS Model	UK	Studies pensioner poverty under a variety of alternative tax and benefit policies (Brewer et al., 2007)
PENSIM	UK	Models the treatment of pensioners by the social security system across the income distribution (Hancock et al. 1992; Curry, 1996)
PENSIM2	UK	Estimates the future distribution of pensioner incomes to analyse the distributional effects of proposed changes to pension policy (Emmerson et al., 2004)
CORSIM	US	Models changes occurring within kinship networks, wealth accumulation, patterns of intergenerational mobility, the progressivity and the life course of the current social security system, as well as potential reforms, household wealth accumulation, health status, interstate migration, time and income allocation, and international collaborations (Caldwell, 1996; Caldwell et al., 1997)
DYNASIM III	US	Designed to analyse the long-term distributional consequences of retirement and ageing issues (Favreault and Smith, 2004)
MINT	US	Forecasts the distribution of income for the 1931–1960 birth cohorts in retirement, MINT5 extends to the 1926–2018 birth cohorts (Panis and Lillard, 1999; Smith et al., 2007; Toder et al., 2002)
PENSIM	US	Analyses lifetime coverage and adequacy issues related to employer-sponsored pension plans in the US (Holmer et al., 2001)
POLISIM	US	Demographic-economic and social security projection for US social security administration (Holmer, 2009; McKay, 2003)
PRISM	US	Evaluates public and private pensions (Citro and Hanushek, 1991a; Citro and Hanushek, 1991b)

Source: Li and O'Donoghue (2013), updated by authors

Despite the constant improvement in the calculation capability and speed of personal computers that makes it possible to build ever more complex models, the specificities of research questions often induce researchers to build new ad-hoc models instead of modifying and updating existing ones. That is why several microsimulation models have been developed in time for the same country. From this point of view, the Italian case is certainly emblematic, with seven different microsimulation models developed until now to study the effects of the Italian pension system.[5] The plurality of models and authors – official government institutions, independent centres for research and university departments – should certainly be considered a value added for the debate on a crucial issue like that of the adequacy and distributive properties of the

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[5] In addition to them, it is worth mentioning the simulation model developed by the Treasury Department (Ragioneria Generale dello Stato) providing the official projections about the medium- and long-term sustainability of the Italian pension system (Ragioneria Generale dello Stato, 2014). Projections are based on a weighted sample of artificial individuals with representative working profiles.

pension system. Here we briefly describe them in turn, referring to the taxonomy proposed by Bourguignon and Spadaro (2006).

For each model we specify the main objective, as the research question normally shapes the design of the microsimulation model to be built, and the legislative frame adopted. This information is crucial as, on the one hand, all the models analysed tackle the topic of pensions from slightly different perspectives, each stressing different aspects; and, on the other hand, many reforms of the pension system have been introduced over time since the early 1990s, radically changing both the age and seniority requirements to access retirement and the rules for the computation of the pension benefits (see chapter 2).

We then specify whether the models are dynamic or static. Dynamic micro simulation models update each attribute for each micro-unit for each time-interval (Caldwell, 1990 cited in Dekkers and Belloni, 2009), projecting the unit into the future according to a set of estimated transition probabilities. Static models simulate the current position of the sample individuals only. Pension models are almost by definition dynamic as pension rights are accrued by individuals during the working age years and the pension benefits are paid out during retirement.

We further distinguish partial from general equilibrium models. Partial equilibrium models do not account for the interactions between individuals' decisions taken at micro level and the macroeconomic variables and scenarios. All the microsimulation models described in this section are partial equilibrium models, however they try to pursue the match between micro and macro level by alignment procedures characterized by different degrees of sophistication.

We also classify microsimulation models on the basis of the population they are based on (population versus cohort models). Population models analyse the effects of a certain policy on a representative sample of the country's population. Dynamic cohort models, by contrast, focus on one or a few cohorts at a time. Each individual in the cohorts analysed is followed from birth to death (Harding, 1996). In addition, some models work on real individuals, others on synthetic samples, that is, individuals artificially built to replicate (on average) the characteristics of the existing population. Most of the analysed models are population models, with only one notable exception represented by CeRPSIM which is a cohort model.

In addition we disentangle open from closed population models. A closed model generates new individuals in the case of birth or immigration only. So, when somebody in the model 'becomes eligible for marriage', his or her spouse is selected from the other living individuals in the dataset. In an open model, a 'synthetic individual' is created and linked to the marriage candidate (Dekkers and Belloni, 2009). The vast majority of the models reported here are closed models.

Finally, we distinguish models on the basis of the rule applied to simulate savings, consumption and retirement decisions (behavioural versus deterministic models). For example, the retirement rule is deterministic when it imposes a fixed retirement age evaluated, for example, according to what has been observed in the past or according to the minimum requirements imposed by the law. Behavioural rules account for the preferences of individuals for leisure and consumption and determine the retirement age so as to maximize their utilities properly accounting for unobserved determinants of the choice or optimization errors. Individuals' optimization behaviour is better captured by structural models, directly estimating the parameters of the utility function, with respect to reduced form equations.

To conclude, for each model, we try to highlight the details concerning the simulation of the pensionable earning process, a feature that plays a key role in the computation of pension benefits. Earnings profiles estimated on administrative data clearly benefit from the fact that earnings are gross of taxes and they are the true reference income for the computation of payrolls (they are not self-reported and subject to reporting errors as in survey data). Conversely, administrative archives are less detailed in the description of the socio-

demographic characteristics of the individuals and do not allow a great precision in the definition of category-specific profiles. Panel data (the complete record of information related to each individual's earnings history) should finally be preferred to cross-sectional data, as they better allow us to capture the evolution of earnings over the life of individuals.

The classification of the models according to the features just described is reported in Tables 3.2 and 3.3.

The DYNAMITE model (Ando and Nicoletti-Altimari, 2004), developed by the Bank of Italy, simulates demographic and income dynamics of a representative sample of the Italian population, to study the evolution of aggregate income, saving and asset accumulation and the effects of alternative assumptions regarding the social security system. DYNAMITE is a partial equilibrium model with a behavioural rule to predict retirement. Retirement is indeed endogenous as it is allowed to depend on the financial incentives embedded in the pension system. The normative framework refers to the 1992 and 1995 reforms and the earnings equation is estimated on repeated cross-sections survey data for the period 1987–1995.

The MIND model (Vagliasindi et al., 2004) is a dynamic ageing model used to evaluate the consequences and the redistributive effects of economic policies and fiscal and pension reforms on a representative sample of the Italian population. It focusses on the effects of the 2004 Italian pension reform (Law 243/2004). MIND is a partial equilibrium model with two alternative behavioural scenarios to simulate retirement decisions: one referring to the Option Value Model (Stock and Wise 1990), the other to bounded rationality models–in particular, earlier retirement and females' retirement decision influenced by partner's choice. The earnings equation is estimated on cross-sectional survey data for the year 1995.

LABORsim (Leombruni and Richiardi, 2006) is an agent-based model of labour supply with a particular focus on population ageing and labour market participation of the elderly. It is a partial equilibrium model based on a representative sample of the working population. Retirement is simulated according to parametric rules. It models and analyses the effects of the pension rules in place from 1992 to 2004 on labour supply and retirement decisions of individuals. It does not model pension benefits.

MIDAS (Dekkers and Belloni, 2009) was developed within the AIM project (Adequacy and sustainability of old-age Income Maintenance) in order to simulate the adequacy of pensions in Italy, Germany and Belgium. It works on representative samples of the population of the three countries. It is a partial equilibrium model with behavioural rules for both the simulation of the labour market transitions, including retirement, and the marriage transitions. The normative framework refers to the pension rules in place until 2008. Its structure has been included in the TYDIMM model.

The CAPP_DYN model (Mazzaferro and Morciano, 2008 rev. 2012), developed by the Centre for the Analysis of Public Policies (CAPP) under the auspices of the European Commission and the Italian Department of Employment and Social Policies, is a dynamic microsimulation model with the aim of assessing the distributional effects of reforms adopted in the Italian pension system. It is a partial equilibrium model with behavioural rules for the simulation of the retirement patterns of a representative sample of the Italian population. It is updated to the last pension reform rules and therefore it takes into account the whole transition to the NDC system in Italy. The base population (roughly 50,000 observations) is the 2007 survey of the National Statistics Institute ITSILC. This population is projected forward to 2050 taking into account the most likely transition probabilities in the demography. The model allows both intergenerational and intragenerational distributive analyses and it is linked to the most plausible macroeconomic evolution of GDP.

CeRPSIM (Borella and Coda Moscarola, 2006 and 2010) is a dynamic partial-equilibrium microsimulation model of the social security system and it is designed to analyse the distributional features embedded in the Italian pension system during its transition from a DB to an NDC system, fully accounting for the rules

characterizing the main social security schemes and for the heterogeneity in the working careers of individuals. Differently from the microsimulation models previously described, it is a cohort population model. Its strengths are the detailed modelization of the pension rules characterizing the different cohorts of workers in time and the accurate procedure for the estimation of the income profiles based on a representative panel sample of administrative data. Retirement is modelled according to either a deterministic rule, that is, the individual retires as soon as eligible, or a structural behavioural rule estimated on administrative panel data by Belloni and Alessie (2010) for Italian workers and fully accounting for individuals' gender-specific time preferences and for their reactions to the financial incentives embedded in the pension rules. The first release of the model simulates the pension rules introduced by each reform from 1992 to 2004; the second release (CeRPSIM2) is updated to the rules in place up to 2008.

The TDYMM model (Caretta et al. 2013) has been developed within a European funded project run by the Treasury Department of the Italian Ministry of the Economy and Finance in collaboration with the Fondazione G. Brodolini, and it is based on the MIDAS model. It is a population partial equilibrium model and it focuses on the evaluation of the sustainability and the adequacy of the Italian pension system. It is updated to the rules in place before the last pension reform (before Law 214/2011). Two scenarios for the modelling of the retirement decisions of individuals are adopted: (i) the individual retires as soon as she becomes eligible; (ii) retirement is simulated on the basis of a set of retirement propensities for 12 different classes of individuals, each characterized by a certain pension level and replacement rate (RR). The use of an innovative dataset that merges administrative and survey information (Ad-SILC) as inputs for the simulations, allows this model to take into account the differences across population socio-demographic groups and to capture fragile careers better. The earnings equation is estimated on a short panel referring to the period 2000–2005.

To this pool of microsimulation models of the Italian pension system we add two models: CeRPSIM3 and NIBAX/Italissimo. CeRPSIM3, presented in the next section, is the third release of the CeRPSIM model. It has been updated with the most recent data available and fully accounts for the latest pension reform rules (Law 214/2011). The simulations are based on gross earnings age profiles estimated using an updated panel dataset drawn from the INPS archive[6] separately for men and women, self-employed and private sector workers, white and blue collar.[7] The estimates account for the presence of an individual specific time invariant error component and a time variant autoregressive AR(1) component. These features distinguish CeRPSIM3 from the other existing models and they are of pivotal importance in the evaluation of the adequacy of the pension system. The NIBAX/Italissimo model simulates the circumstances of a population cross-section through time matched to contemporary survey data for Italy. The focus of the model is the analysis of saving and labour supply decisions in the context of uncertainty over the life cycle.

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[6] The file LoSai (INPS Longitudinal Sample) is available at the Italian Ministry of Labour website (http://www.cliclavoro.gov.it/Barometro-Del-Lavoro/Pagine/Microdati-per-la-ricerca.aspx).

[7] Earnings are gross of the income tax and of the payroll tax paid by the worker.

Table3.2–Characteristics of main microsimulation models on pension in Italy

Model	Objective	Typology	Population	Retirement behaviour	Other features: Pension rules included & simulation of income profiles
DYNAMITE (Ando and Nicoletti Altimari, 2004)	Analysis of the evolution of aggregate income, saving and asset accumulation over the period 1994–2100. The focus is on the effects of ageing and of the 1995 pension reform on aggregate savings.	Dynamic ageing partial equilibrium model. Alignment to the main distinctive features of the population, including participation in the labour market.	Representative sample of the population (SHIW). Unit of analysis: the individual and the household. Closed population	Individuals are simulated to retire according to: (i) the predicted expected retirement age (estimated using SHIW data); (ii) a hazard model for retirement accounting for the financial incentives embedded in the pension rule (estimated using SHIW panel data component).	Earnings profiles: estimated with a two-step Heckman's model on repeated cross-sectional survey data (SHIW 1987-1989-1991-1993-1995) and (for comparison) on the panel component of the same survey data. Pension rules: 1992 and 1995 reforms
MIND (Vagliasindi et al., 2004)	Analysis of : (i) the evolution of life-time incomes from wage and pensions under DB system, mixed system and DC system; (ii) the gender gap in expected life-time income; (iii) the inequalities in the expected life-time income.	Dynamic ageing partial equilibrium model. Alignment to official projections about the demographic and socio-demographic structure.	Representative sample of the population (SHIW). Unit of analysis: the individual and the household. Closed population	Two behavioural approaches to estimate retirement: (i) option-value model; (ii) family bounded rationality model (earlier retirement and female's retirement decision influenced by partner's choice)	Lifetime income profiles: estimated using a Mincerian regression model based on cross-sectional survey data (SHIW 1995). Separate estimations for dependent, self-employed, public and geographical areas (North, Centre, South). Pension rules: pre 2004 and 2004 reform rules
LABORSim (Leombruni and Richiardi, 2006)	Analysis of labour market participation and retirement patterns of the young and the elderly.	Dynamic ageing partial equilibrium model. Agent-based object-oriented framework	Representative sample of the working population (Italian Labour Force Survey 2003 with some	Parametric rule for simulation retirement decisions. Two alternatives considered: (i) retirement when minimum	Earnings profiles: no estimation of earnings Pension rules: 1992–2004 reforms

		Alignment to: Istat demographic projections.	imputations from ECHP). Unit of analysis: the individual. Closed population.	requirements are met; (ii) retirement postponed until the age of 65.	
MIDAS (Dekkers et al., 2009)	Analysis of the adequacy of pension benefits and their impact on inequality and poverty systems.	Dynamic ageing partial equilibrium model. Alignment of predicted aggregate outputs to external macro variables	Representative sample of the population Unit of analysis: the household Closed population.		Earnings profiles: estimated with random effect model on panel data Pension rules: 2004 reform
T-DYMM (Caretta et al., 2013)	Analysis of the financial sustainability and of the adequacy of the Italian pension system.	Dynamic ageing partial equilibrium model. Alignment to official projections related to: couples formation, fertility and mortality rates; employment rates; disability rates.	Representative sample of the population (IT-SILC 2005 integrated with INPS administrative archives data). Unit of analysis: the individual and the household. Closed population.	Retirement decision is based on two main elements: (i) a deterministic transition conditional on achieving necessary requirements for old age pension eligibility; (ii) a probabilistic decision process based on retirement propensities computed retrospectively for 12 classes with different combinations of the level of expected pension benefit (measured with reference to the social allowance) and of potential replacement rate (i.e. the replacement rate received if the worker would retire in that	Earnings profiles: monthly gross income estimated on short administrative panel data (INPS 2000–2005) Pension rules: updated to Laws No. 122/2010, No. 111/2011, No. 148/2011 and the "Stability Law" for 2012 No. 183/11

				moment).	
CeRPSIM (Borella and Coda Moscarola, 2006 and 2010)	Analysis of the adequacy and the redistributive properties of the Italian pension system	Dynamic ageing partial equilibrium model	Cohort population model (15,000 heterogeneous synthetic individuals per cohort). Unit of analysis: the individual (only marital status is simulated). Open population.	Retirement decision: (i) deterministic: the individual retires as soon as he becomes eligible; (ii) behavioural: the individual retires according to the structural behavioural rule estimated in Belloni and Alessie (2010)	Earnings profiles: Gross earnings age profiles estimated using a panel dataset drawn from the INPS archive (individuals are followed from 1975 on) separately for men and women, self-employed and private sector workers, white and blue collar. The estimates account for the presence of an individual-specific, time invariant error component and a time variant autoregressive AR(1) component. Pension rules: pension rules evolution from pre-1992 regime to 2008 reform.
CAPP_DYN (Mazzaferro and Morciano, 2008 rev. 2012)	Analysis of adequacy and the redistributive properties of the Italian pension system	Dynamic ageing, partial equilibrium model aligned with the main demographic and macroeconomic projections	Cross-sectional sample representative of the Italian population (ITSILC 2007). Unit of analysis: the individual and the household. Closed population.	Retirement decision in three steps: (i) eligibility condition; (ii) financial evaluation of retirement decision; (iii) adequacy of the accrued benefit (set exogenously)	Earnings profiles: earnings age profiles estimated on longitudinal-survey data (SILC) separately for men and women, self-employed and private sector workers. Pension rules: updated to 2011 reform (Law 214/2011).

Table 3.3 – Hypotheses and methods to construct income profiles

Model	Method	Data used	Variable used
DYNAMITE	Two-step Heckman's model. To solve the problem of separating age effect from calendar years and cohort-specific effects of productivity growth: (i) cohort effect captured by both age and year dummies; (ii) Deaton and Paxon (1994) method used.[8] In the simulation the first specification is used supplemented with a measure of productivity growth given from outside sources. [Alternative specification tried, based on a linear first-order auto-regression estimated on the (gross) income earnings histories given in the SHIW panel]	SHIW 1987, 1989, 1991, 1993, 1995	First step: <u>Dependent variable</u>: labour force participation <u>Covariates</u>: Gender, marital status, geography, household typology, household composition, cohort dummies Second step: <u>Dependent variable</u>: Log of labour income <u>Covariates</u>: age, age squared, education, occupation, geography, gender, household type, full/part time, private/public sector, employees/self-employed, year dummies, cohort dummies, Mill's ratio
MIND	Log-linear specification on cross-sectional data à la Mincer, following Andreassen, Fredriksen and Ljones (1993). Separate estimations for dependent, self-employed, public and geographical areas (North, Centre, South).	SHIW 1995	<u>Covariates</u>: Age, age squared, gender, education, average number of hours worked
TDYMM	Fixed effect estimation separated for employees, self-employed, parasubordinates. To estimate time invariant observed characteristics, a three-stage procedure Fixed Effects Vector Decomposition (FE-VD) as in Plümper and Troeger (2011) is adopted.	AD-SILC retrospective panel. It is built by merging IT-SILC 2005 with four INPS archives (*Estratti conto*, *archivio imprese*, *casellario attivi e casellario pensionati*,	<u>Dependent variable</u>: logarithm of monthly gross earnings, computed as the ratio between overall labour income earned over the year and the number of months worked over the period. <u>Covariates</u>: Age, age squared, education, marital status, n. of children, work experience, work exp. squared, household typology, full/part time, private/public sector, in work all year

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[8] The Deaton and Paxon method imposes the restriction that the calendar year effect is only a cyclical effect. It restricts year dummies to be orthogonal to a time trend, and assumes that all productivity growth is due either to age or cohort specific effect.

		pensioni). Individuals are followed over the time span 1995–2005.	
CeRPSIM	AR(1) process plus individual random effect. Earnings profiles are estimated separately by gender, job (self-employed and private sector workers) and position (white and blue collars).	INPS Longitudinal Sample The available sample is formed by all individuals born on the first and the ninth of each month of any year – so that the theoretical sample frequency is 24:365 – and reports employment spells from 1975 on.	<u>Dependent variable</u>: logarithm of monthly gross earnings of full time worker. <u>Covariates</u>: a constant, a polynomial in age (third degree for self-employed, fourth degree for employees), ten-year cohort dummies (cohorts 1935, 1945, 1955, 1965, 1975), regional dummies (north, centre, south), and time dummies, which are assumed to sum to zero and be orthogonal to a time trend (Deaton and Paxson, 1994; Deaton, 1997). The unobserved component is assumed to be the sum of a random effect (γ_i) which does not vary over time and is uncorrelated with the explanatory variables included into the equation, plus an autoregressive AR(1) component with parameter ρ. The AR(1) process plus individual random effect has been found to be a good characterization of the unobserved component of earnings in Italy in previous work (Borella, 2004).

4. The effect of the reform on adequacy and distributive properties of the pension system (CeRPSIM3)

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In this chapter we use a microsimulation model to analyse the adequacy and the distributive properties of the pension system after the reform of 2011 as compared with the pre-reform setting. The microsimulation model we build, CeRPSIM3, is the third release of the microsimulation model elaborated to study the Italian pension system in its evolution from a DB to a NDC system (Borella and Coda Moscarola, 2006, 2010).

CeRPSIM3 is a partial equilibrium dynamic microsimulation model by cohorts, according to the taxonomy proposed by Bourguignon and Spadaro (2006). Other microsimulation models designed to capture the different aspects of the Italian labour market and pension system include: Vagliasindi et al. (2004), Mazzaferro and Morciano (2008) and Caretta (2013), who analyse the long-term redistributive effects of social policies; Dekkers and Belloni (2009) who focus on adequacy issues; Ando and Nicoletti-Altimari (2004) who analyse the effects of pension reforms on aggregate income, savings and asset accumulation; Leombruni and Richiardi (2006), who build an agent-based model to study labour supply in Italy (see chapter 3).

Our strategy to study the effect of the 2011 reform is to build a relatively simple simulation model, featuring a detailed modelization of the pension rules characterizing the main social security schemes of Italian workers before and after the reform, and a realistic estimation of the labour income profiles. We simulate representative earnings histories decomposing the earnings process into a deterministic, group-specific age profile, and an unobserved component modelled as an ARMA process plus an individual effect. The needed parameters are estimated from a panel sample of administrative data. We then simulate retirement patterns and pension benefits for various cohorts of workers, including individuals born in 1955, who retire between 2012 and 2020, and younger cohorts who will retire in the future.

We find that the reform of 2011 increased the average retirement age by two to three years for all the cohorts considered, with younger cohorts in general facing a greater increase. The greatest increase in the average retirement age occurs among women currently retiring (i.e., those born in 1955 in our simulations), for whom not only the early retirement option has been removed but also the old-age requirement has been gradually increased in order to match the requirement for men by 2018.

On the adequacy side, we find the average replacement rates from the first pillar increase for all cohorts and groups considered. The largest increase in the replacement rate following each year of retirement postponement occurs among the youngest, purely NDC, cohorts, a consequence of the actuarial adjustment of the benefits in the NDC system.

The reform of 2011 also affects intergenerational redistribution as measured by the ratio of the present value of benefits and the present value of the contributions paid (benefit-to-tax ratio, or Present Value Ratio, PVR). This ratio, before the reform, ranged between 1.5 and 3 for the generation born in 1955; as a result of the reform these values are reduced, although remaining well above one. As expected, younger cohorts display an average PVR very close to one, due to the implementation of the NDC system.

The chapter is structured in the following way. The first section shows the methodological approach adopted in building the microsimulation model. The second section describes the parameters and settings used for the simulations. The third paragraph shows the results. A detailed description of the modules composing CeRPSIM is included in the appendix.

4.1 Methodology

According to the taxonomy proposed by Bourguignon and Spadaro (2006), our model is a dynamic partial-equilibrium microsimulation model of the social security system.[9] It is designed to analyse the distributional features embedded in the Italian pension system during its transition from a DB to an NDC system, fully accounting for the rules characterizing the main social security schemes and for the heterogeneity in the working careers of individuals. It simulates the main life-time events–that is, all the events that can influence the retirement pattern and the amount of pension benefits – of cohorts of individuals born since 1950, computes their retirement age and their retirement benefits and derives indicators to evaluate the adequacy and the inter- and intra-generational distribution of resources. The model allows us to isolate the effects of the change in legislation on retirement patterns and pension benefits of different cohorts of workers, as we can apply different pension rules (pre and post 2011 reform rules) to the same group of individuals (our simulated population), so that the outcomes vary only in response to the pension reform.

The model is made up of two main modules. The population module builds up an artificial cohort of individuals at a given time. The lives of the simulated individuals evolve according to a set of probabilistic rules estimated from the main available surveys and administrative datasets and conditioned to the year of birth and the available socio-economic characteristics. To each individual it randomly assigns a gender and a date of birth. In succession, it simulates the individual's education pattern, marital status and career profile, which includes the number of weeks worked in a given year and earnings, and contributions paid into social security. The number of weeks worked may vary from zero (if unemployment lasts a whole year) to 52 for full employment: the probability of working a certain amount of weeks in a particular year depends on the number of weeks worked in the previous year and on demographic characteristics, such as age, cohort, gender and geographical area. The earnings profiles of individuals, conditional on working, are accurately estimated as the sum of a group-specific deterministic component (that is, a group-specific age profile) and an individual-specific stochastic component estimated from a panel of administrative data. Given the pivotal role of the estimated earnings profiles in the determination of the model outcomes, section 3.2 presents their derivation procedure more extensively.

The pension module computes pensionable earnings and contributions paid, checks eligibility requirements, and calculates the pension benefits for a number of schemes (employees and self-employed) and different regimes (MDB, PR, NDC). If an individual is eligible, then the pension benefit is computed under the assumption that the individual retires as soon as he or she is eligible. Indeed, in recent years (after the 2008 reform), minimum retirement ages have been increased so much that this has become the most likely scenario. Borella and Coda Moscarola (2010) show that for the NDC cohorts the desired retirement age estimated according to the behavioural rule of Belloni and Alessie (2009) is almost equal to or even higher (as in the case of private-sector employees) than the minimum retirement age as set by the legislation in force in 2008.

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[9] For a survey of microsimulation models see also Creedy and Kalb (2006) and Li and O'Donoghue (2013).

We analyse four cohorts of individuals born between 1955 and 1985 in order to show the effects of the reform for MDB workers, retiring between 2012 and 2020, for PR workers, retiring between 2018 and 2030, and for NDC workers, retiring after 2030. Pension benefits are computed according to both the pre and post 2011 reform rules. For each cohort we simulate 15,000 heterogeneous individuals.

We focus on self-employed and private-sector employed workers eligible for the main private employee scheme (FPLD). In the paragraph that follows we report a brief description of the main parameters and settings used in the simulations. A detailed description of the microsimulation model is reported in Appendix 1.

4.2 Parameters and settings

In the microsimulation model the unit of analysis is the individual. In building up the probability matrices used to model transitions across states, we refer to the available official statistics from the National Statistical Institute (ISTAT), the Bank of Italy Survey on Household Income and Wealth (SHIW) and administrative datasets provided by National Social Security Institute (INPS). We do not model household composition, or household income and wealth, but we account for the marital status of our simulated individuals for the computation of the survivor pensions.

Assumptions about the evolution of mortality play a key role in the simulations as they govern the survival of individuals over time, that is, they determine whether simulated individuals reach the retirement age and when and if they will be entitled to a survivor pension; in addition, mortality determines the evolution over time of the annuity rates used to compute the NDC part of the pension benefits hence affecting the distributive impact of the pension rules.[10] In our analysis we use the official ISTAT mortality tables from 1974 to 2010 and the official ISTAT projections from 2011 on. As for the macroeconomic variables, we set the interest rate, the inflation rate and the GDP real growth rate at their historical levels up to the year 2013. For the future they are supposed to reach and maintain the levels of 2 per cent, 1.6 per cent and 1.5 per cent respectively. All the minimum and maximum thresholds for the determination of the payrolls and the benefits are updated with nominal GDP growth to avoid the "fiscal drag effects" (Sutherland et al., 2008). Indexation of pension benefits to inflation are done according to the current rules.

4.2.1 Earnings

Earnings age profiles have been estimated using a dataset drawn from the INPS archive.[11] The INPS archive officially records the complete earnings and contribution histories of all participants, that is, employees in the private sector and some categories of self-employed (for our purposes, crafts- and tradespersons). The available sample is formed by all individuals born on the first and the ninth of each month of any year – so that the theoretical sample frequency is 24:365 – and reports employment spells from 1975 until 2012. The archive contains very rich information about the earnings histories of the workers, recording spells of unemployment and sickness, as well as labour income earned each year.

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[10] The evolution of retirement age strictly depends on the evolution of life expectancy, but this is already embedded in the projections about the minimum age and seniority requirements provided by INPS. These projections have been done for research purposes and do not obligate the INPS in any regard.

[11] The file LoSai (INPS Longidunal Sample) is available at the Italian Ministry of Labour website (http://www.cliclavoro.gov.it/Barometro-Del-Lavoro/Pagine/Microdati-per-la-ricerca.aspx).

Based on these data, we estimate gross earnings profiles separately for men and women, self-employed and private-sector workers, white and blue collar.[12] We base our estimates on the subsample of individuals working full time and for the whole year. Later in our simulations, to allow for unemployment spells, we rescale the simulated annual incomes for the relevant number of weeks worked in any given year.

The estimated equation is:

$$\ln y_{it} = x_{it}\beta + \gamma_i + \varepsilon_{it}$$
$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

$$\ln y_{it} = x_{it}\beta + \gamma_i + \varepsilon_{it}$$
$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

$$\gamma_i \sim (0,\ \sigma_\gamma^2)\ ;\quad \eta_{it} \sim (0,\ \sigma_\eta^2)$$

where x_{it} is a vector of individual characteristics, including a constant, a polynomial in age (third degree for self-employed, fourth degree for employees), 10-year cohort dummies (cohorts 1935, 1945, 1955, 1965, 1975), regional dummies (north, centre, south), and time dummies, which are assumed to sum to zero and be orthogonal to a time trend (Deaton and Paxson, 1994; Deaton, 1997). The unobserved component is assumed to be the sum of a random effect (γi) which does not vary over time and is uncorrelated with the explanatory variables included in the equation, plus an autoregressive AR(1) component with parameter ρ. The AR(1) process plus individual random effect has been found to be a good characterization of the unobserved component of earnings in Italy in previous work (Borella, 2004). The estimated coefficients are reported in Tables A1.5 and A1.6 in the Appendix.

The availability of a long panel of administrative data is clearly an advantage, as it permits the estimation of relatively flexible specifications of earnings profiles for various groups of the population and for different generations, without having to rely on restrictive assumptions needed when the data source is a cross-section (Vagliasindi et al., 2004; Mazzaferro and Morciano, 2008) or a short administrative panel (Caretta et al., 2013).

The average profiles obtained are shown in Figures 4.1 and 4.2. In Figure 4.1 we draw the estimated earnings profiles for private sector employees born in central Italy in 1975 (that is, between 1970 and 1980). White collar men have the higher income profile, followed by white collar women, then blue collar men and women. The average annual growth rate in real wages in the private sector is 2.7 per cent per year for white collar males, while white collar females have flatter profiles with an average yearly growth of 1.9 per cent. For blue collar workers, average annual growth is 1.9 per cent for males and 1.3 per cent for females. Figure 4.2 shows the estimated real income profiles for self-employed workers born in 1975. Also in this case, the average rate of growth is higher for men, about 1.5 per cent, while women display flatter income profiles (with an average growth of about 1.2 per cent).

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[12] The earning are gross of the income tax and of the payroll tax paid by the worker.

Figure 4.1 – Full-time employees working in central Italy, cohort born in 1975
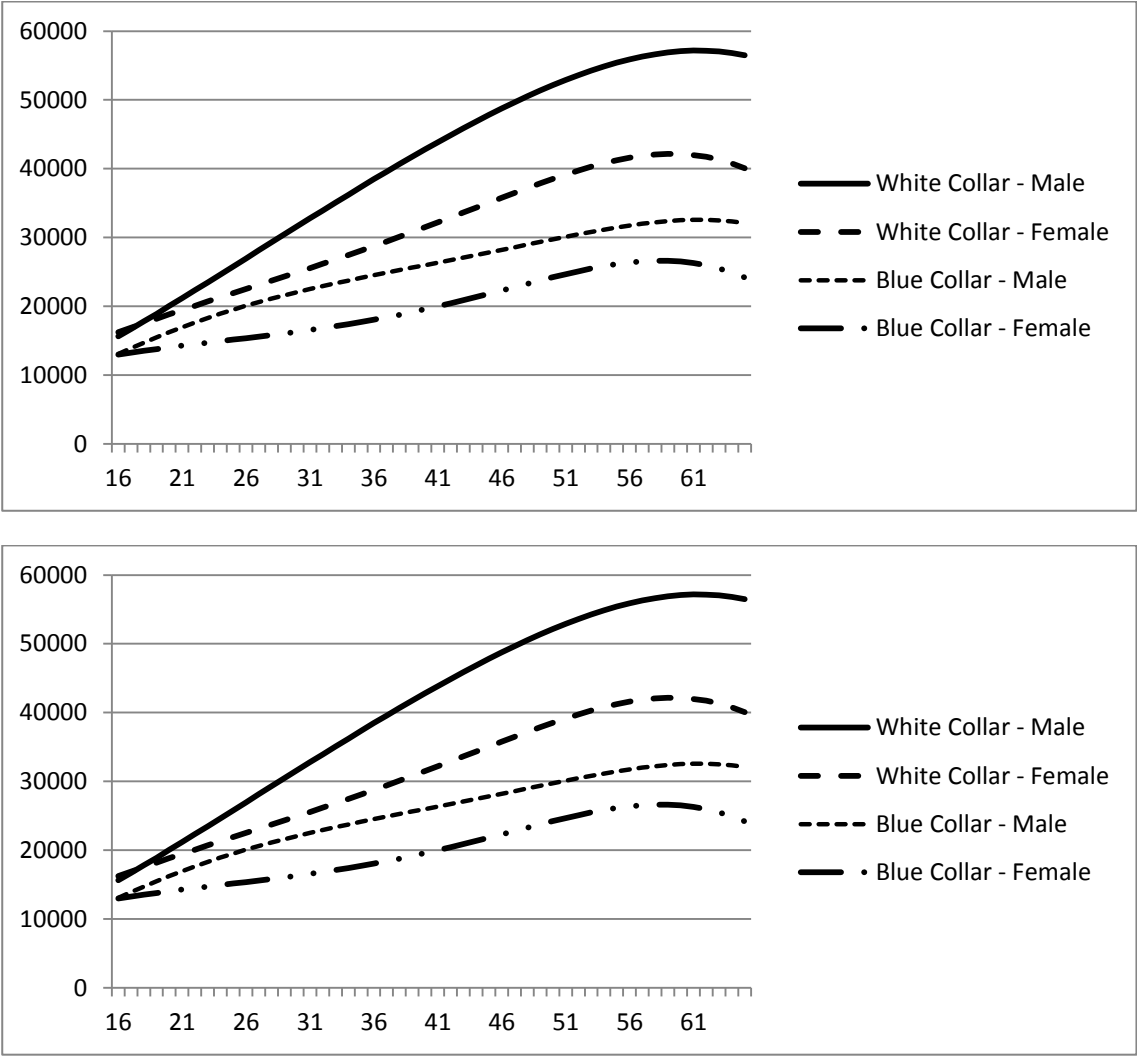
Note: values expressed in 2010 euro.

Source: Authors' calculations.

Figure 4.2 – Self-employed workers working in central Italy, cohort born in 1975
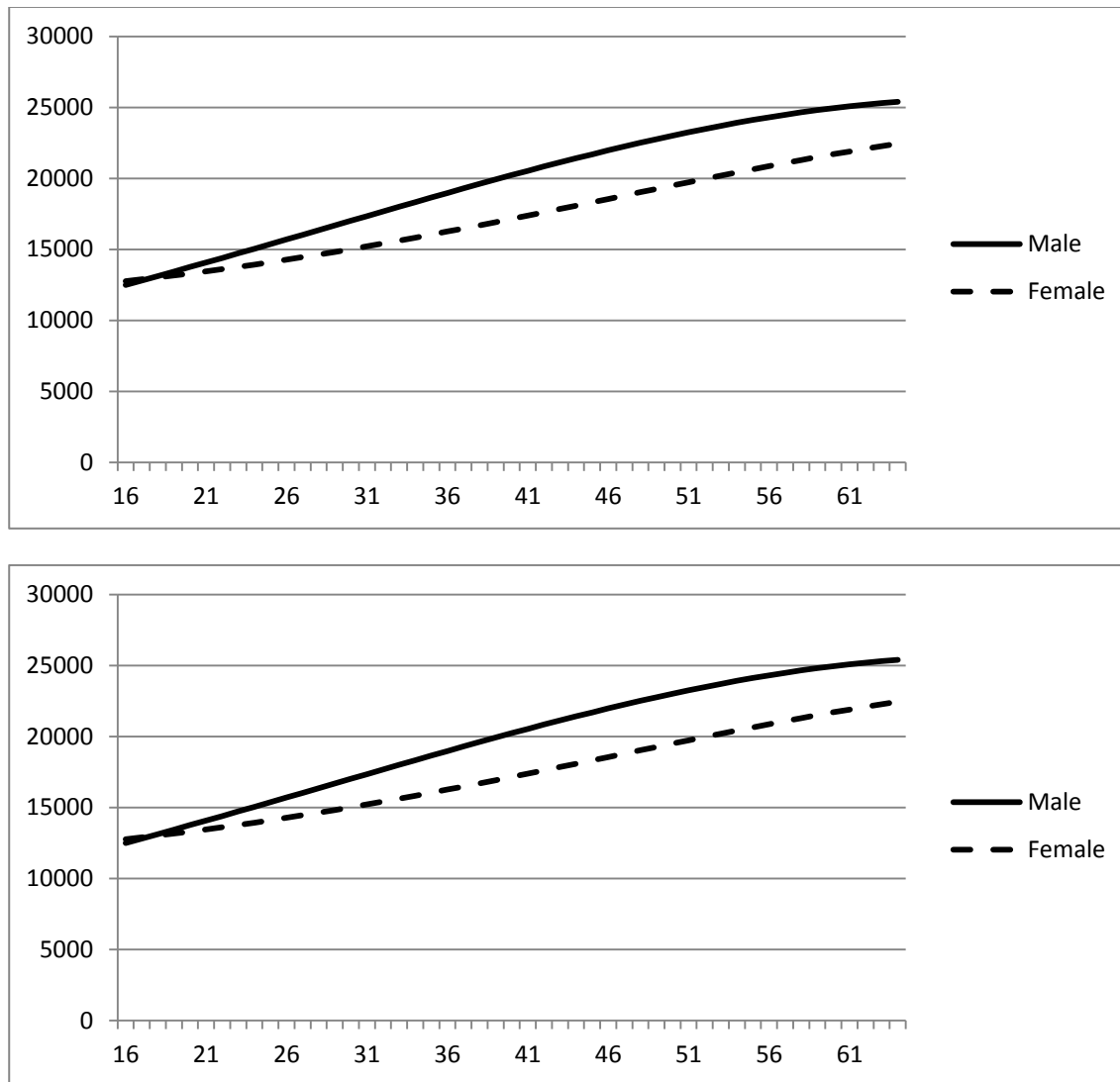
Note: values expressed in 2010 euro.
Source: Authors' calculations.

In the simulations, each individual is given his or her average log earnings profile for his or her age and group (defined by cohort, gender, region and occupation) plus an error term formed by the sum of the two unobserved components. The first one is drawn from a normal distribution with variance σ_γ^2, and it permanently shifts up or down the average profile for the individual it refers to. The second component, which is also individual specific and varies over time, is formed by the shock from the previous period, times the autoregressive parameter ρ plus an error term drawn from a normal distribution with variance σ_η^2.

4.2.2 The annuity rates

An important ingredient for a correct evaluation of the pension coverage of future generations of PR and NDC workers is the annuity rate, that is, the coefficient used to annuitize the present value of contributions. Law no. 247 of 2007 regulates the automatic adjustment, every three years, of the annuity rates to life expectancy. Law no. 122 of 2010 explicitly provided for the extension of the coefficients for ages greater

than 65 years, when the evolution of eligibility to the old age pension would have increased to over age 65. Law no. 214 of 2011 anticipated the update in 2013 and introduced an automatic adjustment to life expectancy every two years from 2018 onwards.

The effect of the adjustment of the annuity rates to the demographic evolution is a reduction in the coefficient at any given retirement age, because of the increase in life expectancy. However, as we show in the rest of this section, the annuity rates are substantially constant at the retirement age, as the latter is also evolving with life expectancy.

Using the latest demographic forecasts published by ISTAT (2011) and the formulae published by the State General Accounting Office (RGS, 2014), we calculate the annuity coefficients in each year in our simulation. To summarize their evolution, in Table 4.1 we report the predicted coefficients at some relevant ages for the PR and NDC generations considered in our simulation, that is, those born in 1965, 1975 and 1985. The table highlights how, for example, the coefficient for retirement at age 65 is reduced over time. For clarity, the inverse of the annuity coefficient is also reported, representing approximately the average expected life captured by the coefficient, which is a weighted average computed for men and women.[13] For example, for the generation born in 1965, the projected minimum age of retirement is 65 years and 2 months, and in 2030, when they reach 65, the annuity coefficient is computed by assuming an average expected life of about 21 years (i.e., which implies that the NDC pension will be computed by dividing the present value of the contributions by about 21). For the generation born in 1975, the expected evolution of mortality implies that the projected minimum age of retirement in the NDC system in the relevant year will be 66 years (and 9 months). In that year, 2041, the annuity rate will also be different as it is constantly updated to mortality: indeed, the coefficient at age 66 implies an expected life of about 21 years, reflecting the lower (predicted) mortality of that generation. For the subsequent generation the same reasoning applies: the minimum age for retirement in the NDC system is higher by about one year (it is predicted to be 67 years and 11 months in 2052), and the annuity rate at age 67 again is updated and reflects an expected life of 21 years. The same indexation mechanism applies to all the relevant ages (normal and maximum age of retirement), as they are all linked to life expectancy. As life expectancy increases, the legal age of retirement increases, the annuity rates at any given age are reduced, but the annuity rates at the legal ages of retirement remain more or less constant.

Table 4.1 – Annuity rates – evolution over time

Born in:	1965		1975		1985	
Age	Δ	1/δ	δ	1/δ	δ	1/δ
65	0.04750	21.1	0.04617	21.7	0.04455	22.4
66	0.04888	20.5	0.04749	21.1	0.04567	21.9
67	0.05027	19.9	0.04825	20.7	0.04693	21.3
68	0.05231	19.12	0.05017	19.9	0.04911	20.4
69	0.05240	19.08	0.05155	19.4	0.04957	20.2
70	0.05516	18.1	0.05391	18.5	0.05118	19.5

Note: predicted annuity rates (δ) at different ages for different generations. 1/δ is approximately the average life expectancy in years implied by δ. The generation born in 1965 is aged 65–70 in the years 2030–35, the generation born in 1975 in the years 2040–45 and the generation born in 1985 in the years 1950–55.

Source: Authors' calculations.

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[13] More precisely, it is the expected life of the pension benefit, whose duration depends on the gender of the pensioner and on the probability of him or her leaving an heir entitled to receive the corresponding survivor benefit.

4.2.3 The validation procedure

Reconciling simulated and recorded estimates is an important component of both the process of building a tax-benefit model and validating the content of micro-data from surveys (Figari et al., 2014).

In order to validate the model's outcomes we compare the gender composition, the mean age of retirement and the mean seniority of the cohort born in 1950 predicted by the model with those observed in the INPS administrative dataset. Ex-post analysis of previous periods can indeed be used to assess the validity of the model (Li and O'Donoghue, 2013). We disentangle individuals by gender and working scheme. The focus is on FPLD and self-employed workers. The comparison is made difficult by the fact that our model is able to reproduce the retirement patterns for the cohorts born from 1950 on, indeed we did not modelize the pension rules for earlier cohorts. In addition, not all the individuals from this cohort have yet retired. Consequently, we have to focus only on individuals who (both in our synthetic cohorts and in the true population) retired before 2015.

Despite these cautions, we find that the gender composition, the average age of retirement and the average seniority for individuals retiring before 2015 are in line with what is observed in the data (see Table 4.2). Women represent the only exception. In particular, they demonstrate a very low seniority at retirement. A further investigation of this issue will be an objective of future improvements of the work.

Table 4.2 – Statistics for the validation procedure: composition by pension scheme and gender, cohort 1950

	CERPSIM		INPS	
FPLD	75%		70%	
Self-employed	25%		30%	
	men	Women	men	women
FPLD	56%	44%	51%	49%
Self-employed	55%	45%	53%	47%

Source: Authors' calculations.

Table 4.3 – Statistics for the validation procedure: type of pension, cohort 1950

	CERPSIM		INPS	
FPLD	Men	women	men	Women
Seniority	94%	28%	98%	36%
Old age	6%	72%	2%	61%
Self-employed				
Seniority	97%	62%	100%	21%
Old age	3%	38%	0%	79%

Source: Authors' calculations.

Table 4.4 – Statistics for the validation procedure: age at retirement, cohort 1950

	CERPSIM		INPS	
	men	Women	Men	Women
FPLD	59.58	60.26	57.06	59.02
Self-employed	59.38	59.69	59.39	60.33

Source: Authors' calculations.

Table 4.5 – Statistics for the validation procedure: seniority at retirement, cohort 1950

	CERPSIM		INPS	
	Men	women	men	women
FPLD	37.41	32.01	37.53	28.55
Self-employed	38.31	35.87	39.50	29.62

Source: Authors' calculations.

4.3 Results

In this section, we will show the effects of the 2011 reform on the age of retirement, the ability of the pension system to preserve pre-retirement income levels and the degree of actuarial fairness. In doing this, we are implicitly considering the pension system in terms of an insurance for the longevity risk (in line with the study by Feldstein and Liebman (2002)) with premia represented by the contributions paid during the working life with which the benefits (the pensions) should be commensurate.

4.3.1 The age of retirement

We begin by exploring the effect of the reform of 2011 on the retirement path of the various cohorts. In Figure 4.3 we draw the percentage of retirees per year and cohort; as in our model individuals retire as soon as they reach the minimum requirements the graph shows the path of minimum requirements through time for both scenarios, before and after the reform.

Figure 4.3 – Retirees before and after the reform of 2011
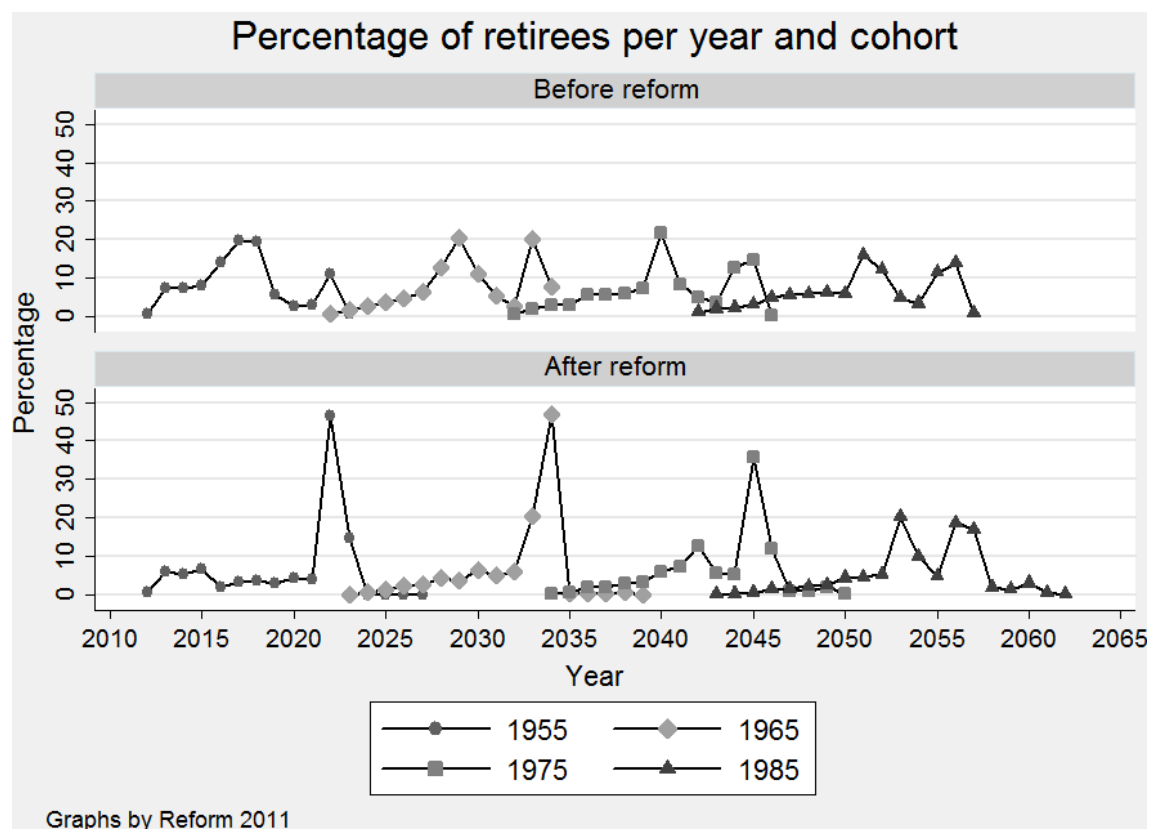
Source: Authors' calculations.

For example, in the upper panel, displaying the "before reform" scenario, the first cohort on the left, born in 1955, retires between 2012 and 2023. In 2013, corresponding to age 58, there is a spike in the exit rate due to the option given to women to retire with the NDC benefit at age 57 plus a deferral time of 12 months (or 18 months, if self-employed). This same cohort exhibits another spike in the years 2017–18, that is, when reaching the minimum age required to claim the seniority pension with the quota mechanism.[14] As the age requirement was necessary but not sufficient to claim an early benefit, as there is also a seniority requirement (in terms of years of contribution), some workers retire later than the early retirement age. In addition, workers reaching 40 years of contribution could retire irrespective of their age, hence the proportion of workers retiring in each year is not equal to zero. At the age of 66 (67 with the deferral), that is, when the old-age requirement for men is met, there is a smaller spike, of about 10 per cent, as most workers are already out of the labour force. The second cohort, born in 1965, retires in the period 2022–2036; the path is similar to the one displayed by the cohort born in 1955, absent the spike at age 58 (because the NDC option for women is no longer available). The spike corresponding to the early retirement age (plus deferral) for this cohort is visible at ages 63 and 64 (years 2028 and 2029), and the spike for old age is in the year 2033 at age 68, a consequence of the indexing of requirements to life expectancy. A similar path is visible for the cohort

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[14] The minimum age for early retirement before the reform would have been 61, which with the deferral of 12 (18) months would become 62 (and a half) years. As our population is born uniformly over the year, individuals born in December 1955, say, meet their minimum age requirement in the year 2018.

born in 1975, where the spikes are at ages 65 in 2040 and 69–70 in the years 2044–45, and, finally, for the cohort born in 1985, with spikes at ages 66–67 and 70–71.

Table 4.6 – Average age of retirement

	Private-Sector Employees				Self-Employed			
	1955	1965	1975	1985	1955	1965	1975	1985
Men								
Before the reform	63.53	64.42	65.05	65.65	62.45	63.44	63.85	64.23
After the reform	65.94	67.48	68.21	68.78	64.34	66.17	67.12	67.96
Women								
Before the reform	60.75	65.79	66.85	67.51	60.74	64.22	64.93	65.76
After the reform	64.87	68.02	69.15	70.15	62.77	66.32	67.59	68.79

Source: Authors' calculations.

The bottom panel of the figure shows the impact of the reform on the retirement pattern. The most striking feature is the disappearance of the early retirement spikes from the figure: starting with the oldest cohort, born in 1955, the highest spike, of about 45 per cent, is at age 67 – the old-age requirement for both men and women that will be in place in 2022. However, the possibility for women to opt for the NDC and retire at age 58 is still in place and evident in the figure. Subsequent cohorts show the retirement path in the presence of the two exit routes allowed by the reform, that is, either a total seniority of at least 41/42 years for women/men (for the 1965 cohort, but increasing with mortality for subsequent cohorts) or the attainment of the old-age requirement, coupled with a minimum of 20 years of seniority. The age at which it is possible to claim the pension is also expected to increase with longevity; for example, for the generation born in 1965 the old-age requirement will be 68 years and 8 months in the years 2033 and 2034. As in our model individuals are born uniformly within the year, individuals born in the first quarter of 1965 accrue the age requirement in 2033 and receive their first pension benefit in that year, while the others accrue the age requirement in the following year (hence the spike in the year 2034). The cohort born in 1975, in addition to the old age spike in 2045, exhibits a spike in 2042, due to NDC workers (that is, workers who entered the labour market after 1995) retiring at the minimum age, which is 66 and 8 months. The workers born in 1985 all belong to the NDC scheme, and exhibit a spike in 2053 (when they reach the minimum retirement age of 68 years and 2 months). Only workers whose accrued pension is at least 2.8 times the social allowance, however, can retire at that minimum age; a second spike occurs in 2056–57, when this cohort reaches the normal retirement age, when it is possible to retire having accrued a pension greater than 1.5 times the social allowance. Workers with poorer working careers remain in the labour force until they reach the maximum age of 75 years and 11 months in the year 2060, or of 76 years and 2 months in 2061.

We next show the average age of retirement for the various sub-groups of workers considered in the model. In Table 4.6 we report the average age of retirement before and after the reform, distinguishing between private-sector employees and self-employed workers, and between men and women. Starting with the upper left panel, in the absence of the reform the average retirement age for male private-sector employees born in 1955 would have been 63.5 years: these workers could retire because they reached the eligible age (65 years, plus a minimum of 20 years of contribution), because they had accumulated 40 years of contributions, or because they were at least 61 with at least 35 years of contribution (with the sum of the two numbers reaching quota 97). Once they reached one of these minimum requirements they still had to wait 12 months

(deferral time) before being entitled to the benefit. The average figure shown in the table reflects the fact that, in our simulations, about one third of the simulated private-sector employees were entitled to retire because they reached the contribution ceiling, while about 43 per cent could retire with the early option of quota 97. Even in the pre-reform scenario, the legal retirement ages were linked to expected longevity, hence for subsequent cohorts the average age of retirement increased accordingly, reaching 65.6 years on average for the cohort born in 1985, which is completely NDC, but in the pre-reform scenario could retire with the same rules as the previous MDB or PR cohorts. A similar pattern is followed by male self-employed workers, in the upper right panel of the table, who reached retirement on average 1.2 years earlier than private-sector employees because their careers are less unstable and they are more likely to complete 40 years of contributions.

For women, shown in the lower panel of Table 4.6, the pre-reform scenario is more or less the same, but with an important distinction, as they had the possibility to opt for the NDC system until 31 December 2015.[15] This possibility is reflected in the relatively low average retirement age displayed by the cohort born in 1955, for whom our model simulates that about 30 per cent retire meeting the requirements for the option to the NDC regime.[16] In addition, the 1955 cohort benefitted from an age of retirement lower than men, while subsequent cohorts faced an increase in the old age requirement to meet that for men (parity of requisites was due by the year 2026). Hence, younger cohorts no longer had the option to opt for the NDC system, and were required to reach an older age: as a consequence the average retirement age increased substantially: for example, for the cohort born in 1965 it increased to almost 66 years, that is about five years more than the 1955 cohort. It is interesting to notice that the predicted average age of retirement was higher for women than for men: this follows the fact that relatively few women reach the maximum contribution level for which it is possible to retire irrespective of age (which was equal to 40 years of seniority before the 2011 reform).

The comparison with the results obtained in the "after the reform" scenario shows that the average retirement age increases for all categories of workers and for all the cohorts considered. Starting with men, for private-sector employees born in 1955 the average age of retirement increases to 65.9 years, with an average increase of almost 2.4 years with respect to the pre-reform scenario. Younger generations, for whom the NDC system is gradually phased in, face a bigger increase in average retirement age of about 3 years. For the self-employed men the pattern is the same, with an average retirement age increasing by about 2 years for the oldest cohort born in 1955, and by 3 to 3.7 years for younger cohorts. In addition, their average retirement age is lower than that for employees because they tend to retire with seniority pensions.[17]

For women the increase is less pronounced, with the sole exception of the 1955 cohort for whom the increase, in the case of employees, is about four years, a result of the acceleration imposed by the reform in the alignment of the age requirements between genders. Before the reform, the age requirement was 61 (62, including deferral time) in the years 2016–2017; after the reform, in the same years, it becomes 65, further increasing to 66 in 2018, hence women born in 1955 will be able to retire, with the old age option, in 2021.[18] Women born in 1965 already in the pre-reform scenario faced an increase in the old age requirement, and

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[15] This possibility has been confirmed by the reform of 2011.

[16] That is an age equal to at least 57 years and 3 months, and 35 years of contributions, plus a deferral of 12–18 months for employees/self-employed workers.

[17] The required years of contributions were gradually increased after the reform, but less than the old age requirement.

[18] In our simulations, about 62 per cent of women employees retire with the old age option.

now display a smaller increase of about 2.2 years. For subsequent cohorts, the average increase in retirement age ranges from two to three years both for employees and for the self-employed. In addition, the average retirement age is about one year older than that for men, again because for women, especially when private-sector employees, the total number of years of contributions tends to be lower than for men, and as a consequence they are less likely to qualify for a seniority pension.

4.3.2 The replacement rate

As a measure of the ability of the pension system to preserve income levels, we compute the replacement rate as the ratio between the first benefit and the average income of the last four years.[19] The ability of the pension system to preserve income levels can be considered a spurious but very intuitive and widespread indicator of the adequacy of a pension system.[20]

Looking at the scenario before the 2011 reform, the effect of the gradual shift to the contribution-based benefit is quite striking. For example, men who were private-sector employees born in 1955 (MDB workers) were entitled on average to a benefit equal to about 72 per cent of their final salary. For the generation born in 1965, which includes pro-rata workers, the replacement rate reduced to 65 per cent, although the average retirement age increased by 0.9 years, as shown in Table 4.7. The pre-reform replacement rate reduced to about 64 per cent for younger generations, for whom the contribution-based part of the benefit was almost (born in 1975) or completely (born in 1985) active. For the self-employed workers the reduction in the average replacement rate was even more dramatic, as in the MDB system their benefit was computed with more or less the same rules in force for the employees, while their payroll tax rate was considerably lower. Before the reform, the average replacement rate for men fell from 74.7 per cent (1955 cohort, MDB) to about 42.9 per cent (1985 cohort, NDC).

For women, both employees and self-employed, the pre-reform situation was analogous, although it should be noted that for the cohort born in 1955 the average replacement rate was lower than for men, reflecting the lower average retirement age of women, already shown in the previous section (due to the possibility of retiring earlier if opting for the NDC system and to the lower old age requirement).

The "after the reform" scenario shows the great increase in the benefit and in the replacement rate that follows from an increase in the retirement age when the benefit is computed with the contribution-based formula. This is due to the increase in the annuity rates which govern the computation of the pension entitlement in the NDC system: as they reflect residual life expectancy at the moment of retirement, a one-year postponement induces an increase of the coefficient of about 4 per cent. For example, while for the cohort born in 1955 the increase in the replacement rate is about 6.6 percentage points for private-sector employed men, that is, about 3 percentage points for each year of postponement, for younger cohorts of employees the advantage of each year of postponing retirement is an increase of about (and even in excess

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[19] We take the average to smooth out temporary shocks to income. All figures are gross of the income tax and of the contributions paid by the worker, so this is a gross replacement rate.

[20] Indeed, it focusses on the pension system alone and does not account for the compensatory (re)distributive effects of the tax system or of other welfare state programs. In addition, in a life-cycle framework, adequacy does not directly imply the constancy of the income as individuals more generally smooth (the marginal utility of) consumption across time.

of) 4 percentage points in the replacement rate. Hence, for example, an employed man born in 1985 could expect to retire with an average replacement rate equal to 64.2 per cent before the reform, while after the reform he can expect to retire with a replacement rate equal to 77.5 per cent (having worked four years longer). For self-employed workers the figures are about the same, with the cohort born in 1955 benefiting very little from the postponement of retirement, while the subsequent cohorts increase their replacement rate by about 4 percentage points per additional working year. Hence, the increase in the retirement age contrasts, at least partially, the reduction in the replacement rates faced by self-employed workers.

Finally, the cohort of women born in 1955, who face the greatest increase in the retirement age, benefit from an increase of 13.2 percentage points in their replacement rates.[21]

Table 4.7 – Average and median replacement rate (first pillar, per cent)

| | Private-Sector Employees | | | | Self-Employed | | | |
	1955	1965	1975	1985	1955	1965	1975	1985
Men								
Before the reform								
Average	72.06	65.00	63.18	64.25	74.72	50.83	44.58	42.88
Median	*72.13*	*65.10*	*62.92*	*64.02*	*76.66*	*51.43*	*44.74*	*40.84*
After the reform								
Average	78.70	76.64	77.40	77.55	76.62	59.94	56.70	57.41
Median	*80.78*	*77.10*	*77.35*	*77.24*	*78.23*	*60.31*	*56.78*	*56.98*
Women								
Before the reform								
Average	62.78	64.03	62.92	64.20	67.30	49.72	46.39	45.95
Median	*61.78*	*63.92*	*62.42*	*63.29*	*71.43*	*50.06*	*45.82*	*43.02*
After the reform								
Average	76.00	72.10	72.49	73.97	70.33	56.72	54.76	56.41
Median	*70.56*	*71.22*	*71.51*	*72.86*	*71.25*	*57.46*	*54.11*	*57.56*

Source: Authors' calculations.

4.3.3 The Present Value Ratio

As a money's worth measure we compute the so-called Present Value Ratio (PVR) or, in other words, the benefit-to-tax ratio, that is, the ratio between the present value of the pension benefits to be received and the present value of payroll taxes paid, both valued at retirement. If the PVR is greater than one when calculated at an interest rate equal to the growth rate of GDP, then the system is granting to retired individuals more

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[21] Our model is also able to simulate the second pillar pension, as in 2007 a reform incentivized participation in the second pillar. Assuming a contribution rate of 6.91 per cent (that is, the percentage devoted to the severance pay – Trattamento di Fine Rapporto, TFR – that the reform incentivized to divert to the second pillar) for all workers, a real return of 2 per cent, and contributions starting in 2007, would result in an additional 5 percentage points in the replacement rate for the cohort born in 1955, increasing to 16 percentage points for the cohort born in 1985.

than would be justified in a pension system in financial equilibrium. Hence this quantity also measures inter-generational redistribution, indicating, when greater than one, that on average the system is redistributing resources from generations active in the labour market to currently retired ones.

Inspection of Table 4.8, the pre-reform scenario, reveals how in the MDB system (cohort born in 1955) the average present value of pension benefits was higher than the present value of the payroll taxes paid: private-sector employed men, before the reform, had a ratio equal to 1.55, or, in other words, on average they received from the system 55 per cent more than they paid in. As the PR and the NDC systems were phased in, the PVR was reduced: in the NDC system, for men employees, it was very close to one (1.03). Self-employed workers born in 1955 had a much higher PVR (2.71), as they benefitted from a defined benefit entitlement and a payroll tax rate lower than employees. Under the NDC system (cohort born in 1985) self-employed men still had a PVR greater than one (1.36 before the reform) as they were more likely than employees to qualify for the social allowance. Women followed the same pattern, with a higher PVR on average due both to higher life expectancy and to a higher probability of qualifying for the social allowance.

After the reform the PVR is reduced for all categories. For the cohort born in 1955 this reduction is also due to the change in the benefit computation formula which, although only for the last working years, is based on the contributions effectively paid. This shift, coupled with a less likely resort to the minimum benefit, implies a reduction in the PVR of about 20 percentage points for all the categories considered.

As the NDC reform is phased in, the reduction in the PVR implied by the 2011 reform is lessened, although it does not disappear especially for women and for self-employed workers, both men and women. This is due to the fact that the increase in their retirement age implies an increase in their pension payments as well, and the probability that they will end up receiving the social allowance is consequently lower.

Table 4.8 – Average Present Value Ratio (PVR)

	Private-sector Employees				Self-Employed			
	1955	1965	1975	1985	1955	1965	1975	1985
Men								
Before the reform	1.55	1.12	1.02	1.03	2.71	1.52	1.43	1.36
After the reform	1.41	1.09	1.00	1.01	2.37	1.33	1.17	1.10
Women								
Before the reform	1.88	1.21	1.13	1.18	3.11	1.66	1.63	1.71
After the reform	1.64	1.18	1.10	1.13	2.75	1.44	1.30	1.26

Source: Authors' calculations.

In Figure 4.4 we show the path of the individual PVR, before and after the reform, through time. For the cohort born in 1955, formed by workers of the MDB type, the PVR is almost always greater than one, decreasing with retirement age. For the following cohorts, as the NDC system is phased in, not only does the average PVR decrease, but individuals retiring later, within each cohort, tend to earn a higher PVR. This is due to the eligibility requirements for the pure NDC workers, who must wait until the maximum age if their accrued pension entitlement is lower than a certain threshold, and hence have a higher probability of qualifying for the social allowance. After the reform, this tendency is mitigated by the increase in the maximum age requirement, which lowers the probability of qualifying for the social allowance.

Figure 4.4 – Present Value Ratio before and after the reform of 2011

PVR values per year - I pillar
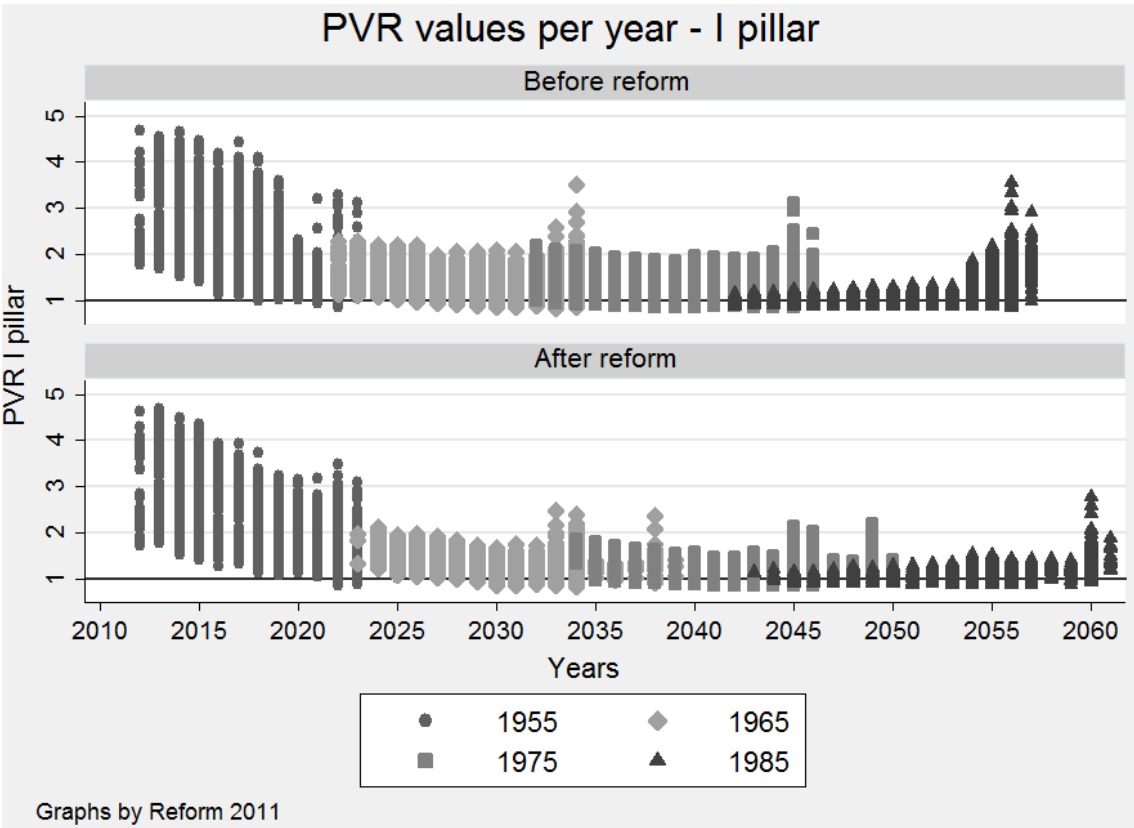
Source: Authors' calculations.

Participation in the second pillar, which at present is still not pervasive in Italy (Commissione di Vigilanza sui Fondi Pensione, 2013), would increase replacement rates and adequacy in an obvious way.

5. The retirement readiness of the working-age population: the Italian case compared with other OECD countries

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The OECD has recently published an analysis of the role that pensions play in the retirement readiness of the working-age population (Chapter 3, OECD 2014). This analysis estimates the potential future pension income of today's working-age population by calculating individuals' actual accumulation of pension rights and pension assets in different pension plans available to them in their respective countries (e.g. pay-as-you-go (PAYG) public pensions, defined benefit (DB) and defined contribution (DC) private pensions) and complementing it with what individuals may accumulate going forward until they retire according to different scenarios. Six OECD countries are examined: Chile, France, the Netherlands, Norway, the United Kingdom, and the United States. The analysis identifies subgroups of the population in each country that may be insufficiently prepared to finance their retirement.

In this section we reproduce the analyses conducted by the OECD focussing on the case of Italy. In particular, using the simulations output provided by the CeRPSIM3 model, we replicate for Italy the comparative tables available in OECD (2014). The exercise allows us to explore further the adequacy issues, highlighting aspects not already covered in paragraph 4.3.2, and to compare the Italian situation with that of a representative sample of OECD countries.

The analysis detects some noteworthy features. First of all, low-income workers, women and the self-employed are more vulnerable. This is particularly evident for Italy, but is also found in all the other OECD countries analysed. In fact, workers belonging to these groups are more likely than their counterparts to receive a future pension that will be: (i) lower than the pensions received by current retirees; (ii) below the poverty threshold. Secondly, future generations in Italy will not only be more at risk of not reaching the country-specific replacement rate once retired (a feature common to all the other analysed countries), but they will also attain on average lower pensions with respect to current retirees (something not observed in the other countries). Thirdly, even under the optimistic assumption of a complete adhesion of all private-sector employees and self-employed workers to the pension funds, the role of the second pillar in determining the total pension income would be limited to 12 per cent, a share which is lower than all the other analysed countries, with the sole exception of France.

The chapter is organized as follows. Section 5.1 explicates the methodological approach used in our calculations. Section 5.2 describes the (potential) role of second pillar pensions in determining the retirees' income. Section 5.3 highlights how first and second pillar pensions help in maintaining living standards at retirement. Section 5.4 shows the proportion of individuals of future generations worse-off than the cohorts already retired. Section 5.5 evaluates poverty rates among the retirees. Throughout the chapter we adopt a comparative perspective.

5.1 Methodology

In running our comparative exercise some caution should be adopted as the methodologies used in CeRPSIM3 and in the OECD models do not perfectly overlap. The main methodological differences are detailed in Table 5.1. and we briefly describe them in turn.

The first divergence lies in the population on which simulations are run. The OECD analysis is conducted on representative samples of each country's working-age population (aged 35–64) taken from available surveys and, when possible, integrated with administrative archive information. Individuals' lives are supposed to evolve in the future according to the transition probabilities estimated from the available data. CeRPSIM3, simulates the entire lives of a few artificial cohorts of individuals (1955, 1965, 1975 and 1985, thus individuals aged between 24 and 54 in 2009) participating in the labour market as employees or self-employed workers according to transition probabilities estimated from observed administrative and survey data. In addition CeRPSIM3 adopts an individual perspective and does not account for household composition, while OECD looks at the household as a unit (e.g. earnings are transformed according to the OECD equivalence scale).

Another difference is in the predicted age of retirement. In the six countries analysed by OECD it is assumed (in the intermediate scenario) that the future age of retirement will be the same age of retirement as the one currently observed in the country. In CeRPSIM3 the age of retirement is predicted by the model on the basis of the legislative requirements and under the hypothesis that individuals retire as soon as minimum requirements are reached.

As for the evaluation of the income at retirement, the OECD analysis accounts for all the potential sources that are earmarked for retirement, while CeRPSIM considers first and second pillar pensions only, excluding third pillar pensions. Of course, the computation of the benefits fully accounts for the country specific pension rules. Moreover, to simulate the coverage of the second pillar pensions, in CeRPSIM3 we constructed a sort of upper bound scenario, assuming that all workers will join a pension fund from the year 2008 on; while in OECD countries the participation rates are the ones currently observed in the data.

Table 5.1 – Main methodological assumptions

Variables/parameters/selections	OECD Methodology – Intermediate scenario	CeRPSIM3 Methodology
Population	A representative sample of heads of households + spouses, with head having a working history	Artificial cohorts of individuals Employees and self-employed
Unit of analysis for the results of projections	Singles or couples (spouse's weight 0.5)	Individuals
Age limits in the sample	35–64	Born between 1955 and 1985 (aged 24–54 in 2009)
Age of retirement	Actual average age of retirement observed in the country	Retirement when legal minimum requirements are reached
Projection of employment status and earnings	Transition probabilities and wage equations from survey or admin. data	Transition probabilities and wage equations from survey and admin. data
Retirement income	All sources that are earmarked for retirement (PAYG public pensions, funded private pensions–occupational and personal pension plans –, public safety net, solidarity pensions)	Public social security schemes (PAYG public pensions, solidarity pensions) and pension funds
Private pension coverage	Most reasonable scenario for each country	Upper bound scenario: all workers are assumed to join a pension fund from 2008 on and contribute at a rate of 6.91% of their earnings
Rate of return of first pillar assets	Country specific rules	GDP growth
Real rate of return of second pillar assets	2.0%	2.0%

5.2 The (potential) role of the second pillar

The second pillar pension system was formally enacted for the first time in the 1993 (Legislative Decree, no. 124) and incentives for its development have been introduced at various times. The reference normative framework is currently the 2005 Decree Law no. 252, as modified by the Budget Law of December 2006 which imposed the so-called tacit approval mechanism for newly hired workers to devolve severance payments to pension funds.

Adhesion to the second pillar is voluntary; however, once enrolled, the employees have to fulfil legal and contractual arrangements in terms of minimum contribution, minimum duration in the fund and conditions to withdraw part of the accumulated capital. At present "contractual" pension funds are the core of the second pillar of the Italian pension system. These funds are created by employers' associations or trade unions and collect contributions from workers pooled on the basis of their occupational schemes, geographic areas of

residence and firm, or are created through a direct agreement between workers (either employees or self-employed). A residual role is instead played by the so-called "open" pension funds which are founded by banks, insurance companies, and savings management companies (Messori, 2013).

There are two financial sources for the Italian pension funds: (i) contributions from employers and/or employees which are of a minimum level determined by contractual agreements between parties, and (ii) the shares of the flows of severance payments (TFR) rescued from the firms to be allocated to the pension funds.

Table 5.2 reports the rates of payroll tax levied by the contractual funds. Contributions are determined by quotas on the part of the worker, a component that is in charge of the employer and a share attributable to the devolution of the TFR. Payroll levies also differ between old and young workers, where by the former we mean workers already adhering to the pension fund before 1 January 2006. The overall contribution is highly variable across funds and ranges between 1.39 and 15.91 per cent for older workers and between 8.16 and 15.91 per cent for younger workers.

Table 5.2 – Payroll tax rates on gross earnings by contractual pension fund in percentage points, year 2012

Fund	Payroll rate paid by worker	Payroll rate paid by employer	TFR of older workers	TFR of younger workers	Total contribution of older workers	Total contribution of new workers
FONCHIM [3]	1.2–1.5	1.3–1.7	2.28–6.91	6.91	4.78–10.11	9.41–10.11
FONDENERGIA [3]	1.5–2	1.9–2	2.49–6.91	6.91	5.89–10.91	10.31–10.91
QUADRI E CAPI FIAT	2	2	3.45–6.91	6.91	7.45–10.91	10.91
COMETA	1.2–1.5	1.2–1.5	2.76–6.91	6.91	5.16–9.91	9.31–9.91
PREVIAMBIENTE	1–1.3	1–2	1–6.91	6.91	3–10.21	8.91–10.21
ALIFOND	1	1.2	2–6.91	6.91	4.2–9.11	9.11
COOPERLAVORO	0.5–1.5	0.5–2	1–6.91	6.91	2–10.41	7.91–10.41
FOPEN	1.35	1.35	2.07–6.91	6.91	4.77–9.61	9.61
PEGASO	1–1.21	1–1.21	1.6–6.91	6.91	3.6–9.33	8.91–9.33
PREVICOOPER	0.55	1.55	3.45–6.91	6.91	5.55–9.01	9.01
TELEMACO	1	1.2	1.1–6.91	6.91	3.3–9.11	9.11
ARCO	1.2–1.4	1.2–1.4	2.07–6.91	6.91	4.47–9.71	9.31–9.71
FONCER [3]	1.4	1.8	2.28–6.91	6.91	5.48–10.11	10.11
FONDAPI	1–1.5	1–1.5	1–6.91	6.91	3–9.91	8.91–9.91
PREVIMODA	1–2	1–2	1.8–6.91	6.91	3.8–10.91	8.91 –10.91
CONCRETO	1.4	1.4	2.76–6.91	6.91	5.56–9.71	9.71
FONTE	0.5–1	0.5–2.2	1.11–6.91	6.91	2.11–10.11	7.91–10.11
BYBLOS	0.5–2	0.75–7	0.14–6.91	6.91	1.39–15.91	8.16–15.91
GOMMAPLASTICA	1.26	1.26	2.28–6.91	6.91	4.8–9.43	9.43
MEDIAFOND	0.5	1	2–6.91	6.91	3.5–8.41	8.41
PREVAER	1–2	1–3	0.07–6.91	6.91	2.07–11.91	8.91–11.91
FILCOOP	1	1.2	2–6.91	6.91	4.2–9.11	9.11
EUROFER	1	1	2–6.91	6.91	4–8.91	8.91
PREVEDI	1	1	1.24–6.91	6.91	3.24–8.91	8.91
PRIAMO	1–2	1–2	0.35–6.91	6.91	2.35–10.91	8.91–10.91
FONDOPOSTE	1	1.5	2.5–6.91	6.91	5–9.41	9.41
ASTRI	0.5–1	0.5–1	0.07–6.91	6.91	1.07–8.91	7.91–8.91
AGRIFONDO	0.55–1.5	1–1.55	2–6.91	6.91	3.55–9.96	8.46–9.96
PREVILOG	1	1	0.07–6.91	6.91	2.07–8.91	8.91
FONTEMP	1	1	-	6.91	-	8.91
FONDAEREO	1–2	2–5.28	6.91	6.91	9.91 -14.19	9.91 -14.19

Source: COVIP, 2012.

The amount of contributions by employers and/or by employees into the pension funds is crucially influenced by the fiscal incentives in place (Messori, 2013).

COVIP estimates that almost all the productive sectors of the Italian economy are covered by a contractual fund, with the sole notable exception being a large share of the public sector. However, notwithstanding the constant but slowly increasing pattern over time, participation in the second pillar is still quite low even among private-sector employees and the self-employed (see Table 5.3). Indeed in 2012 participation reached

the value of 22.7 per cent of the overall labour force: 29.8 per cent among private-sector employees, 26.6 per cent among the self-employed and only 4.8 per cent among public employees (see Table 5.3).

Table 5.3 – Participants in the pension funds as a percentage of the total occupation by sector

	Private employees	Public employees	Self-employed
1999	10.6	0.3	2.5
2000	12.0	0.8	3.9
2001	14.0	0.9	6.6
2002	14.5	1.0	8.8
2003	15.0	1.1	10.6
2004	15.5	1.1	11.8
2005	15.7	2.5	13.7
2006	16.1	3.3	14.9
2007	24.8	3.8	17.0
2008	25.7	4.0	18.7
2009	26.6	4.1	21.3
2010	27.8	4.2	22.5
2011	28.6	4.6	24.4
2012	29.8	4.8	26.6

Source: COVIP data.

Contrary to what might be expected on the basis of the common perception about the high uncertainty that younger generations will face regarding their first pillar benefits, adhesion to the second pillar is lower among the young than among older workers. Our interpretation is that the great difficulties that the young currently meet in the labour market prevent them from saving appropriately for retirement.

Table 5.4 – Participation in the second pillar by age-class, as a percentage of the labour force

Year	Age class					
	<25	25-34	35-44	45-54	55-64	65+
1999	0.6	2.8	4.7	5.6	1.5	0.1
2000	0.9	3.7	5.9	7.1	2.6	0.4
2001	1.1	4.3	6.7	7.8	3.4	0.5
2002	1.1	4.2	7.2	8.3	4.2	0.8
2003	0.8	3.9	7.3	9.0	5.5	1.3
2004	0.5	1.8	3.3	3.8	3.0	1.3
2005	1.0	4.0	7.5	9.8	6.7	1.8
2006	1.1	4.0	7.8	10.3	7.5	2.1
2007	7.3	16.2	22.1	25.0	19.0	5.2
2008	7.8	15.5	21.0	24.4	21.2	8.5
2009	7.4	15.5	21.5	25.8	23.6	10.7
2010	7.7	16.0	21.8	26.1	26.4	18.0
2011	8.7	16.6	22.4	26.9	28.1	21.4
2012	9.4	16.4	22.6	27.3	30.1	30.1

Source: COVIP data.

Summing up, coverage rates in Italy are much lower than in any other country analysed in the OECD study, as can be seen from Table 5.5 below.

Table 5.5 – Coverage of different pension income sources at retirement

	PAYG / public pension	FP based on rights	FP based on assets
Italy	Universal	Non-existent	**23%** of the labour force, mostly older generations, in the private sector, self-employed
Chile	**92%** of the w.a.p., mostly low to medium-income, younger generations, women, in the private sector, self-employed	Non-existent	Universal
France	Universal	**0.25%** of the w.a.p., mostly high-income	**39%** of the w.a.p., mostly high-income, younger generations, men, in the private sector, self-employed
Netherlands	Universal	Universal	**47%** of the w.a.p., mostly high-income, middle-aged generations, men
Norway	Universal	Universal in the public sector **58%** of the w.a.p., mostly low-income, older generations, women	**42%** of the w.a.p., mostly high-income, younger generations, men, in the private sector
United Kingdom	Universal	**52%** of the w.a.p., mostly high-income, middle-aged generations, women, in the public sector, employees	**68%** of the w.a.p., mostly high-income, younger generations, men, in the private sector
United States	Universal	**33%** of the w.a.p., mostly high-income, older generations, men, in the public sector, employees	**75%** of the w.a.p., mostly high-income, employees

Notes: PAYG=pay-as-you-go; FP= funded pensions; w.a.p.=working-age population. Cells in green represent cases where the corresponding type of pension plan is mandatory. Cells in yellow represent cases where the corresponding type of pension plan is voluntary or conditional on certain requirements. Coverage rates are calculated as the proportion of working-age individuals who may receive the corresponding pension income source at retirement.

Source: OECD (2014) and authors' own calculations.

As already anticipated, in our simulations about the participation of workers in the second pillar, we make the hypothesis that all the individuals simulated in CeRPSIM3 adhere to the second pillar and contribute to it at a rate of 6.91 of their gross income (the TFR rate) starting from the year 2008.

This scenario should be considered a sort of upper boundary since, as already shown, participation is currently well below the simulated levels and it is particularly low for the young. What is observed now can be due to the contingent negative business cycle and the current situation is hardly to be considered steady for the future. Under the simulated scenario, second pillar pensions could contribute 12 per cent of the final income of the pensioners. Such a percentage is greater for the self-employed (14 per cent) than for employees (11 per cent) and higher, given the hypothesis on which the exercise is based, for younger cohorts, the latter having a longer contribution period. In the simulated scenario, no sensible differences are detected across genders. Even under the optimistic assumption of a complete adhesion of all private-sector employees and self-employed workers to the second pillar, the role of second pillar in determining the total pension income would be limited and lower than most of the other analysed countries, with the sole exception of France.

Table 5.6 – Average composition of potential pension income at retirement

	PAYG / public pension	FP based on rights	FP based on assets	Other
Italy	88		12	
Chile	54	0	46	
France	95	0	5	
Netherlands	57	39	4	
Norway	71	21	3	5
United Kingdom	63	21	15	
United States	64	13	23	

Notes: PAYG=pay-as-you-go; FP= funded pensions. The category "Other" for Norway represents the collectively negotiated labour market pension system (AFP).

Source: OECD (2014) and authors' own calculations on CeRPSIM3 output

5.3 How first and second pillar pensions help in maintaining living standards

According to the life-cycle theory, the utility of individuals is maximum when they can smooth consumption across time periods, retirement included.[22] Indeed, a pension system granting high replacement rates (RR) is often perceived by public opinion and the policy-makers as the ideal instrument to lead the overall population to pursue such an objective.

In section 4.3 we have already had the occasion to show how the RRs of Italian private-sector employees and self-employed workers will vary across generations and genders in time as a consequence of the last pension reform. In this section, we deepen the discussion by looking at the percentage of individuals who at

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[22] In general, utility maximization implies that the marginal utility of consumption is constant over time. If utility depends upon consumption only under equality between the interest rate and the subjective discount rate, then the result converts into constant consumption.

retirement will receive a RR lower than a few pivotal benchmarks. In particular, the OECD study uses either 54 per cent of final salary – the benchmark used in the OECD *Pension at a Glance* (2013) publication – or the statutory RR defined at national level by the different countries. Italy does not have a statutory RR, so we opted to present statistics using both the benchmark of the 54 per cent and a benchmark of 70 per cent. This last rate can be considered a sort of "common perception benchmark", that is, what is currently perceived by the generality of workers as the target RR an individual should reach at retirement.

In Table 5.7 the statistics are broken down by the reform scenario, income groups (20% lowest pre-retirement income; 20% highest pre-retirement income; 60% remaining middle pre-retirement income), cohort, gender and employment status (employee vs. self-employed). The specific roles of the first and second pillars are highlighted.

In presenting the results let us first focus on the overall population of individuals simulated in CeRPSIM3. Before the 2011 pension reform occurred, individuals with expected RR at retirement below 54 per cent of final earnings were about 28 per cent of the overall sample, while individuals with a RR below 70 per cent were about 74 per cent. In other words about half of the individuals had an expected RR between 54 and 70 per cent. After the reform, for the reasons discussed in chapter 4, the proportion of individuals that may not reach the 70 per cent replacement rate moves from 74 to 47 per cent, while the share of individuals below the 54 per cent replacement rate halves. In fact, the expected RRs generally and sensibly increase after the pension reform, and about 53 per cent of individuals may be able to reach a RR higher than the 70 per cent of final earnings. The situation further improves if we also consider the potential contribution from the second pillar pensions. In this case (panel B) only one out of four individuals will have pension incomes lower than 70 per cent of final earnings, and only 4 per cent a RR lower than the 54 per cent.

Table 5.7 – Proportion of individuals below country specific replacement rates, Italy

	A				B			
	I Pillar only				I + II Pillar			
	Before reform		After reform		Before reform		After reform	
	70% of final earnings	54% of final earnings	70% of final earnings	54% of final earnings	70% of final earnings	54% of final earnings	70% of final earnings	54% of final earnings
All individuals	74	28	47	13	47	14	25	4
Low income	77	30	51	9	44	11	23	0
Medium income	71	27	43	12	45	15	23	4
High income	79	27	56	19	54	13	33	9
1985 cohort	80	31	50	14	40	14	19	3
1975 cohort	84	34	52	17	51	14	25	5
1965 cohort	80	27	51	12	54	12	29	5
1955 cohort	51	18	36	8	42	14	27	4
Men	72	24	41	11	43	11	19	3
Women	77	32	56	16	52	18	32	5
Employees	70	15	36	6	37	6	17	3
Self-employed	86	63	80	31	74	34	47	8

Notes: Figures refers to private sector only

Source: Authors' own calculations on CeRPSIM3 output.

The pension system appears to be only barely progressive, being the percentage of high income individuals with a RR lower than the 70 per cent slightly higher than that registered for the other income groups. Considering the first pillar only in the after the reform scenario, the percentage of high income individuals below the 54 per cent benchmark is 19 per cent versus 9 per cent of low income earners. Adhesion to the second pillar would lead almost all low income earners to have a RR greater than 54 per cent and only 23 per cent to have a RR lower than 70 per cent.

As expected given their lower average RR (see also section 4.3), the share of individuals below the threshold is greater among women than men, among younger cohorts than older ones and among self-employed workers than employees. Again, participation in the second pillar could significantly help these categories of workers to maintain their living standards once retired.

If compared with the other countries' statistics, the Italian system offers quite high RRs and a low percentage of the population falls below the threshold of 70 per cent of the income. However, our analysis also highlights two important and problematic features of the Italian system. One is the still great and persistent imbalance of the first pillar in favour of the older generations – the gap between the younger and older generations is still greater than in other countries[23] if we consider the first pillar pension only. The second is the imperfect ability of the system to grant the pre-retirement standards of living to low-income individuals – the share of these below the threshold is higher in Italy than in all the other countries. Full participation in the second pillar could in principle solve the first problem. The second problem will lead us to a more comprehensive reflection on the overall redistributive impact of the pension system. Such a topic would be better analysed by jointly accounting for the effects of the tax system, but this goes beyond the scope of this work.

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[23] There are different reasons behind the country specific gaps: decreasing performance of the pension system (Chile, Netherlands), changes in the pension rules about indexation (France, Netherlands), extension of the contribution period needed to get a full rate state pension (France), unmodified retirement habits in presence of increasing official age of retirement (US, Netherlands, Norway) and shift of pension provisions from DB to DC plans (US).

Table 5.8 – Proportion of individuals below country specific replacement rates. Country comparison

	Italy I pillar	Italy I+II pillars	Chile	France	Netherlands	Norway	UK	US
	70% of final earnings	70% of final earnings	54% of final earnings	65% of final earnings	70% of final earnings	66% of final earnings	50% to 80% of final earnings (80% low earnings; 67% median earnings; 50% top earners)	54% of final earnings
All individuals	47	25	49	61	58	64	36	40
Low income	51	23	21	45	18	17	7	12
Medium income	43	23	55	69	62	68	41	41
High income	56	33	57	84	86	93	47	57
25–29	50	19						
35–39	52	25	53	67	69	70	38	45
40–44			47	65	68	68	35	45
45–49	51	29	51	59	61	65	34	44
50–54			44	57	54	62	37	43
55–59	36	27	49	59	44	54	37	30
60–64			45	59	38	53	34	32
Men	41	19	48	65	44*	71	48*	37*
Women	56	32	51	58	18*	56	30*	40*
Public sector			54	59	60	49	28	28
Private sector	47	25	48	62	63	74	38	44
Employees	36	17	42	62			33	40
Self-employed	80	47	69	40			52	47

Note: Italy: Pension income includes first and second pillar pensions. Figures refer to private sector only. The breakdown by age refers to the 1985, 1975, 1965, 1955 cohorts, thus corresponding to age 24, 34, 44, 54 in 2009.
NL, UK and US: * The breakdown by gender is only provided for single individuals.
FR, NL, NO, UK: The threshold considered for RR is the country-specific reference RR. Denominator is inflation or wage-indexed career-average earnings, depending on the definition of the reference.
Chile and US: The threshold considered for RR is the OECD average rate of 54%, as there is no country-specific reference replacement rate. The denominator is the final earnings.

Source: OECD (2014) and authors' own calculations on CeRPSIM3 output.

5.4 Proportion of individuals in future generations worse-off

In this section we compare future generations of retirees with the current generations (Table 5.9) to assess whether current workers will be better-off, once retired, than current pensioners. The potential pension income of future retirees is discounted by nominal GDP growth to express it in purchasing power equivalent in the same year as current retirees' pension income (see Table 5.1 for the hypothesis on the parameters of the simulations). To describe the Italian case we have considered two different benchmarks: the mean and

median pension of current retirees. The pension of current retirees is defined as the pension received by simulated individuals born in 1955.[24]

The results are quite impressive, but somehow expected given the progressive transition of our pension system from the generous DB formula characterizing the past to the more severe NDC formula (applied *in toto* to young workers and *in pro-rata* to older ones from 2012 on, see chapter 2). According to our simulations, when considering first pillar pensions only, 71% of future retirees will be worse-off than current retirees. These results are driven as before by the reduced generosity of the pension system and by the low growth rate of the wage profiles of the young generations (see estimates in the Appendix). Indeed, Table 6.9 reveals that younger workers are more likely than older workers to have a present value of future pensions below those that current retirees are receiving.

Once more, low income individuals (99 per cent of them will be worse-off), women (80 per cent of them will be worse-off) and the self-employed (98 per cent of them will be worse-off) are in the less favourable condition. Second pillar participation, besides helping to improve their situation, is anyway not sufficient to resolve it completely.

Table 5.9 – Proportion of individuals with potential pension income at retirement below recent retirees' pension income. Italy

	I pillar only				I + II pillar			
	Before reform		After reform		Before reform		After reform	
	Benchmark = Mean pension of current retirees	Benchmark = Median pension of current retirees	Benchmark = Mean pension of current retirees	Benchmark = Median pension of current retirees	Benchmark = Mean pension of current retirees	Benchmark = Median pension of current retirees	Benchmark = Mean pension of current retirees	Benchmark = Median pension of current retirees
All individuals	78	70	71	59	72	63	60	51
Low income	100	100	99	96	100	100	96	94
Medium income	89	79	75	59	81	69	61	49
High income	29	21	39	27	22	17	27	19
1985	81	75	77	63	74	66	62	52
1975	79	72	73	60	73	65	61	52
1965	72	63	64	55	68	58	58	49
Men	73	64	64	52	66	57	53	43
Women	84	78	80	69	79	72	71	62
Employees	70	60	62	47	62	96	49	90
Self-employed	99	98	98	95	98	52	94	38

Notes: Figures refers to private sector only

Source: Authors' own calculations on CeRPSIM3 output

[24] In the OECD analysis current retirees are those who have spent up to five years in retirement. For the Italian case it was not possible to recover such a measure, as official statistics only report the average amount of pension benefits paid to the overall stock of living pensioners, including individuals who retired a long time ago. For this reason we could only rely on the figures produced by the CeRPSIM3 model, and we proxied the pension of current retirees with the pension received by our oldest cohort.

The proportion of Italian future retirees worse-off than current retirees is higher in Italy than in the other analysed OECD countries (see Table 6.10). This is the result of the combination of two factors. On the one side, the Italian pension system in the past has been comparatively very generous, providing quite high pension benefits. On the other side, the pension reform process undertaken since the 1990s to recover the short- and long-term financial sustainability has been quite radical in rapidly reducing such a generosity.

For sake of brevity and clarity, let us focus on the group of workers who are now in their thirties. The percentage of individuals who will receive pension incomes lower than the average pensions received by the current retirees ranges between 23 and 31 per cent in the other OECD countries, while it is above 70 per cent in Italy. Heterogeneity across income groups, gender and working schemes are in line or below what is registered in the other countries.

Table 5.10 – Proportion of individuals with potential pension income at retirement below recent retirees' average pension income. Country comparison

	Italy I pillar	Italy I+II pillars	Chile	France	Netherlands	United Kingdom	United States
All individuals	71	60	42	35	35	42	29
Low income	99	96	82	88	77	90	84
Medium income	75	61	41	28	31	36	25
High income	39	27	6	2	4	8	2
25–29	77	62					
35–39	73	61	25	28	31	23	29
40–44			40	30	33	31	25
45–49	64	58	52	35	35	34	28
50–54			53	39	36	46	30
55–59			45	41	38	58	27
60–64			37	40	41	72	35
Men	64	53	26	18	45	52	50
Women	80	71	61	51	63	73	61
Public sector			19	26	9	28	13
Private sector			39	37	32	42	29
Employees	62	49	30	34		38	25
Self-employed	98	94	59	48		64	37

Notes:

Italy: Pension income includes first and second pillar pensions. Figures refer to private sector only. Current retirees are defined as people belonging to the 1955 cohort. The breakdown by age refers to the 1985, 1975 and 1965 cohorts, thus corresponding to age 24, 34, 44 in 2009.

For Chile, FR, NL, NO, UK and US: current retirees are defined as those who have spent up to five years in retirement.

The potential pension income of future retirees is discounted by inflation and GDP growth to express it in the same year as current retirees' pension income

Source: OECD 2014 and authors' own calculations on CeRPSIM3 output.

5.5 Poverty rates among retirees

To conclude, we measure the percentage of retirees whose potential simulated retirement income falls below the poverty line, that is, those who are more vulnerable than others to the risk of poverty in their old age. For this purpose, we use the discounted gross simulated pension income (not equalized, as we do not know the household composition of our simulated individuals) and we compare it to a current measure of poverty. Our

vulnerability threshold is equal to the OECD poverty threshold for a single person in 2013 (about 9,205 euro per year).

As in OECD (2014), it is important to stress that this is not a poverty rate as it does not take into account household composition, social transfers and other sources of income that individuals can have. The exercise aims at evaluating whether the pension income per se can be adequate to put retirees above the conventional poverty threshold.

Similarly to the findings for the OECD countries analysed, the share of individuals that may have a present value of pension income below the poverty threshold (vulnerability rate) is higher for low-income workers, women and the self-employed. As observed for countries like France and the US, Italian younger generations are more at risk than their elders as, on the one side, they are facing (and will face) less favourable economic scenarios and, on the other side, they are dealing with less generous pension rules. Participation in the second pillar can reduce in a sensible way the percentage of workers with an income at retirement below the poverty threshold.

Table 5.11 – Proportion of individuals with potential pension income at retirement below the poverty threshold

	I pillar only		I+II pillar pensions	
	Before reform	After reform	Before reform	After reform
All individuals	28%	18%	14%	5%
1955 cohort	7%	3%	5%	2%
1965 cohort	19%	11%	10%	4%
1975 cohort	30%	16%	16%	7%
1985 cohort	37%	21%	18%	9%
Low income	71%	46%	41%	18%
Medium income	22%	13%	10%	3%
High income	2%	2%	1%	0%
Men	19%	10%	10%	4%
Women	29%	16%	15%	7%
Self-employed	63%	47%	45%	21%
Employees	11%	2%	2%	0%

Source: Authors' own calculations on CeRPSIM3 output.

6. NIBAX/ITALISSIMO

Authors: Elena Lucchese*, Paolo Lucchino**, Carlo Mazzaferro*, Justin Van De Veen***[25]

In light of the steady increase in longevity across most developed countries, pensions systems around the world are increasingly becoming subject to the pressure to guarantee adequate benefits to future pensioners but at the same time remain financially sustainable. To address this challenge, economists and international institutions have typically suggested two main policy tools:

    i)   increasing the effective retirement age of current and future workers;

    ii)   developing a private pension pillar, to integrate (declining) incomes from public PAYG systems.

The effectiveness of such policies depends crucially on the labour supply choices and saving behaviour of current working generations. A behavioural model is therefore well suited to analyse the effects of these policies and understand the incentives they generate.

With this in mind, part of the work carried out under Strand 1 of the Wealth at Retirement and Saving Adequacy (WERSA) project focussed on developing the Italian Life cycle Income and Saving Simulation Model (ITALISSIMO). This was the product of the collaboration between the National Institute of Economic and Social Research (NIESR) and the University of Bologna, and the sharing of knowledge in their respective competencies in behavioural dynamic microsimulation and the detailed knowledge on the Italian pension system and main economic and demographic trends. Lucchese et al. (2015) present a detailed overview of the model.

The model allows policy scenarios to be run that incorporate both first and second order effects of changes to the pension, tax and benefit systems, as well as alternative hypotheses on financial and demographic trends in the future. In this chapter, we present early findings from using ITALISSIMO to simulate a set of policy interventions aimed at raising the retirement age and at developing a private and funded pension pillar in Italy. The results are intended to provide insights into these specific questions, as well as to illustrate the sort of analyses possible with the model.

A part from the specific findings discussed within the report, some crosscutting emerging themes can be identified:

- The nature of pension benefits has changed over the years. These are increasingly no longer seen as a 'right' or 'reward' in recognition of the end of a long career, but rather as an individual investment that one actively saves and plans for. This change of logic underpins the shift from DB to DC schemes. Our simulations make the *financial* nature of pension saving choices evident. In all cases considered, changes in pension policy affect individuals' wider portfolio choices in terms of liquidity and alternative pension savings. This suggests that policies focusing of the private pension pillar cannot avoid considering the nature of the public pension pillar as well as that of other alternative saving options.
- Having time to prepare for a policy allows for quantitatively and qualitatively different responses. Allowing a minimum period lag between announcement and implementation may therefore attenuate the adverse effects of reforms.

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Finally, this report also offer the opportunity to showcase the sort of analyses possible with ITALISSIMO and highlight the importance of accounting for second order behavioural effects. We hope has stimulated interest among researchers and policy makers in Italy, and that it will encourage use of the model for policy analysis.

This chapter is structured as follows. Section 6.1 provides an overview of policies that have been implemented in recent decades to raise the retirement age, focussing first on international trends and then on Italy in particular. It then proceeds to present two simulations exploring behavioural responses to policies changing access to retirement conditions. Section 6.2 provides a similar overview in relation to policies to develop the private pension pillar and presents the corresponding simulations.

6.1 Policies aimed at raising the retirement age

6.1.1 International trends and policies

This section briefly presents historical trends in retirement ages and the main policies implemented in recent decades to increase them.

International comparisons of trends in employment later in life and retirement ages reveal some important common patterns. They can be synthesized as follows:
  i. average pensionable age decreased at least until the 1990s, both for men and women;
  ii. during the same period life expectancy at retirement increased;
  iii. labour market participation rates among 55–65 year olds decreased;
  iv. in many countries effective retirement age was well below the pensionable age;
  v. the majority of pension systems in developed countries was based on Defined Benefit (DB) mechanisms which were not structured to be "actuarially fair".

The implications of these stylized facts on the adequacy and efficiency of pension systems have been analysed and discussed at length in the economic literature (OECD, 1998; Gruber and Wise, 1999). Two main conclusions emerge. Firstly, pension systems based on DB contracts distort retirement choices and generate incentives for individuals to retire as soon as possible. Secondly, the decline in labour force participation deriving from the above implies a loss of productive capacity, which decreases the economy's income and welfare, as well as the financial sustainability of the pension system itself.

Over the last two decades, governments across developed countries have implemented reforms to redress the above distortions and set pension systems onto a financially sustainable path (OECD, 2009). Two main tools were used by policymakers to raise the effective retirement age of the working population. The first one consists of increasing the legal or statutory retirement age. Some countries made this increase endogenous, by linking the retirement age to life expectancy at retirement. Secondly interventions to reduce the incentive to retire early were also embedded in national pension rules. This took the form of actuarial adjustments in the computation of the pension benefit in case of early retirement (i.e., when retirement occurs before the statutory age), or indeed should individuals choose to stay in work. This means that the pattern of benefit accrual in these cases is designed in such a way that an individual working one more year (once he/she is considered eligible for retirement) does not decrease his/her "net pension wealth".[26] In this case the pension

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[26] In other words, when this condition holds, the increase in pension benefit resulting from working one more year compensates for the shorter period over which this will be received.

system does not have any distorting effect on the choice to retire, and in particular will not encourage early retirement. As is well known, in the case of public PAYG schemes, a Notional Defined Contribution (NDC) system achieves this aim.

Assuming individuals do not face barriers to lengthening their time in employment, the combination of these two main policies can have advantages for current workers/future pensioners in terms of the adequacy of future pension benefits. A higher retirement age increases seniority at work and shortens the retirement period, allowing a pension system to pay individuals higher benefits without compromising the financial soundness of the system.

As a result of the above measures, a reversal in the trend of the pensionable age is starting to take place. Looking at its member countries, for example, OECD (2012) notes that men's pensionable age, defined as "the age at which people can first draw full benefits (that is without actuarial reduction for early retirement)", increased from 62.4 in 1992 to 62.9 in 2010 and is expected to be 64.6 in 2050 for men. The corresponding figures for women were 61 in 1993, 61.8 in 2010 and will be 64.4 in 2050.

From the macroeconomic point of view it is important to stress that increasing the retirement age will mean that a higher number of "relatively older" individuals will remain in the labour market and they will, other factors remaining equal, increase the level of GDP. This macroeconomic effect will be stronger in countries where past fertility rates are relatively low, so that current and future young cohorts are numerically lower than current cohorts; where net migration is low and where labour productivity does not decline abruptly in old age. If these conditions are met, increasing retirement age means extending the economic base that funds future pension benefits.

6.1.2 The case of Italy

Italy is an interesting "case study" since it used to have a particularly low pensionable age and low labour force participation rates among workers in the age bracket 55–65 in international comparisons.[27] Effective retirement age was even lower, given the numerous possibilities for workers to retire before the legal retirement age without any kind of actuarial penalization.[28]

In Italy, as in many other countries, two retirement mechanisms coexist: a worker can retire when s/he reaches a certain age, called "statutory" retirement age, or alternatively when s/he accumulates a certain number of years of contribution seniority, independently of age. This dual exit route is complicated by the fact that access conditions vary between private and public employees and for the self-employed.[29]

Starting from 1992, a series of reforms to the public pension system introduced numerous changes in the access conditions to the statutory and/or seniority pension aimed at raising the effective retirement age. An attempt to synthesize this evolution is described in Table 6.1.

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[27] Until 1992, the statutory retirement age was 55 for women and 60 for men in the main pension scheme, that for private-sector employees.

[28] Until 1992, retirement was possible before reaching legal retirement age, subject to a contributory requirement of 35 years of service in the scheme of private-sector employees. This seniority requirement was even lower for public-sector employees at 20 years. For these cases, no penalty was applied upon retirement before the statutory age.

[29] This will continue to be the case until 2018.

Table 6.1 – The evolution of eligibility conditions to retirement in Italy

		2004			2005			2006			2007		
		Only seniority	Age and Seniority	Extra months	Only seniority	Age and Seniority	Extra months	Only seniority	Age and Seniority	Extra months	Only seniority	Age and Seniority	Extra months
Seniority Pension	Private Employees	38	57+35	+4.5	38	57+35	+4.5	39	57+35	+4,5	39	57+35	+4,5
	Public Employees	38	57+.35	+4.5	38	57+35	+4.5	39	57+35	+4,5	39	57+35	+4,5
	Blue Collar	38	56+35	+4.5	38	56+35	+4.5	39	57+35	+4,5	39	57+35	+4,5
	Self Employed	40	58+35	+7.5	40	58+35	+7.5	40	58+35	+7,5	40	58+35	+7,5
Notional Defined Contribution		40	57+5	+0	40	57+5	+0	40	57+5	+0	40	57+5	+0
Old Age Defined Benefit Men			65+20	+0		65+20	+0		65+20	+0		65+20	+0
Old Age Defined Benefit Women			60+20	+0		60+20	+0		60.20	+0		60+20	+0

Source: Authors' calculations.

Table 6.1 -

		2008–June 2009			Jul. 2009–Dec 2009				2010				2011			
		Only seniority	Age and Seniority	Extra months	Seniority	Age and Seniority	Age+ Seniority	Extra months	Seniority	Age and Seniority	Age+ Seniority	Extra months	Seniority	Age and Seniority	Age+ Seniority	Extra months
Seniority and NDC	Employees Men	40	58+35	+9 / 4.5**	40	59+35	95	+9 / 4,5**	40	59+35	95	+9 / 4,5**	40	60+35	96	+9 / 4.5**
	Self Employed Men	40	59+35	+15 / 7.5	35 / 40	60	96	+15 / 7.5	35 / 40	60	96	+15 / 7.5	35 / 40	61	97	+15 / 7.5
Seniority Women	Employees Women		Like Men			Like Men				Like Men			35 / 35 / 40		Like Men	
	Self Employed Women		Like Men		35 / 40		Like Men		35 / 40		Like Men		35 / 40		Like Men	
NDC Women	Employees Women	40	57+35	+9	40	57+35		+9	40	57+35		+9	40	57+35		+9
	Self Employed Women	40	58+35	+15	40	58+35		+15	40	58+35		+15	40	58+35		+15
Old Age	Employees Men	65,20 (DB) 65.5 (NDC)		4.5	65,20 (DB) 65.5 (NDC)			4.5	65,20 (DB) 65.5 (NDC)			4.5	65,20 (DBt) 6.,5 NDCr)			4.5
	Self Employed	65,20 (DB) 65.5 (NDC)		7.5	65,20 (DB) 65.5 (NDC)			7.5	65,20 (DB) 65.5 (NDC)			7.5	65,20 (DB) 65.5 (NDC)			7.5
	Employees Public Women	60,20 (DB) 60.5 (NDC)		4.5	60,20 (DB) 60.5 (NDC)			4.5	61,20 (DB) 61.5 (NDC)			4.5	61,20 (DB) 61.5 (NDC)			4.5
	Employees Private Women	60,20 (DB) 60.5 (NDC)		4.5	60,20 (DB) 60.5 (NDC)			4.5	60,20 (DB) 60.5 (NDC)			4.5	60,20 (DB) 60.5 (NDC)			4.5
	Self Employed Women	60,20 (DB) 60.5 (NDC)		7.5	60,20 (DB) 60.5 (NDC)			7.5	60,20 (DB) 60.5 (NDC)			7.5	60,20 (DB) 60.5 (NDC)			7.5

Source: Authors' calculations.

Between 2004 and 2011, attempts were made to restrict the eligibility conditions for seniority pensions. Initially, an age condition was added to the seniority condition. Subsequently, a quite complex system, called "*sistema delle quote*", allowed an individual to retire if the sum of her/his age and seniority was above a determined number which was to increase year by year. Additionally, another intervention introduced a small temporal gap between the time when the right to retire was accrued and the time when the pension benefit was paid. This system, called "*finestre*", was a subtle attempt to further increase effective retirement age.

As for statutory retirement ages, the 1993 reform progressively raised these from 55 to 60 for women and from 60 to 65 for men. Subsequently, the 1995 reform introduced a Notional Defined Contribution (NDC) rule and the retirement age was made flexible in the bracket between 57 and 65 years of age. While the government abolished the possibility to choose to retire within an age bracket and reintroduced fixed ages in 2004, this was overturned by the 2011 the Monti-Fornero reform. The reform re-introduced the age bracket, with the minimum age set at 63.

Additionally, alongside the age requirements, the reform introduced strict minimum conditions on the amount of the pension benefit that a worker has to accrue in order to exercise her/his right to retire. There are two main exit routes in the reformed system (see also Figure 6.1): the "normal" retirement age and "early" retirement age. In order to be eligible for early retirement, the accrued pension benefit must be at least equal to 2.8 the amount of the social pension.[30] Additionally, the worker's contribution seniority must at least 20 years. The monetary threshold to retire at the "normal" retirement age is set at 1.5 times the social pension. If the worker does not respect this constraint s/he has to stay in the labour market until a "late" retirement age, when no minimum monetary conditions apply. In 2012, the minimum ages for early, normal and late retirement were 63, 66 and 70 respectively, for men. The minimum ages for women were somewhat lower.

As per the 2010 legislation, the statutory retirement age is now set to track the evolution of life expectancy. Additionally, the 2011 reform set out a convergence path, shown Figure 6.1 such that retirement ages will no longer be differentiated by gender or sector by 2018. According to the National Institute of Statistics's central projections for life expectancy, the normal retirement age will be at 66 years and 7 months in 2018 and increase to 69 years and 9 months in 2050. Similarly, the early retirement age is expected to increase to 66 years and 9 months in 2050.

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[30] The yearly maximum amount of the social pension was equal to 5846 Euro in 2014. The benefit is means tested, so its amount can also be lower.

Figure 6.1 – The evolution of statutory retirement ages
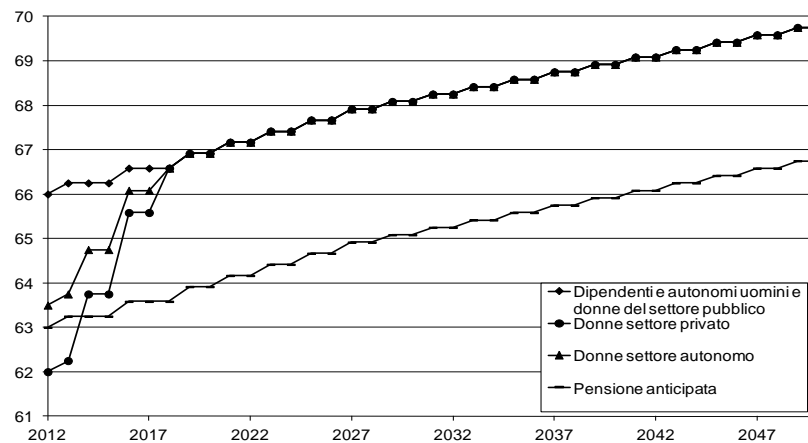
Source: Authors' calculations

The reform process described above is expected to have important consequences for the labour market dynamics of older workers. Figure 6.2 shows historical and projected average retirement ages for the period 1993 to 2050. Historical data from the Survey of Household Income and Wealth (SHIW) and projections are derived from CAPP_DYN a probabilistic dynamic microsimulation model described above.

Figure 6.2 – Historical and projected average retirement ages, 1993–2050
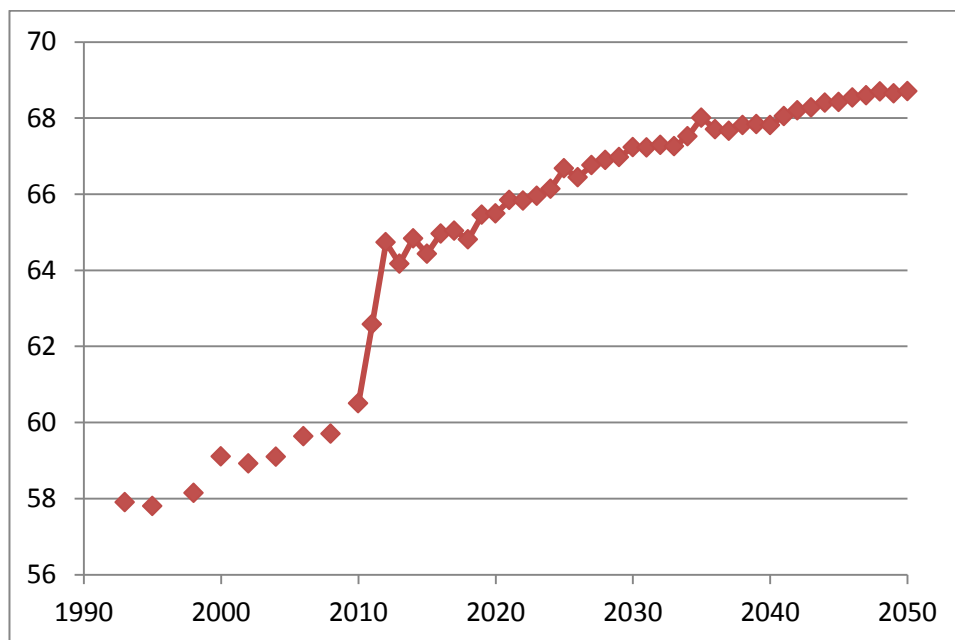
Source: Authors' calculations on CAPP_DYN

Looking at the period before 2012, reform efforts had already started to have effects on the effective retirement age, even if slowly. Over this period, the effective retirement age increased by 2.9 years (2.6 years for men and 3.3 years for women respectively). During the same period, labour force participation rates among older workers increased sensibly, albeit from very low levels. Importantly, however, projected figures give us an immediate impression of the dramatic effects of the 2011 reform on retirement ages, particularly around the reform year. This is likely to have significant implications for the level and composition of the labour force. There is therefore a high degree of uncertainty about the knock-on effects of the reform, and this raises a number of questions about the possible need for additional policy measures to complement the reform efforts.

6.1.3 Simulations

In this section, we present early findings from using ITALISSIMO to simulate a set of policy interventions aimed at raising the retirement age in Italy. The results are intended to provide insights into these specific questions, as well as to illustrate the sort of analyses possible with the model. Before discussing the results, some important caveats are necessary.

Firstly, it is important to point out that ITALISSIMO simulates from a population cross-section rather than simulating the evolving population cross-section. The model simulates the past and future circumstances of households living in the base year, as well as their choices with respect to labour supply and consumption/saving. It does not model new entrants into the population. This means that it is only able to understand the implications of different policy scenarios on households that are in existence in 2012.

Secondly, the primary focus of the model is simulating the endogenous optimal household decision with respect to consumption and labour supply under uncertainty. As explained elsewhere (Lucchese et al., 2015) this is quite a burdensome process that constrained us to simplify the implementation of the very complex Italian pension legislation into the model.

This is a limitation to keep in mind. As discussed above, there is a particularly high degree of historical heterogeneity within the Italian pension system, and eligibility conditions will be aligned for all workers from 2018 only. Similarly, the phasing in of the NDC system in Italy, introduced in 1995, was originally very gradual. It was only with the 2011 reform that all workers were transferred onto a single, uniform scheme. To address these limitations, at least partially, the model converts DB pension rights in the starting survey data into NDC-equivalent rights (Lucchese et al., 2015). Similarly, the historical evolution of age and seniority access rules has been set to represent an "average" or most modal situation for each particular year.

These stylizations may undermine the credibility of the results, especially if one wishes to analyse the complete distributive path of the reform, and in particular the intergenerational one. However, that is not our focus here. Instead, we focus on the lifetime redistributive performance of the policy scenarios for cohorts that are living in the 2012 base year of the simulation in a context where second order effects are explicitly taken into account.

The simulations discussed in this section focus on alternative access rules for retirement. In particular, we are interested in understanding the implication of policies that offer individuals different degrees of flexibility with respect to the choice to retire. Starting from the context presented in the previous sections, we will present three scenarios:

- Our *baseline scenario* approximates the situation before 2012. This represents the circumstances before the 2011 structural reform that radically altered the eligibility conditions to retire in Italy.

- While not modelling the full set of features of the *2011 reform*, this scenario approximates some of the core aspects of that reform, particularly in relation to access conditions.
- Finally, our third scenario introduces a high degree of *flexibility*, by modelling the removal of all eligibility conditions on the retirement age, subject to ages being within defined brackets.

In terms of flexibility, the 2011 reform scenario is the most rigid one; the *flexibility* scenario is the most flexible; while the *baseline scenario* represents an intermediate situation. By comparing the results of our simulations we aim to understand the dynamics generated by such policies and simulate their implications.

i.   The 2011 reform

Initially, we compare our baseline with the 2011 reform scenario. This simulation aims to evaluate the effects of a policy that introduces stringent constraints on the possibility to retire, intervening on the statutory pensionable age and by imposing minimum requirement on accrued pension benefits. We set the parameters governing the evolution of eligibility conditions as follows:

- **Baseline:**
    – *Access is allowed from 61 if the pension is above 1.2 of social assistance pension*
    – *Access is allowed from 65*
    – *Ages increase with life expectancy*
- **Simulation:**
    – *Access is allowed from 62 if the pension is above 2.8 of social assistance pension*
    – *Access is allowed from 66 if the pension is above 1.5 of social assistance pension*
    – *Access is allowed from 70*
    – *Ages increase with life expectancy*

As mentioned in the previous section, the 2011 reform imposed some dramatic changes to access to retirement conditions, and the possible knock-on effects of these are still to be fully understood. With this simulation, we therefore attempt to provide some initial answers to questions such as: "How much are people affected by such a policy change?"; "Who is affected most?"; and "How can families adapt to or prepare themselves for the change?".

We start by considering the cohort of 62 year olds in the year of the implementation of the policy itself. Individuals in this cohort are interesting to analyse as they will be the ones who are immediately affected by the policy with no time to prepare.

Figure 6.3 – Changes in income and consumption flows for those aged 62 in 2012
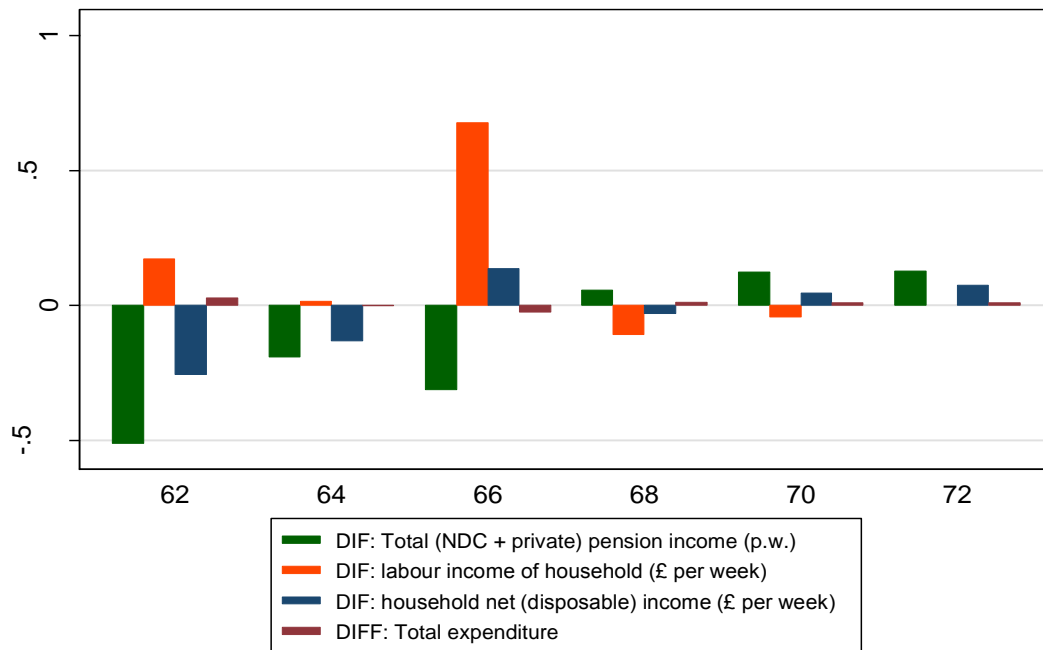
NOTES: Fraction of BASE: Lifetime net disposable income

Source: Authors' calculations

The results in Figure 6.3 report simulated changes in fractions of incomes and consumption of the average net income over the lifetime. We consider changes in pension income (green), labour income (orange), total household income (blue) and consumption expenditure (brown).

Two dynamics are evident in Figure 6.3. Firstly, there is a reduction in income between the ages of 62 and 66. As this generation does not have time to prepare for the reform, the stricter eligibility constraints result in a substantial reduction in pension income until at least 66 years of age. Workers react to the shortfall in pension income over those years by increasing labour income. However, we see that the substitution pension for labour income is not complete, and results in a lower net disposable income until the age of 66.

A number of possible factors can explain such a reduction in net income. Firstly, while agents my find it optimal to continue to work, they may nevertheless suffer involuntary unemployment. Alternatively, agents might choose to extend their working life in part-time rather than full-time jobs. Finally, for some individuals, accrued pension rights may have been higher than current earnings potential.

The second important finding is that, despite the fall in incomes, consumption remains fundamentally stable. This result is consistent with the desire for simulated households to smooth consumption over the life-cycle. Inevitably this implies a reduction in saving. Indeed, while agents buffer the fall in pension incomes by working more they also resort to decumulating liquid wealth in order to finance the transition years between the introduction of the policy and the (higher) retirement age.

Figure 6.4 – Wealth stocks for those aged 62 in 2012
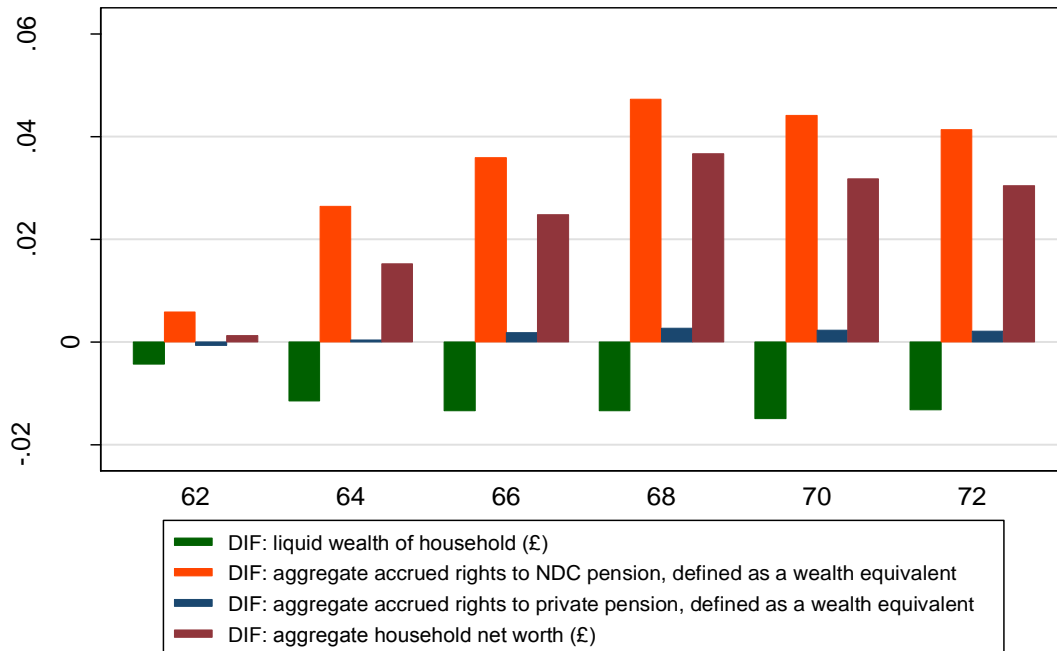
NOTES: Fraction of BASE: aggregate household net worth (£)

Source: Authors' calculations

The recourse to savings is evident in Figure 6.4. The stock of liquid wealth (green) falls increasingly below it's pre-reform level and peaks at 70 years of age. In inter-temporal terms this result is consistent with the fact that the same agents are at the same time accumulating a higher level of pension wealth and therefore anticipate higher levels of pension incomes in the near future.

Overall, agents seek to compensate lower pension benefits by a combination of earning more from work and decumulating their savings. It is therefore interesting to explore how this reaction differs according to the agents' starting level of savings. Figure 6.5 presents the behavioural response of individuals in the cohort falling within the bottom, middle and top quintiles of liquid wealth at the time of the reform.

Figure 6.5 – Response by liquid wealth quintile
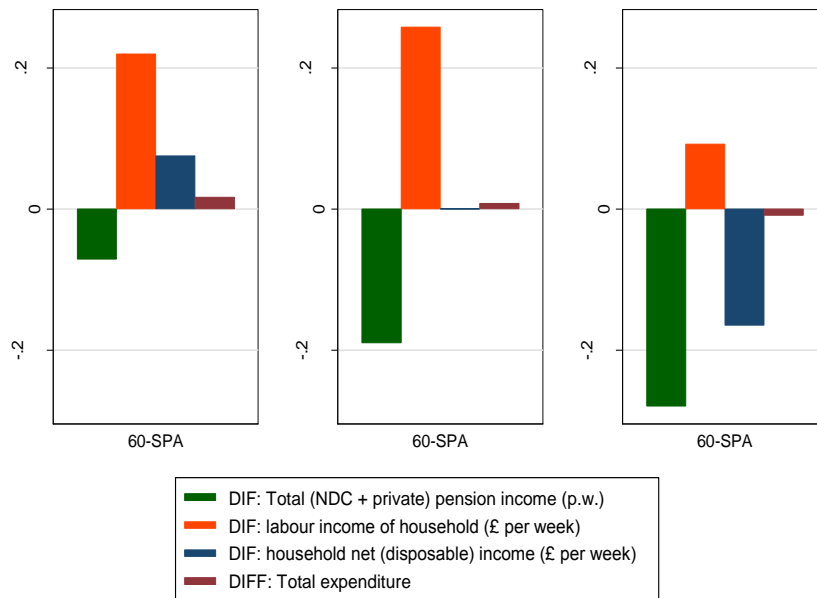
NOTES: Fraction of BASE: household net (disposable) income (£ per week)

Source: Authors' calculations

Figure 6.5 shows that those with a higher level of wealth can sustain baseline consumption with only modest recourse to increased labour supply. Agents in the central part of the wealth distribution wholly substitute lower pension income with labour income, resulting in no net change in disposable income. Those in the bottom of the liquid wealth distribution, however, increase their labour input substantially, to the point that their net income is actually higher than at the baseline. Liquidity constraints therefore greatly affect the extent to which households can fully insulate themselves from the effects of the policy, and increase the need to rely on labour market participation to sustain baseline living standards.

Finally, Figure 6.6 compares the responses of agents from different cohorts and consequently different time horizons to respond to the policy. In particular, we compare the changes in income flows of the cohort analysed above (left) with those of the cohort of 30 year olds at the time the reform was announced (right).

Figure 6.6 – Adaptation mechanisms for old and young workers

DIF: Total (NDC + private) pension income (p.w.)
DIF: labour income of household (£ per week)
DIF: household net (disposable) income (£ per week)
DIFF: Total expenditure

NOTES: Fraction of BASE: Lifetime net disposable income
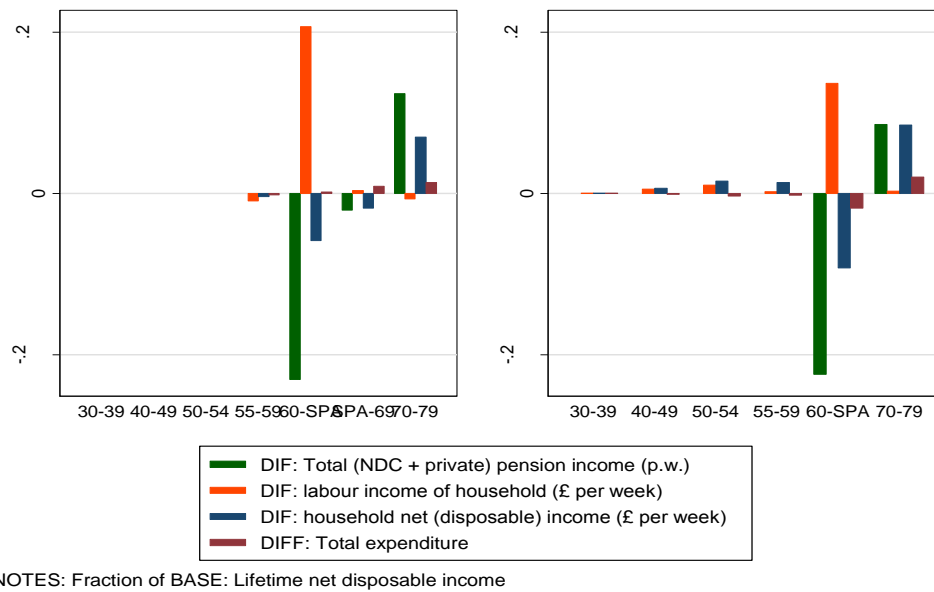
Source: Authors' calculations

Two key points emerge from this comparison. Firstly, the qualitative nature of the adjustment mechanisms is the same across the two cohorts. Both react to the reform by increasing their labour supply and decumulate savings to ensure total expenditure remains constant compared with the baseline. However, the younger cohort exhibits a lower labour supply response and can finance a greater fall in net income in the years between the age of 60 and state pension age (SPA). Indeed, having more time to prepare for the policy change, this cohort can increase their wealth accumulation during their working lives so as to be better prepared and less constrained in their choices during the years of delayed retirement.

Agents therefore accommodate the impacts of the reform using a combination of increased labour supply and access to savings. However, these results highlight the fact that individuals lacking sufficient savings and/or with low or declining labour market potential may be severely affected by the postponement of their access to pension income.

ii.   *Flexibility in the retirement age*

The introduction of limits to access conditions like those considered in the previous simulation is arguably not consistent with some principles and policy objectives of a Notional Contribution Scheme: actuarial equity and freedom of choice. Indeed, when a scheme is actuarially fair, the net present value of the balance between the individual and the state over the entire lifetime of the individual is unaffected, in expectation, by the timing of retirement. Limiting access to retirement, therefore, does not fundamentally affect the financial sustainability of the system, but only affects the temporal dynamics of revenue and expenditure of the PAYG system (and their effect on the public budget). At the same time, limits to access to retirement may exacerbate other policy challenges, such as supporting vulnerable older workers.

Our second simulation in this section therefore tries to approximate the implications of a policy that fully exploits the actuarial equity of the NDC system. We simulate the effect of abolishing all age and monetary minima conditions for retirement. Instead, individuals would be free to choose when to retire within a fairly wide age bracket, with their pension benefit being the actuarially fair annuity value of their accumulated pension wealth at the point chosen. By comparing the 2011 reform scenario with the flexibility scenario, we aim to evaluate the implications of a policy that introduces individual freedom in the retirement decision.

The hypotheses governing the baseline and the simulation are reported below:

- **Baseline:**
  - *Access is allowed from 62 if the pension is above 2.8 times social assistance pension*
  - *Access is allowed from 66 if the pension is above 1.5 times social assistance pension*
  - *Access is allowed from 70*
  - *Ages increase with life expectancy*
- **Simulation:**
  - *Access is allowed from 57*
  - *Ages increase with life expectancy*

A first interesting result is the number of households that decide to change their retirement age as a result of the new possibilities created by the policy. This is reported in Figure 6.7.

Figure 6.7 – Change in retirement age
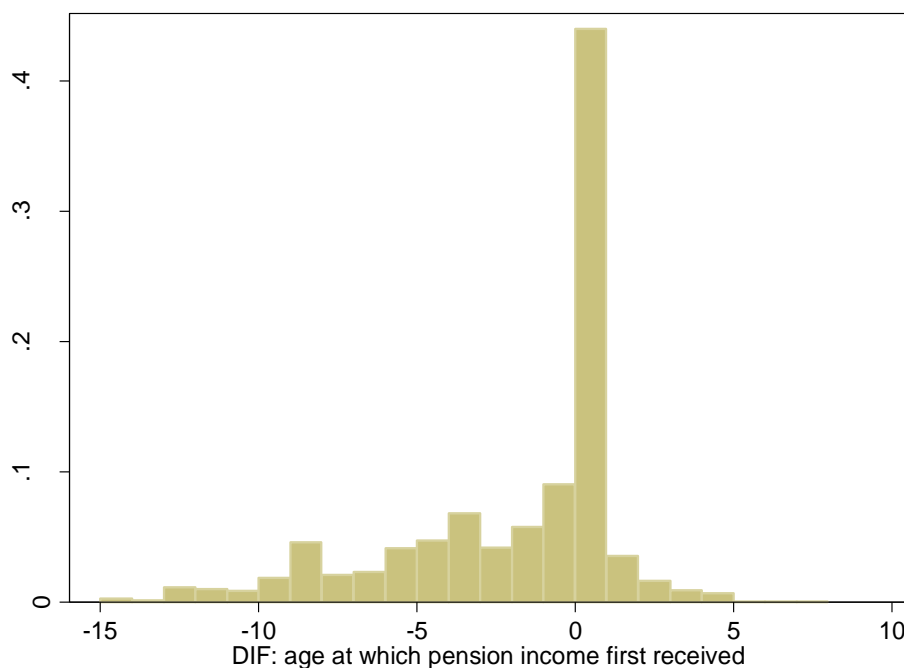
Source: Authors' calculations

Relaxing the constraints induces around 50% of the population to bring forward their retirement. The majority of these retire between one and five years earlier, although a non-negligible minority do so as much as five to ten years earlier.

Figure 6.8 shows changes in incomes in response to the policy for the cohort that is only a few years from retirement when the new rules come into effect. As expected, the model estimates an increase in pension benefits and a decrease in labour income. It is however interesting to notice that the increase in pension income is higher than the fall in labour income, implying a positive change in household income. This indicates that individuals with a high replacement ratio are more likely to bring forward their retirement.[31] Figure 6.8 also shows that, from 65 years of age, the amount of pension benefits is lower, compared with baseline, as a result of earlier retirement.

Figure 6.8 – Changes in incomes and consumption for those aged 57 in 2012

NOTES: Fraction of BASE: Lifetime net disposable income
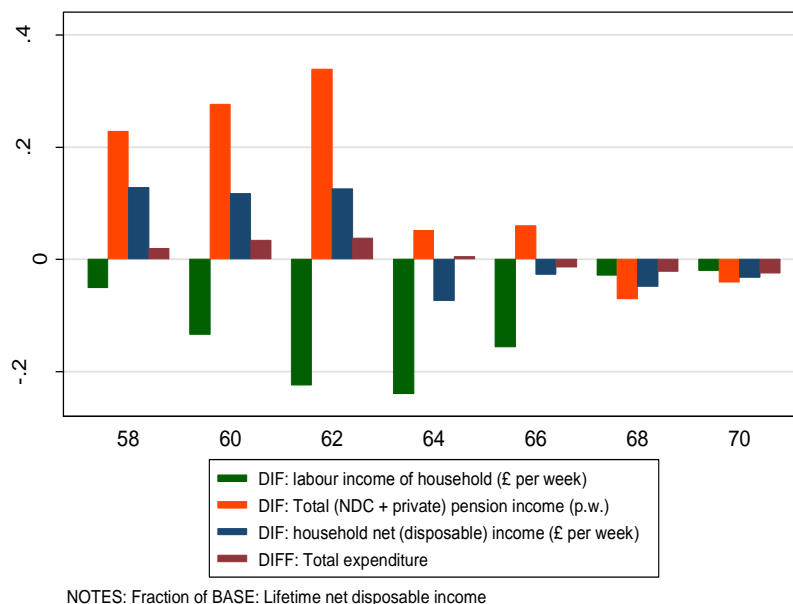
Source: Authors' calculations

As we saw with the previous simulation, the time available to respond to a policy can determine both the quantitative and qualitative nature of the behavioural response.

Figure 6.9 contrasts the change in wealth stocks over the lifetime of the cohort individuals who were old (left) and young (right) at the time of the policy change. In this case, it is interesting to see that the behavioural reactions are very different. Making the timing of retirement more flexible induces the older of the two cohorts to accumulate more liquid wealth "after" retirement. This happens as individuals are aware that their pension income is lower than the baseline (as they access it sooner) and they therefore accumulate more liquid savings to sustain consumption at later dates. On the other hand, individuals in the younger cohort have three decades to prepare themselves for the possibility of retiring earlier. They increase private

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[31] Simultaneous receipt of pension and labour income was not allowed in this simulation.

pension savings as a way to compensate the response in NDC wealth associated with earlier retirement age. At the same time, as pension saving is now more liquid, the need for precautionary saving is less. Accordingly, the younger cohort saves less in liquid assets compared with the baseline. Having time to prepare therefore allows younger cohorts to make more use of the opportunities offered by flexible retirement ages, and to adapt their portfolio choices accordingly.

Figure 6.9 – Responses of older and younger workers
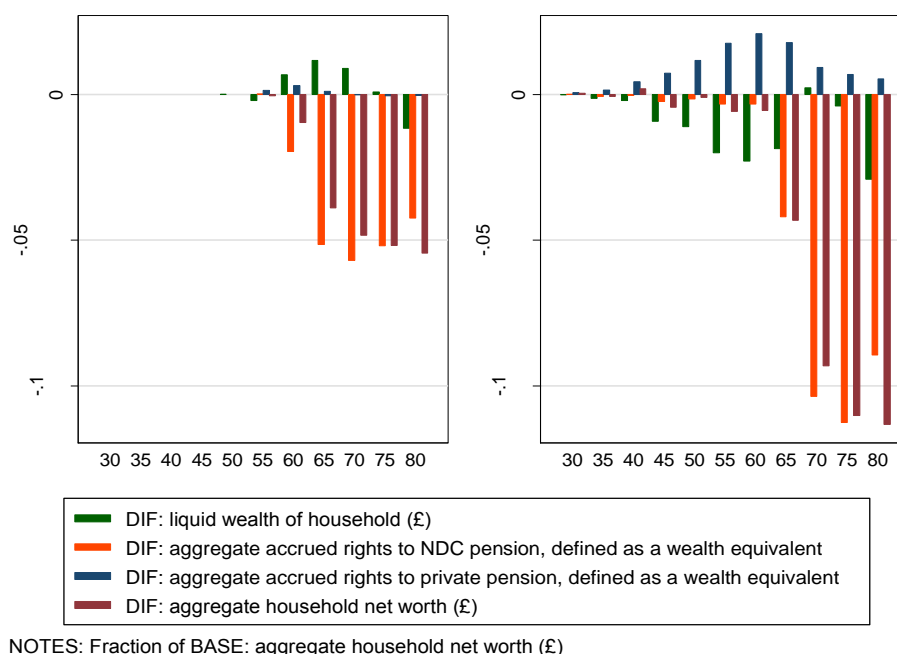
NOTES: Fraction of BASE: aggregate household net worth (£)

Source: Authors' calculations

Overall, the simulation provides some important insights. Specifically, it suggests that there is a not insubstantial demand for trading off lower pension benefits with earlier timing of retirement. This is especially the case for workers with earnings capacity in old age that is significantly lower than their career average. Examples of such workers could be those who have been made redundant in old age, especially if their long-term skills have lost value in the labour market, or workers who have become incapacitated but are not eligible for support from the welfare system. The results from our simulations suggest that allowing for flexibility in retirement age could therefore form part of a package of solutions aimed at protecting vulnerable older workers.

6.2 Policies aimed at promoting private pension saving

6.2.1 International trends

The "portfolio" composition of pension saving is very heterogeneous in the international comparisons. Social expenditure for pensions (public and private), according to the OECD statistics reported in the figure below, shows that both the level of pension assets and its composition is very diverse among a significant number of countries.

Figure 6.10 – Pension assets in OECD countries
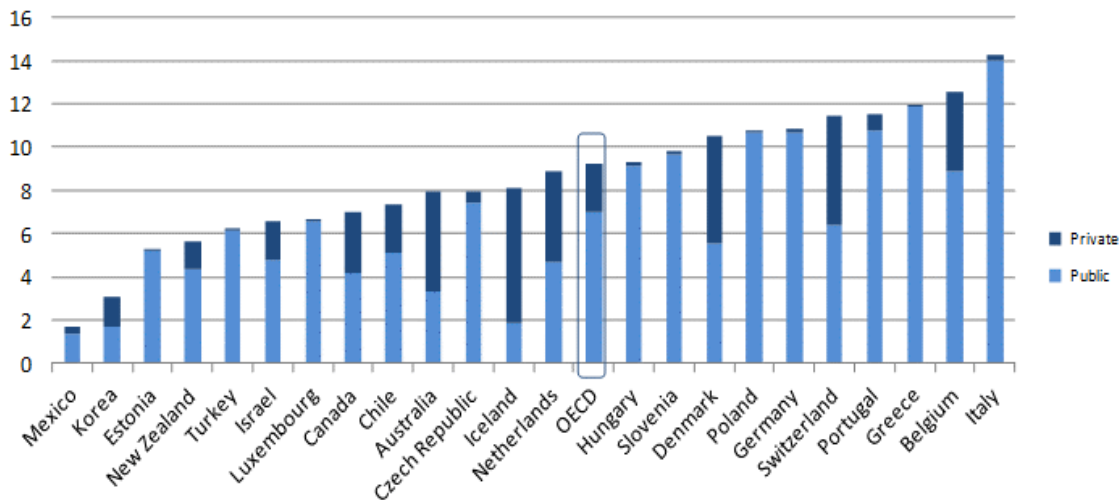
Source: OECD, *Pensions Markets in Focus*, 2012

The development of a funded pension pillar has microeconomic and macroeconomic implications. If the pension fund's participation increases net saving for current workers then they will be better prepared for a future scenario where the public pension benefits are expected to decrease with respect to the past and where life expectancies are expected to be higher. Moreover "putting one's eggs in different baskets" is a diversification strategy that allows individuals better to face the risks that inherently surround any pension contract.

From a macroeconomic point of view, therefore, increasing the funded component of the pension system means raising the capital intensity of the economy and/or a better international diversification of pension savings.

6.2.2 The case of Italy

Only recently has there been in Italy also some significant development of a private pillar, namely from the 2007 reform which by introducing a default mechanism on the use of the "severance pay" (*Trattamento di Fine Rapporto*) determined a certain development of the private component. The composition of the pension portfolio is however still unbalanced (see also considerations of research in strand 2 of this project) and more efforts to understand the reasons for the weak development of the private component of the pension pillar would be important. As the figure below shows, Italy is one of the countries where the share of income devoted to the building of a future pension is highest and where the share of the public component is dominant.

Figure 6.11 – Share of income devoted to the building of a future pension in OECD countries
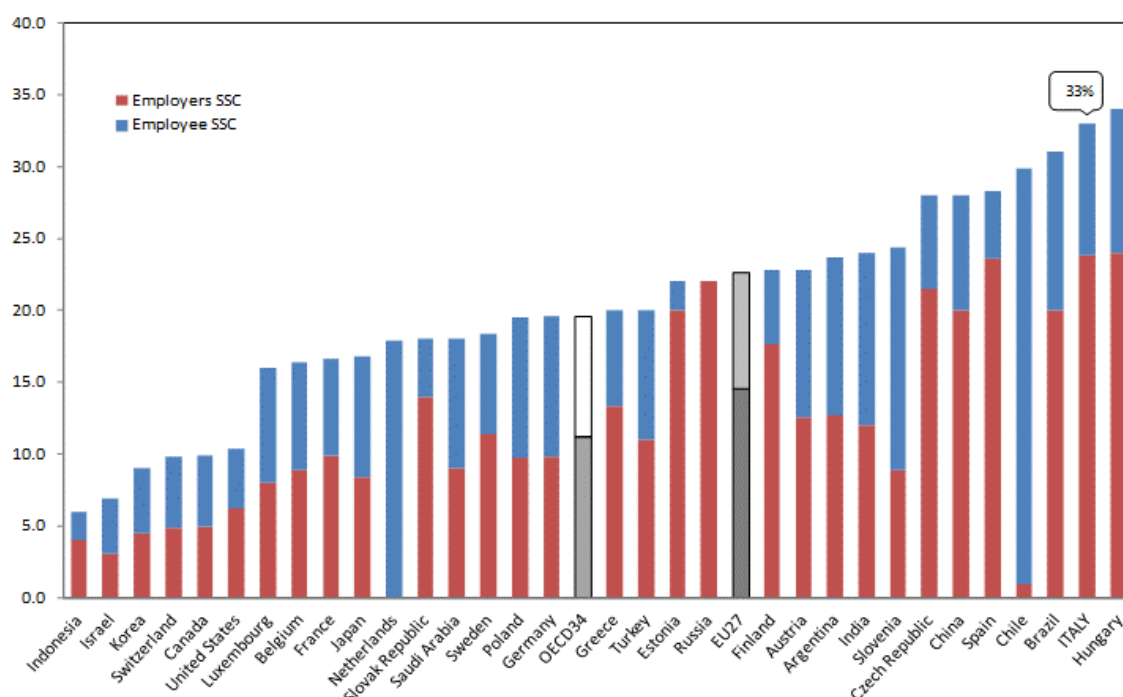
Source: OECD, *Pensions at a Glance*, 2013

6.2.3 Simulations

i.   *Reducing the NDC contribution rate*

In light of the evidence and arguments presented in the previous section, our third simulation explored the effects of lowering the mandatory NDC contribution rate for dependent workers from 33 per cent to 24 per cent of their gross wage. This simulation aims to provide some insight into a number of questions in relation to the adequacy of pension saving under the current system. Firstly, it will generate simulated evidence to assess the claim that the current mandatory contribution rate may be higher than optimal. Indeed, agents in the model for whom the reduced rate is too low will be able to increase their contribution to private pensions saving. As discussed by Lucchese et al. (2015), public and private pensions are modelled using very similar assumptions to reduce computational times This makes them very substitutable. Therefore, if agents compensate the reduction in NDC contributions with private pension savings, we can conclude that the original 33 per cent contribution rate was preferred. If, instead, they do not take up private pensions, we would conclude that 24 per cent is closer to the optimal rate for simulated households. The second insight offered by this simulation is what agents would do with the extra income generated from reduced contributions, should they not choose to shift this into private pensions.

The parameters for this simulation are as follows:

- **Baseline:**

  – *Dependent workers must contribute 11% of their gross earnings to the NDC system. Employers must contribute 22%, making the total contribution rate 33%.*

  – *Individuals can make additional contributions equal to 7.9% of their gross earnings to a private pension. If they do so, their employer will contribute an additional 1% of gross earnings.*

- **Simulation:**

  – *Dependent workers must contribute 5% of their gross earnings to the NDC system. Employers must contribute 19%, making the total contribution rate 24%.*

  – *Individuals can make additional contributions equal to 7.9% of their gross earnings to a private pension. If they do so, their employer will contribute an additional 1% of gross earnings.*

Contrary to the case of the previous simulations, looking at the cohort that is very close to retirement is likely to provide little insight. The policy affects the flows into pension wealth, and will therefore lead to significant changes in pension wealth only over a period of time. We therefore focus on the cohort of individuals who are young when the policy comes into effect. The majority of their working lifetime is affected by the policy, and their behavioural response is show in Figure 6.12.

Figure 6.12 – Behavioural response for those aged between 20 and 30 in 2012

DIF: Contributions to NDC pension
DIF: aggregate household tax burden (£ per week)
DIF: labour income of household (£ per week)
DIF: household net (disposable) income (£ per week)
DIF: aggregate contributions to private pension (including employer contribution
DIFF: Total expenditure

NOTES: Fraction of BASE: Lifetime gross earnings
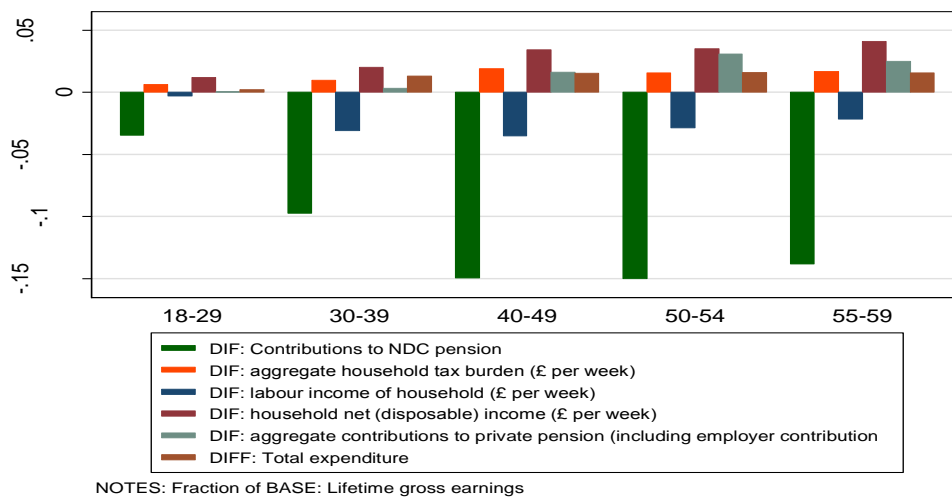
Source: Authors' calculations

As expected, individuals in this cohort contribute less to NDC pensions compared with the baseline (green bar). Note that the graph shows the change in the value of contributions from both employees and employers. Without further behavioural changes (that is, what we would see in a static model), individuals would have additional funds, which they would need to decide how to allocate. The other bars help us explore this, and reveal a fairly intricate behavioural response with a number of different elements:

- Firstly, the agents use some of these additional funds to "buy" leisure. We see labour income falls throughout the working lifetime (blue bar).
- Despite lower labour supply, we nevertheless see an increase in private pension contributions (grey bar). However, this is far from fully compensating the fall in NDC contributions.
- Lower labour supply and higher private pension contributions are still more than offset by lower NDC contributions, so that pre-tax income is higher than baseline on average. Tax liability (orange bar) and net income (purple bar) are therefore higher.
- Higher net incomes result in higher consumption (brown bar). This relationship is not one to one, however, implying an increase in saving in liquid assets.

The behavioural response indicates agents prefer lower levels of contributions into pension savings, as the increase in private pension saving is only a fraction of the fall in NDC savings. Instead, they prefer to use those resources to reduce labour supply and increase consumption during the working lifetime.

Figure 6.13 – Retirement circumstances for those aged between 20 and 30 in 2012

NOTES: Fraction of BASE: Lifetime gross earnings
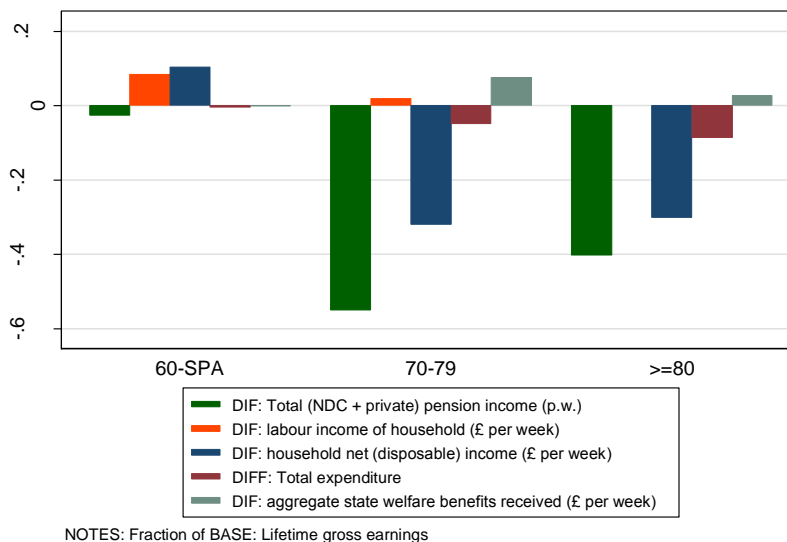
Source: Authors' calculations.

Inevitably, all things being equal, this cohort reaches old age with substantially lower total pension wealth (that is, including both NDC and private pensions). To offset this at least partially, the cohort exhibits a series of compensating behaviours, seen in Figure 6.13:

- Labour income is higher later in life compared with baseline. This is driven by the fact that agents extend their working lifetime to partially compensate the lower pension contributions paid. Overall, the results suggest that, over the life cycle, individuals reduce labour supply on the intensive margin, but increase it on the extensive margin.
- The delay in retirement explains why agents increase saving in liquid wealth during their working lifetime. As they know they will access the (certain) pension income later, and therefore extend the period during which they will depend on (uncertain) labour income, they increase precautionary saving.

- Despite agents extending their working lifetimes, this is very far from offsetting the fall in pension income once they retire. Pension income, and therefore disposable income, a substantially lower than the baseline.
- While consumption is also lower during retirement, the reduction is much lower than that in net income. This implies that agents partially compensate the lower total pension wealth by using part of their non-pension wealth, at the expense of legacies to future generations.

During the years around retirement, agents therefore react at least partially to buffer the reduction in total pension wealth accumulated during the working lifetime. These mechanisms include working later in life and reducing inheritances.

Overall, however, agents ultimately still choose to consume less during retirement (that is, they lower their living standards). The results across the life cycle therefore signal a clear demand to shift consumption from retirement to working age. This is consistent with the idea that the current NDC contribution rate may be higher than optimal.

If one accepts that the mandatory NDC contribution may be too high, the simulation also indicates that the private pension pillar could have an important role to play in helping individuals choose the right level of pension savings for them. Indeed, where the mandatory contribution is set at a low to medium level, the private pension pillar would allow individuals to boost their private pension saving up to the level that they consider optimal.[32] In the simulation, we see evidence of some agents taking up private pension savings to offset the fall in NDC contribution. This is consistent with the presence of heterogeneous optimal saving rates across the population.

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[32] The same objective could be achieved by allowing individuals to choose their level of NDC contributions

7. Pension Reforms, absenteeism and grandmothers

Authors: Flavia Coda Moscarola[•], Elsa Fornero[•] and Steinar Strøm[♣]

In all the previous chapters the effects of pension reforms have been analysed as if individuals simply adapted their lifestyle and behaviour to the new rules. Changing perspective, this chapter investigates whether they have put in place strategies to oppose to some extent to the increase in the retirement age. In particular we analyse whether a hardening of age/seniority prerequisites for retirement determines an increase in sick-leave spells taken by workers.

We focus on middle-aged women employed in the private sector, that is, the group who still enjoyed more favourable retirement conditions (possibly as an implicit ex-post compensation for subtle discrimination in the labour market), and who have experienced, because of the rapid switch to the new rules, the sharpest restriction in the age/seniority requirements. Our aim is to look for a possible "substitution effect" between (postponed) retirement and sick-leave.

The literature on absenteeism is quite rich. Both economic and epidemiological research has highlighted that perceived high strain at work and low social support are good predictors of sick-leave (Andreassen and Kornstad, 2010; Moreau et al., 2004). It has also been shown that the cost of being absent significantly affects work absence behaviour (see Johannson and Palme, 1996; 2002). Both sick-leave regulation and its implementation play a key role in determining individuals' absence choices. Concerning Italy, Scoppa (2010) and Scoppa and Vuri (2014) have already pointed out how sick-leave is higher among workers with higher seniority and more stable contracts, employed in the public sector or in big private firms and living in regions with low unemployment levels. These findings, which refer to the pre-reform situation, are explained by the authors as the result of workers' opportunistic behaviour in a country with low controls and high employment protection.

The literature on the effects of pension reforms, on the other hand, has concentrated on the consequences of a change in retirement rules on wealth accumulation and savings (Attanasio and Rohwedder, 2003); on work and retirement decisions of individuals and couples (Belloni and Alessie, 2009; Colombino et al., 2011); on the adequacy of retirement resources and on income distribution (Fornero, Lusardi and Monticone, 2010, Borella and Coda Moscarola, 2006; 2010); on long-term employment and growth (Buyse et al., 2013).

To the best of our knowledge, the effects of pension reforms on absenteeism have not yet been analyzed. We find evidence of higher sick-leave absences for women who were obliged by the reform to postpone retirement and who in 2011, before the reform (which was approved just before the end of the year), had already experienced a sick-leave spell, with a significant direct correlation between weeks of absence and years of retirement delay. Women who had not taken any sick-leave spell in 2011 reacted to the postponement of retirement only if they are grandmothers, possibly as a last resort solution to cope with caregiving duties towards grandchildren (or other relatives).

The remainder of the chapter is organized as follows. Section 7.1 describes the Italian regulatory framework. Section 7.2 describes the empirical model. Section 7.3 presents the data and the descriptive statistics. Estimates of the effects of the pension reform on absenteeism are presented in Section 7.4.

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7.1. The Italian regulatory framework

Since our analysis is centred on how reforms shape individuals' behaviour, we start with a brief overview of the Italian sick-leave regulation.

The Italian sick-leave regulation is based on the principle of not penalizing the sick worker, and therefore to guarantee both salary and pension rights. All absences due to illness lasting more than one week lead to notional payroll periods, that is, contributions that are financed by either health payroll taxes or general taxation. Notional contribution periods are used for the computation of both eligibility requirements and the pension benefit. Accreditation is conditional on having contributed to the Social Security scheme for more than one week before the start of the illness and since 2009 it is subject to a maximum of 96 weeks in the whole working life (National Social Security Institute (INPS), Circolare no. 11, 24-01-2013).[33]

For the details concerning the Italian retirement regulation, please refer to chapter 2.

7.2. The empirical model

7.2.1 Possible outcomes of an increase in age/seniority requirements

Workers affected by the restrictions of a pension reform can either continue to work or withdraw from the labour market, and live on savings and/or their spouse's income. In what follows, we only consider those who continue their working activity. Some of them go on working with no increase in their morbidity rate (or following the trend shown in previous years), while others resort to additional sick-leave. This group may consist of workers who effectively experience a worsening in their health status, or subjectively perceive a worsening of their wellbeing, or simply react to the pension restrictions. Of course resorting to sick-leave requires validation by a doctor, which should in principle only be given for the first case. However, apart from lack of controls,[34] there is a "grey area" in which, in the presence of subjective discomfort, it can be very difficult for doctors to deny certification (as in the case of psychological complaints or nervous break downs).

Whatever the reasons, our a-priori is that sick-leave could be the response by some workers to the pension reforms and that this is more likely in the case of individuals who had planned early retirement for circumstances that the reform could not accommodate. This does not mean we are assuming opportunistic behaviour on the part of workers; on the contrary, we would like to test whether the disruption of personal life plans caused by a pension reform result in longer/more frequent sick-leave.

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[33] Individual must present a demand for notional payroll accreditation, however, the events declared in the monthly individual reports (*denunce individuali mensili*, EMens) to the INPS (and reported in the *Estratti Conto* archive) are automatically registered.

[34] After several decades of continuous increase, since the early 1990s the average number of weeks of sick leave per person per year exhibits a decreasing (although discontinuous) trend that has accelerated and stabilized from 2006 on (source: our elaborations on Estratti Contro INPS). This is probably due to the tightening up of the controls. At the same time, the counter-action against the recourse to invalidity pensions (Law 222/1984) starting from the mid 1980s significantly restricted access to this type of pension (Ragioneria Generale dello Stato, 2014).

Of course, if the health condition is serious and this status is validated by a doctor, the worker can also apply for a disability pension. In this paper we do not consider this possibility, as we do not have access to the archive of disability applications. In any case, since the early 1980s, the achievement of disability pensions in Italy has become increasingly difficult and very few people attain them.

7.2.2 The econometric specification

In order to test our thesis, we adopt a First Differencing approach (FD) and estimate the following equation on a balanced panel referred to the years 2011 and 2012:

$$\Delta Y_{it} = (Y_{i2012} - Y_{i2011}) = T \; + (\mathbf{Z_{i2012}} - \mathbf{Z_{i2011}})\gamma + \alpha Dtreated_{i2012} + (u_{i2012} - u_{i2011})$$

Where Y_{it} is the number of weeks of sick-leave in the year t (with t equal to 2012 or 2011) for the individual i; T is the trend dummy that is equal to 1 in 2012 and 0 otherwise; $\mathbf{Z_{it}}$ is a set of individual time-varying explanatory variables measured at time t; and u_{it} is the individual specific error term in time t.

The reaction of individuals to the 2011 pension reform is measured by the estimated coefficient of the dummy variable *Dtreated*. *Dtreated* is equal to 1 if the individual has been obliged in year 2012 to postpone retirement because of the 2011 pension reform (i.e., belongs to the treated group) and zero otherwise (i.e., belongs to the control group). Treatment in year 2011 is zero for both the treated and the control groups.[35] If being affected by the pension reform has a positive impact on the number of sick-leave weeks, then the estimate of α is positive.

In the base model, the set of time-varying individual regressors ($\mathbf{Z_{it}}$) includes: seniority, the interaction between seniority and age, the number of weeks of notional contribution throughout the whole working life (all seniority variables are measured at the beginning of each year), the age squared, the logarithm of the weekly wage, the regional unemployment rate and a constant capturing the time trend. As usual, in the FD setting, the effect of the time-invariant regressors cancels out and the influence of the variation in age cannot be disentangled from the time trend.

We further try different specifications including interactions between some time-invariant individual characteristics and the time trend and/or the treatment variable. Finally we repeat all the estimations using the variable *Delay*, indicating the number of years of delay in retirement imposed by the reform to each individual, in place of the dummy *Dtreated*. The variable *Delay* is positive when the dummy *Dtreated* is equal to one, and zero otherwise.

In order to test strict exogeneity, following Wooldridge (2002) we add $\mathbf{Z_{i2012}}$ (the complete set of time-variant regressors observed in year 2012) to the set of regressors in the First Difference specification and we run an F test of significance of $\mathbf{Z_{i2012}}$. Strict exogeneity implies that $\mathbf{Z_{i2012}}$ are not jointly statistically significant.

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[35] Given that we have two periods only, fixed effect and FD produce identical estimates and inferences and both cope with the elimination of the possible time-invariant individual specific component of the error term. However, in the paper we opt for the FD as it allows for easier heteroscedasticity robust inference.

7.3. Data and descriptive statistics

The analysis is based on data from an administrative data set provided by the Italian Social Security Institute (INPS), the so-called "Estratti conto" archive.[36] This archive collects all the information related to the contribution spells of workers into the INPS pension schemes, namely the beginning and end dates of any contribution period; the classification of all contributions (regular employed work, sick-leave, maternity leave, unemployment, etc.) and the gross earnings (used to compute payrolls and pension benefits). INPS provided a sample of registered individuals born on the 1st and the 9th of each month of each year. The data are updated to 31 December 2012, that is, the sample contains all the working life information of the selected individuals from the date of their first contribution to one of the INPS schemes up to the end of 2012.

Despite being a very rich dataset in terms of individuals' working careers, the INPS archive reports only all absences due to illness lasting more than one week and provides no information on seniority built up by individuals in other pension schemes (i.e., as civil servants or as freelance professionals), which leads to the impossibility of getting the complete picture for workers with mixed careers. It further provides only very limited information on socio-demographic conditions of the individual and their household, namely: year of birth and death, gender and region of residence. However, we can still identify mothers and women in charge of informal caregiving duties from observed spells of maternity leave and caregiving leave.[37]

We focus on the subsample of women registered in the main private employee scheme (FPLD), born between 1947 and 1959 and not yet retired in 2012 (i.e., who did not already reach the requisites to access the retirement pension in 2011). The sample collects all the information on their spells of work and sick-leave from 1962 up to 31 December 2012.[38] We analyse the determinants of the variation in the length of their sick-leave spells between 2011 and 2012.

To define whether the individuals are obliged to delay retirement as a consequence of the reform (whether they belong to the "treated" group), we use a simulation procedure. Starting from the observed age and seniority in 2012 for each individual in the sample, we simulate the year in which pension requisites for seniority or old age pensions[39] can be reached under pre- and post-reform rules in the hypothesis of a

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[36] The "Estratti conto" archive has been available to the public for research since 2012 (http://www.cliclavoro.gov.it/Barometro-Del-Lavoro/Pagine/Microdati-per-la-ricerca.aspx).

[37] Maternity leave spells are coded as: esn_tipcr=320; esn_tipcr=321; esn_tipcr=322; esn_tipcr=329; esn_tipcr=301; esn_tipcr=382; esn_tipcr=384; esn_tipcr=386; informal caregiving as esn_tipcr=324.

[38] We start with a sample of 7,169,385 spells of contribution related to our sample women and referring to the period 1962–2012. We drop observations related to individuals who started to work before the age of 15, as they show up unusual working patterns. We exclude individuals who have taken leave to provide care-giving to relatives (they are less than 1 per cent of the sample) as they have special pension rules, and individuals with more than 96 weeks of notional payrolls as after this threshold notional seniority is not accounted for in the computation of the pension requisites. We drop also: individuals who reached the requisites to access the pension in 2011; individuals with no contribution in 2012; individuals with "outlier" wages in 2012 (lower than first percentile or greater than 99th percentile); women with more than 52 weeks of seniority in 2011 and 2012; and individuals aged 65+ with less than 15 years of contribution in 2012 (as they are probably retiring with the non-contributory social allowance, *pensione sociale*). We excluded unemployed individuals (*mobilità, cassa integrazione e disoccupazione*) in 2012. We end up with a balanced panel of 44,685 women, either blue- or white-collar, observed working in 2011 and 2012 of whom we have summarized the working seniority, the total number of weeks of leave and unemployment, and all the other lifetime information relevant for our analysis.

[39] We exclude the possibility of access to retirement with the DC option as it implies a great reduction of the benefit and it has been effectively chosen by a very small number of workers.

continuous (future) career. Pension requirements evaluation refers to 31 December of each year. In some cases, the evaluation of retirement requisites requires the month and the day of birth, information that is not provided in the dataset. We deal with this by randomly assigning a month of birth to the individuals in the sample. We further assume that they are all born on the last day of the month.[40]

According to our simulations, as a consequence of the 2011 pension reform, about 74 per cent of women in our sample experienced an increase in the minimum age requirements for retirement from one up to six years; these women represent our "treatment group". The other 26 per cent were unaffected and can be used as a "control group" (see Table 7.1). The average delay for women in the treatment group is about three years.

Table 7.1 – Delay in retirement (years) imposed on women in private-sector employment by the reform

Years of delay in retirement imposed by the reform	Number of workers affected	%
0	5,790	26%
1	5,054	23%
2	2,320	10%
3	2,808	13%
4	1,697	8%
5	2,941	13%
6	1,732	8%
Total	22,342	100%

Source: our simulations using INPS data.

The time profile (measured in 2012) of the delay is hump-shaped (see Table 7.2). The average increase in the retirement age for individuals up to the age of 55 or from the age of 60 on is about two years. It increases to three years for women aged 56 and to more than four years for individuals aged 57–59. This is due to the joint effect of the new age/seniority requirements to access retirement and of the workers' heterogeneity in age and seniority at the time the reform was introduced. Women aged 62 and over were unaffected.[41]

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[40] Sensitivity analysis to these assumptions is shown in Tables 1B and 2B in the Appendix.

[41] This is due to the safeguard conditions included in the reform and to the decision to exclude from our sample all the individuals aged 65+ with less than 15 years of seniority in 2012.

Table 7.2 – Age composition and dimension of control and treatment groups

Age	Control group Frequencies	Treatment group Frequencies	Average no. of years of delay
53	864	2,960	1.85
54	575	2,969	2.28
55	759	2,553	2.77
56	797	2,249	3.53
57	643	1,930	4.02
58	563	1,552	4.36
59	343	1,259	4.31
60	222	1,060	2.60
61	207	20	1.70
62	303		1.85
63	218		
64	180		
65	116		
Total	5,790	16,552	
Mean age	57.04	55.75	
Mean delay (years)			3.02

Source: Authors' elaborations on INPS data.

Table 7.3 reports the type of pension to which (sample) women could have access before and after the pension reform under the hypothesis that they retire as soon as they are eligible.[42] Within the control group, 46 per cent of women reached the old age requirements first and 54 per cent the pure seniority requirements; in the treatment group, the same numbers for the pre-reform provision were 64 and 36 (12 per cent "quota" pensions and 24 per cent pure seniority pensions).

Once the reform is introduced, the "quota" pensions are abolished. As a consequence, 52 per cent of women that fulfilled the quota requirements under the pre-reform regime can retire on pure seniority requirements, while 48 per cent have to await the accrual of their old age requirements.

Most of the women who in the pre-reform regime had access to old age and pure seniority pension still have the possibility to receive the same type of pension (but with the new higher age and seniority requirements).

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[42] To account for the fact that very few women have been observed to retire according to the DC option, as the pension benefit can be sensibly reduced by the application of the DC rule, we did not simulate retirement according to the DC option.

Table 7.3 – Types of pension accruable under pre- and post-reform rules for treatment and control groups

Typology of pension accruable under pre-reform rules	Typology of pension accruable under post-reform rules						
	Control group		Treatment group				
	no.	%	Pure seniority	Old age	Temporary	Total	Total %
Pure seniority	3,139	54%	3,961	0	0	3,961	24%
Old age	2,651	46%	1,820	8,264	543	10,627	64%
Quotas			1,024	940	0	1,964	12%
Total	5,790	100%	6,805	9,204	543	16,552	100%
Total (%)			41%	56%	3%	100%	
Pure seniority			100%	0%	0%	100%	
Old age			17%	78%	5%	100%	
Quota			52%	48%	0%	100%	

Source: Authors' simulations.

In 2012 and 2011, about 3 per cent of women in the sample had a sick-leave spell[43] lasting more than seven days[44] determining a credit of notional contributions. Figure 7.1 shows the distribution of the sick-leave weeks for them.

Figure 7.1 – Distribution of the weeks of sick-leave in 2011 and 2012
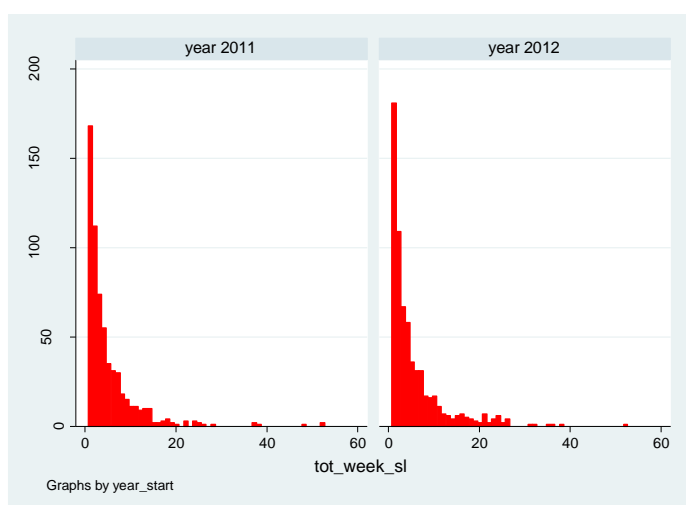
Note: Observations 619 in 2011 and 649 in 2012. Maximum value 52 weeks.

Source: Authors' elaborations on the sample of women with a sick-leave spell in 2012.

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[43] The week of sick-leave is defined with the contribution codes: esn_tipcr=310; esn_tipcr=315; esn_tipcr=319; esn_tipcr=350; esn_tipcr=359.

[44] According to INPS data (INPS 2013), about 33 per cent of the women in private-sector employment had at least one sick-leave absence in 2012 (1.8 million out of 5.2 million of female dependent workers in private-sector employment). However, 82 per cent of the sick-leave absences registered by INPS in 2012 lasted less than seven days and thus did not lead to the accreditation of notional contributions (our elaborations on INPS 2013 data, page 4).

The number of sick-leave weeks in 2012, besides being on average very low, is slightly higher in 2012 and for women in the treatment group relative to women in the control group (0.16 weeks versus 0.14). The same is observed also concerning the total number of weeks of sick-leave in the whole career and for the total joint number of weeks of sick-leave and unemployment in the whole career (relevant for the accrual of the seniority requirement, see section 2). However, the differences are not statistically significant.

The control and the treatment groups do not differ significantly either in terms of the other observable characteristics except age, which is slightly higher in the control group (see Table 7.4).

Table 7.4 – Descriptive statistics of the sample

Variable	Obs	Year 2012		Year 2011	
		Mean	Std. Dev.	Mean	Std. Dev.
Treatment group					
Weeks of sick-leave in 2012	16,552	0.16	1.44	0.14	1.32
Delay in retirement due to Monti-Fornero reform (years)	16,552	3.02	1.77	0.00	0.00
Seniority in 2012 (weeks)	16,552	1384.29	425.63	1331.49	425.89
Sick-leave weeks in the whole career	16,552	1.98	7.63	1.84	7.26
Sick-leave and unemployment weeks in the whole career	16,552	15.79	36.00	15.65	35.88
Age	16,552	55.75	2.16	54.75	2.16
Weekly wage (euro)	16,552	478.64	245.25	471.30	240.55
Grandmothers	16,552	0.40	0.49	0.40	0.49
North	16,552	0.57	0.50	0.57	0.50
Centre	16,552	0.28	0.45	0.28	0.45
South	16,552	0.15	0.36	0.15	0.36
Control group					
Weeks of sick-leave in 2012	5,790	0.14	1.26	0.13	1.17
Seniority in 2012 (weeks)	5,790	1410.50	680.97	1357.57	680.76
Sick-leave weeks in the whole career	5,790	1.49	5.69	1.36	5.41
Sick-leave and unemployment weeks in the whole career	5,790	12.10	35.53	11.97	35.48
Age	5,790	57.04	3.27	56.04	3.27
Weekly wage (euro)	5,790	475.36	266.22	460.26	229.37
Grandmothers	5,790	0.41	0.49	0.42	0.49
North	5,790	0.61	0.49	0.61	0.49
Centre	5,790	0.26	0.44	0.26	0.44
South	5,790	0.12	0.33	0.12	0.33

Source: Authors' elaborations.

7.4. Results

In the estimations presented in this section, our dependent variable is the variation in the individuals' number of sick-leave weeks that occurred between the year 2011 and 2012.

In our baseline specification, the set of regressors includes a dummy capturing the time trend between 2011 and 2012 (T) and a dummy identifying treated workers (D-treated). The estimated coefficient of the latter variable captures the different reactions of individuals obliged to postpone retirement by the pension reform compared with the individuals who were not affected. We also control for a set of individual specific characteristics as the individuals' variations in seniority, in the interaction between seniority and age, in the number of weeks of notional contribution throughout the whole working life (all seniority variables are measured at the beginning of each year), in the age squared,[45] in the logarithm of the gross weekly wage and in the regional unemployment rate.[46]

We observe a negative time trend in the sick-leave absences and a positive effect of the treatment. However, neither of the effects is significant at any standard significance level. The effect of the other control variables is in line with the literature. Indeed, we find that higher seniority corresponds to higher absences. However, in our regressions such an effect depends on the age. The higher the age, the smaller the effect (the interaction term between age and seniority, besides being small, is negative). In addition, an increase in the total number of weeks of notional contribution because of sick-leave or unemployment reduces the weeks of sick-leave. This result was expected as notional contribution is not considered to have access to seniority pensions. Finally, an increase in the regional unemployment rate reduces absences.

In model 2 specification we allow for different behaviour between grandmothers and non-grandmothers, we indeed add an interaction term between the dummy treated and the dummy identifying grandmothers. The coefficient of such an interaction term is positive and significant at the 10 per cent significance level. Our intuition is indeed that grandmothers are in charge of informal caregiving duties towards grandchildren and could overreact to the postponement in retirement induced by the pension reform.

In model 3 we further allow for a different trend and a different reaction to the treatment according to the sick-leave history of the individuals. We use the dummy identifying individuals with a sick-leave spell in 2011 and we interact it with both the time trend and the treatment dummy. We find that the reaction to the treatment is actually higher for individuals who had already experienced a sick-leave spell in 2011, but we do not find evidence of a specific time trend for them.

Finally in model 4 we also differentiate the effect for treated grandmothers according to whether they had a sickness spell or not in 2011. We indeed expect that only healthy grandmothers can actually be in charge of caregiving duties. The estimates are in line with what we expected: we find evidence of a positive reaction of grandmothers to the postponement in retirement induced by the reform only for grandmothers who in 2011 did not experienced a sick-leave spell. The dummy identifying grandmothers that experienced a sick-leave spell in 2011 has, on the contrary, a negative sign. This evidence can have several explanations: perhaps, in this case, being a grandmother simply captures an overall better health condition compared with non-grandmothers. However, the limited dimension of the group of grandmothers who were observed to take in sick-leave in 2011 suggests caution in the interpretation of this result.

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[45] In a FD setting, we cannot disentangle the variation in the age from the time trend.

[46] The literature shows that absence normally increases with usual hours of work (Barmby et al., 2002). Unfortunately, we do not have any information about the usual hours of work of the individuals in the sample.

Table 7.5 – Regression results I: FD – Dependent variable: variation in weeks of sick-leave between 2011 and 2012

	Model1 b/se	Model2 b/se	Model4 b/se	Model5 b/se
T	-0.501	-0.531		
	(0.346)	(0.344)		
T $_{sick\ in\ 2011}$			-0.301	-0.302
			(0.302)	(0.302)
T $_{not\ sick\ in\ 2011}$			-0.509	-0.509
			(0.302)	(0.302)
Dtreated	0.020	0.005		
	(0.026)	(0.027)		
Dtreated $_{sick\ in\ 2011}$			0.317**	0.361**
			(0.009)	(0.007)
Dtreated $_{not\ sick\ in\ 2011}$			-0.004	-0.006
			(0.009)	(0.007)
Dtreated* grandmother		0.038*	0.037*	
		(0.003)	(0.006)	
Dtreated* grandmother$_{sick\ in\ 2011}$				-0.069**
				(0.001)
Dtreated* grandmother$_{not\ sick\ in\ 2011}$				0.040***
				(0.000)
ΔSeniority	0.005**	0.005**	0.005*	0.005
	(0.000)	(0.000)	(0.001)	(0.001)
ΔSeniority*age	-0.000*	-0.000*	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
ΔNotional seniority	-0.740***	-0.740***	-0.776***	-0.775***
	(0.001)	(0.001)	(0.000)	(0.000)
ΔAge^2	0.006	0.006	0.006	0.006
	(0.003)	(0.003)	(0.003)	(0.003)
ΔLog(wage)	-0.264	-0.266	-0.269	-0.268
	(0.107)	(0.107)	(0.113)	(0.112)
ΔRegional unemployment rate	-0.003**	-0.002*	-0.001	-0.001
	(0.000)	(0.000)	(0.002)	(0.002)
Adjusted R-square	0.332	0.332	0.333	0.333
N	22,342	22,342	22,342	22,342

Note: Significance levels:* 0.10 ** 0.05 *** 0.01. Robust errors clustered at level of dummy "sick in 2011".

We then use the delay in retirement (Delay) in place of the dummy identifying treated workers (D-treated). The delay is the number of years of postponement in retirement induced by the pension reform; values are rounded up to the nearest integer. For the control group, the variable Delay is zero. As before we try different specifications; the results are reported in Table 7.6. This new set of regressions confirms previous findings and reveals that the effect of the treatment is actually proportional to the number of years of postponement in retirement induced by the reform.

Table 7.6 – Regression results II: FD – Dependent variable: variation in weeks of sick-leave between 2011 and 2012

	Model6 b/se	Model7 b/se	Model9 b/se	Model10 b/se
T	-0.435	-0.464		
	(0.259)	(0.254)		
T $_{\text{sick in 2011}}$			-0.243	-0.244
			(0.216)	(0.214)
T $_{\text{not sick in 2011}}$			-0.444	-0.443
			(0.217)	(0.216)
Delay	0.004	-0.002		
	(0.006)	(0.007)		
Delay $_{\text{sick in 2011}}$			0.092***	0.118***
			(0.001)	(0.000)
Delay $_{\text{not sick in 2011}}$			-0.005	-0.006**
			(0.001)	(0.000)
Delay*grandmother		0.016*	0.015	
		(0.003)	(0.004)	
Delay*grandmother $_{\text{sick in 2011}}$				-0.047***
				(0.001)
Delay*grandmother $_{\text{not sick in 2011}}$				0.018***
				(0.000)
ΔSeniority	0.004*	0.005*	0.005	0.005
	(0.000)	(0.000)	(0.001)	(0.001)
ΔSeniority*age	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
ΔNotional seniority	-0.740***	-0.740***	-0.775***	-0.775***
	(0.001)	(0.001)	(0.000)	(0.000)
ΔAge^2	0.005	0.006	0.005	0.005
	(0.003)	(0.003)	(0.002)	(0.002)
ΔLog(wage)	-0.265	-0.267	-0.271	-0.271
	(0.108)	(0.108)	(0.115)	(0.115)
ΔRegional unemployment rate	-0.003**	-0.002*	-0.001	-0.001
	(0.000)	(0.000)	(0.002)	(0.002)
Adjusted R-square	0.332	0.332	0.334	0.334
N	22,342	22,342	22,342	22,342

Note: Significance levels:* 0.10 ** 0.05 *** 0.01. Robust errors clustered at level of dummy "sick in 2011".

For sake of brevity, we focus on Model 8 which accounts for the differential time trend and effect of delay in retirement of individuals who did or did not experience a sick-leave spell in 2011. As before, the treatment has a positive significant effect on women who did experience a sick-spell in 2011 and on grandmothers with no sick-leave spell in 2011. Women who in 2011 did not experience a sick-leave spell and are not grandmothers show a small decrease in their sick–leave absences. Grandmothers with a sick-leave spell in 2011 increase their sick-leave absences less than non-grandmothers, but once again the interpretation of this finding is compromised by the limited size of the group.

According our estimations, the average variation in the length of the sick-leave spell for the average women is very low, about 0.004 weeks if we suppose no delay in retirement. If she had no sick-leave spell in 2011

and experiences one year of delaying retirement as a consequence of the pension reform, the average length of her sick-leave almost triples. With six years of delay it becomes 16 times longer.

8. The expectations of Italians about retirement

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Standard economic theory assumes that all agents base their retirement decisions on rational expectations, that is, workers know their future pension benefits and adapt their expectations to changes in the pension legislation. However, empirical evidence shows that future pensioners often have little knowledge about the retirement rules that affect their pension benefits (Gustman and Steinmeier, 2001; Lusardi and Mitchell, 2006; 2007).

In this chapter and the following, we explore the expectations of the Italian population about retirement and how they changed as a consequence of the reform. The present chapter addresses in particular to what extent individuals have reacted to changes in pension legislation. Chapter 9 evaluates whether individuals correctly understood the changes brought by the pension reform.

Several studies have analysed the effect of pension reforms on expected retirement age in Italy. Brugiavini (1999) analyses the effect of the 1992 pension reform and finds that expected retirement age seems to have increased between 1989 and 1995, particularly for younger individuals working in the private sector. Mastrogiacomo (2004) finds that the 1992 and the 1995 pension reforms increased both the planned retirement age and uncertainty, with the rise in uncertainty being more pronounced after the 1992 reform. Bottazzi et al. (2006) estimate the effect of the pension reforms introduced in the 1990s on households' expectations of retirement outcomes. They find that after the reform expected retirement age increases for all middle-aged workers, and particularly for public employees, the self-employed, workers in the South and for workers with a college degree.

In this chapter we update existing findings, providing some descriptive evidence about the effect of the latest pension reform on retirement expectations. Similarly to the reported literature, our analysis relies on the Bank of Italy's SHIW data.

8.1 Data and descriptive statistics

We use the 2010 and 2012 data from the Survey of Households Income and Wealth (SHIW) where respondents are asked to answer to the following question: "At what age do you expect to retire?". Since the pension reform was introduced in 2011, the availability of data about expected retirement age in year 2010 and 2012 allows us to analyse the effect of the reform in shaping workers' expectations. In particular, we focus on the panel component of SHIW, which includes 11,142 individuals. We restrict our analysis to the individuals born between 1950 and 1989 who classify themselves as dependent workers or as self-employed (2,716 individuals). We then exclude individuals who did not respond at the questions about the expected retirement age or declared it to be lower than 57 or greater than 70. We also exclude individuals who declared they had not previously paid contributions to a pension scheme (the same methodology is also followed in chapter 9). We end up with a sample of 1,279 individuals of whom 973 are dependent workers and 306 are self-employed. Table 8.1 reports the number of observations in our final sample.

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Table 8.1 – The sample

	N. of individuals in the sample	
	Employees	Self-employed
ALL	969	310
Male	523	207
Female	446	103
Cohort 1950–1959	290	110
Cohort 1960–1969	420	133
Cohort 1970–1979	210	56
Cohort 1980–1989	49	11

Note: figures refer to individuals who are surveyed at two points of time, year 2010 and year 2012, thus we have two observations for each individual.

Source: Authors' elaborations.

Table 8.2 shows that on average Italian workers have revised their expectations about the retirement age upwards by about two years. However, the high standard deviation found indicates a large heterogeneity across the sample and this may signal a lack of knowledge among the population about the details of the pension rules. The shift is more pronounced among women and for the 1970–1979 cohort, while not significant differences are found between employees and the self-employed.

Table 8.2 – Individual expected retirement age in 2010–2012. Mean and standard deviation by gender and cohort

	Employees		Self-employed	
	2010	2012	2010	2012
ALL	63	65	64	66
	(2.9)	(3.0)	(3.1)	(3.0)
Male	64	66	65	66
	(2.9)	(3.0)	(2.9)	(2.8)
Female	62	65	63	65
	(2.7)	(2.8)	(3.1)	(3.1)
Cohort 1950–1959	63	64	65	65
	(2.8)	(2.7)	(3.3)	(2.8)
Cohort 1960–1969	63	65	65	66
	(3.0)	(3.1)	(3.0)	(3.1)
Cohort 1970–1979	63	66	64	66
	(2.9)	(2.9)	(3.0)	(3.2)
Cohort 1980–1989	65	66	64	66
	(2.6)	(2.7)	(2.8)	(1.5)

Note: standard deviation in parenthesis

More precisely, Figure 8.1 (employees) and Figure 8.2 (self-employed) show the distribution of expected retirement age in the two years. Figures clearly highlight how the expectations of individuals about the age of retirement peak at ages 60, 65 and 70. They also show that expectations have shifted, for male dependent workers, significantly from the age of 60 and 65 to ages 67 and 70, while for women there is a sizeable drop in the expected retirement at age 60, with a concomitant increase at age 65 and beyond. The picture is not very different for the self-employed who showed, however, higher expectation about their retirement age also in 2010.

Looking at the different cohorts, Figure 8.3 shows that the peak of the expected retirement age at specific thresholds is particularly evident for the younger cohorts who are the most distant from retirement. However, they too have modified their expectations in 2012, revising them upwards.

Figure 8.1 – Distribution of expected retirement age in 2010 and 2012. Employees, by gender
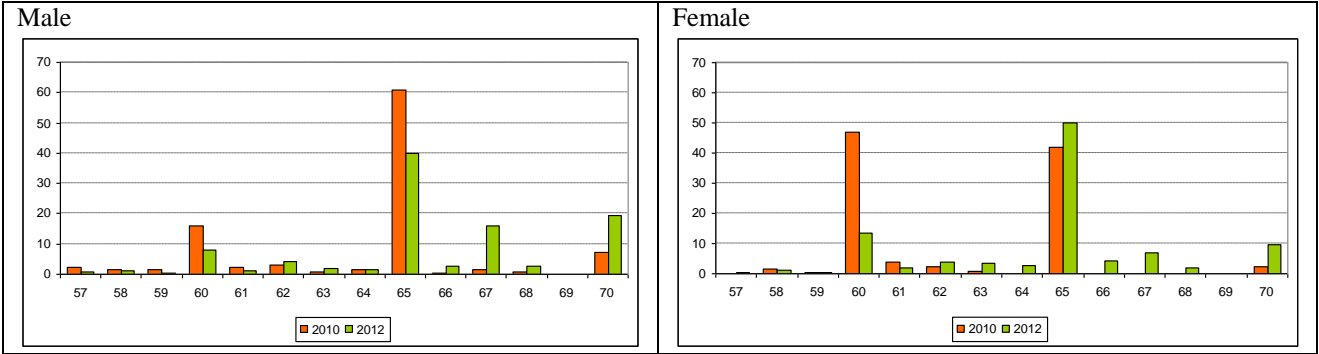
Source: Authors' calculation on SHIW 2010–2012 data

Figure 8.2 – Distribution of expected retirement age in 2010 and 2012. Self-employed, by gender
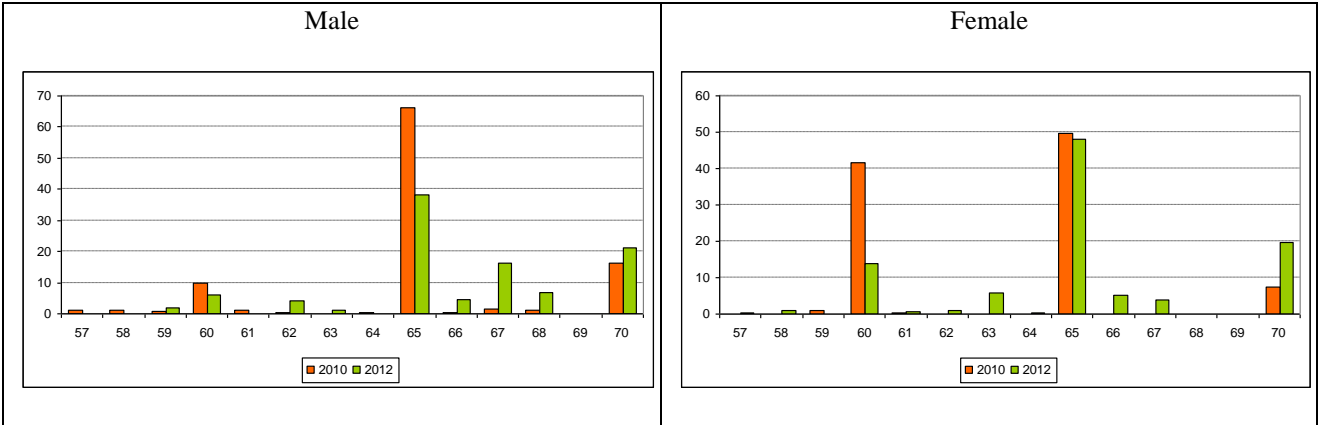
Source: Authors' calculation on SHIW 2010–2012 data

Figure 8.3 – Distribution of expected retirement age in 2010 and 2012. Employees, by cohorts
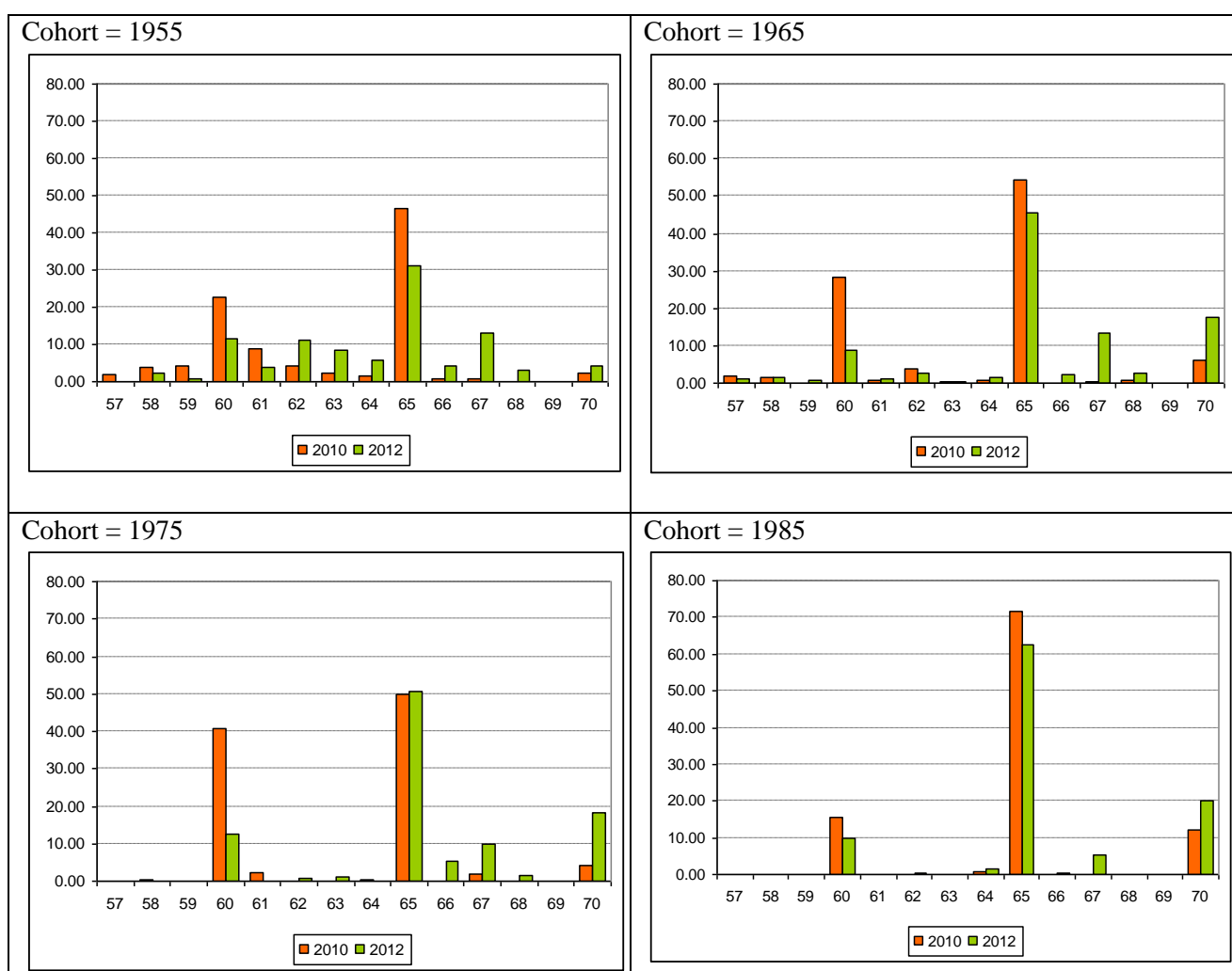
Source: Authors' calculation on SHIW 2010–2012 data

To have a more complete overview on this issue, we have computed for each individual the change (in absolute values in number of years) in the expected retirement age between 2010 and 2012.

About one third of workers in the sample had not changed their expectation about retirement age, while more than half had increased it (Figure 8.4). There was also about 10% of workers who had revised their estimations downwards between 2010 and 2012, probably due to a better knowledge of their personal pension situation. On average dependent workers had increased the value of the expected retirement age between 2010 and 2012 by a little less than two years, while the same expectation had increased by about 1.3 years for the self-employed. The highest revisions in the expectations had occurred among women and for the 1970–1979 cohort (Table 8.3).

Figure 8.4 – Individual change in the expected retirement age between 2010 and 2012. Distribution (%)
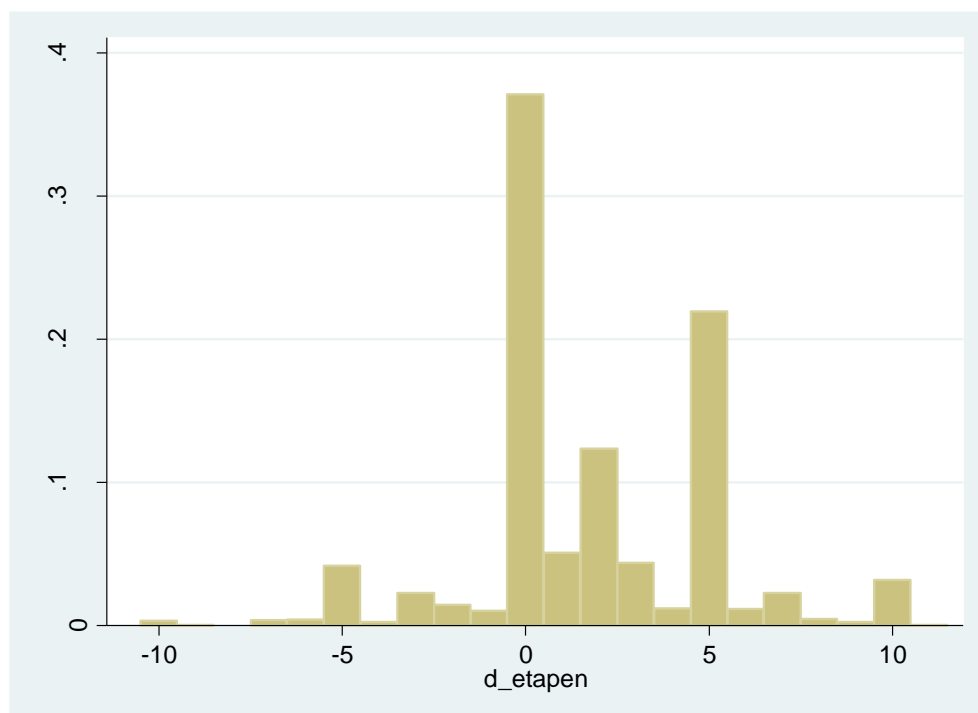
Source: Authors' calculation on SHIW 2010–2012 data

Table 8.3 – Individual change in the expected retirement age between 2010 and 2012. Mean and standard deviation by gender and cohort

	Employees	Self-Employed
ALL	1.9	1.3
	(3.3)	(3.2)
Male	1.6	0.99
	(3.3)	(2.9)
Female	2.3	2
	(3.4)	(3.4)
Cohort 1950–1959	1.2	1.1
	(2.5)	(3.3)
Cohort 1960–1969	2	1.5
	(3.3)	(3.2)
Cohort 1970–1979	2.4	1.5
	(3.6)	(3.0)
Cohort 1980–1989	1.7	1.1
	(4.0)	(2.6)

Source: Authors' calculation on SHIW 2010–2012 data

8.2 Change in expectations and socio-demographic characteristics

In order to understand better which factors affect the change in the expectations, we have regressed the individual change in the expected retirement age over a number of individual characteristics. Our dependent variable, the change in the individual expected retirement age, is a count variable with a peak at value zero. The vector of explanatory variables includes demographic characteristics (gender, cohort, marital status, nationality, education, number of family components, macro region of residence) and type of employment (dependent worker/self-employed).

We aim to understand which are the characteristics of individuals who are more likely to increase their expected retirement age. The opposite case of those who reduce their expected retirement age in the period appears to be less important for our analysis. We believe in fact that the motivations behind the downward revisions lie in the availability of updated information about the personal pension situation rather than the pension reform itself. For this reason, our main sample of interest is composed by those individuals reporting positive or null variations in the expected retirement age (y>=0).

The most straightforward approach is a linear model estimated by OLS. A shortcoming of OLS estimation is that it allows for the predicted values of *y* to be negative, while our dependent variable is non-negative for all *x* by definition. For positive variables another possibility is instead to fit a Poisson model[47] which is more appropriate for count data as is the case here. Since we also observe an excess of zero counts in our sample, the zero-inflated Poisson regression model (ZIP) appears to be the model that fits better for the case at hand, where the dependent variable is zero in about 30 per cent of cases (see Figure 8.4). This model assumes that the excess zeros are generated by a separate process from the count values and that the excess zeros can be modelled independently. Thus, the ZIP model has two parts, a Poisson count model for the strictly positive values of the dependent variable, and the logit model for predicting excess zeros.[48]

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[47] In the Poisson model $E(y|x) = \exp(\beta x)$.

[48] Results are confirmed also using the zero-inflated negative binomial model which is still based on the Poisson one but controls for over-dispersion in the data.

Table 8.4 – Estimation sample: descriptive statistics

	All sample		Only y>=0	
	Mean	Std. Dev.	Mean	Std. Dev.
Change in expected retirement age (in years)	1.777	3.297	2.450	2.710
Female	0.438	0.496	0.449	0.498
Self-employed	0.225	0.418	0.219	0.414
1955 cohort	0.255	0.436	0.242	0.429
1965 cohort	0.408	0.492	0.412	0.492
1975 cohort	0.281	0.450	0.291	0.455
1985 cohort	0.056	0.229	0.054	0.227
Foreign	0.081	0.273	0.082	0.275
Single	0.286	0.452	0.286	0.452
Up to lower-secondary education	0.320	0.466	0.323	0.468
Upper and post-secondary education	0.503	0.500	0.491	0.500
Tertiary education	0.178	0.383	0.186	0.389
Household with 1 component	0.171	0.376	0.171	0.377
Household with 2 components	0.171	0.377	0.164	0.371
Household with h>= 3 components	0.659	0.474	0.664	0.472
North West	0.191	0.394	0.177	0.382
North East	0.356	0.479	0.364	0.481
Centre	0.170	0.376	0.168	0.374
South	0.205	0.404	0.208	0.406
Islands	0.078	0.269	0.083	0.276
N. obs	1279		1121	

Source: Authors' calculation on SHIW 2010–2012 data

Table 8.5 presents the regression results for the two models applied. Gender has a significant effect on the upward revisions of expectations. Hence, between 2010 and 2012, women's expected retirement age had increased more than men's. The effect of gender is particularly strong when the OLS model is applied. Instead, once controlled for the other demographic variables, self-employees do not appear to behave differently from dependent workers in modifying their expectation on retirement age.

When the ZIP model is used, greater differences are detected between cohorts. Interestingly, the 1965, 1975 and 1985 cohorts have a higher probability than the 1955cohort of maintaining in 2012 the same expectation reported in 2010. However, in these cohorts, individuals who have modified their expected retirement age have increased it by more than the oldest cohort. Therefore younger cohorts appear to be composed of two different groups of workers. One group has not modified their retirement expectations, most probably because a lack of correct information or because they see their retirement age as still too far away. As a support for this last explanation, we find that the younger the cohort, the higher the probability that they have not changed their ideas on retirement age from 2010. The second group, instead, increased significantly the expected retirement age between 2010 and 2012. Hence, better informed younger cohorts have perceived that the pension reform has tightened the requirements for accessing retirement and thus have significantly revised upwards their expectation about the retirement age. Similarly, workers with a foreign citizenship either are more likely than natives not to have changed their expectation, or, once they modify it, they increase the expected retirement age by more than Italian workers.

Interestingly, not significant differences are detected among different educational levels. On the contrary, having tertiary education is found to have a negative effect on the change of expectations. This seems to

suggest that knowledge about the effect of pension reform does not depend on education, but as already pointed out, on having gathered a sufficient level of financial and economic literacy and proper information.

Finally, household dimension and geographical residence do not significantly affect changes in the retirement age, with the only exception being workers living in the islands, who seem to be less likely to revise their expectations upwards.

Table 8.5 – Regression results

VARIABLES	(1) OLS all observations Dependent variable = Change in expected retirement age (in years)	(2) OLS only observations >= 0 Dependent variable = Change in expected retirement age (in years)	(3) Zero inflated Poisson regression Dependent variable = Change in expected retirement age (in years)	(4) Dependent variable = 1 if no changes in expected retirement age
Female	0.82***	0.65***	0.19***	-0.14
	(0.19)	(0.17)	(0.057)	(0.19)
Self employed	-0.36	-0.21	0.044	0.32
	(0.23)	(0.20)	(0.071)	(0.21)
1965 cohort	0.58**	0.51**	0.46***	0.65***
	(0.23)	(0.21)	(0.075)	(0.23)
1975 cohort	0.78***	0.57**	0.59***	0.88***
	(0.26)	(0.23)	(0.088)	(0.25)
1985 cohort	0.24	0.38	0.54***	0.98**
	(0.43)	(0.38)	(0.12)	(0.40)
Foreign	0.050	0.15	0.29***	0.61*
	(0.36)	(0.32)	(0.089)	(0.36)
Single	0.074	0.039	-0.020	-0.090
	(0.27)	(0.24)	(0.081)	(0.26)
Upper and post-secondary education	-0.16	-0.036	-0.0080	0.038
	(0.21)	(0.19)	(0.062)	(0.21)
Tertiary education	-0.25	-0.50**	-0.21***	-0.0069
	(0.28)	(0.24)	(0.069)	(0.26)
1 component household	0.26	0.37	0.14	0.0061
	(0.33)	(0.29)	(0.097)	(0.32)
2 component household	-0.51*	-0.26	0.056	0.37
	(0.26)	(0.23)	(0.091)	(0.27)
North East	0.85***	0.22	-0.11	-0.42*
	(0.26)	(0.24)	(0.075)	(0.25)
Centre	0.38	-0.099	-0.11	-0.12
	(0.31)	(0.28)	(0.086)	(0.29)
South	0.63**	0.089	-0.020	0.073
	(0.29)	(0.26)	(0.090)	(0.29)
Islands	0.029	-0.92***	-0.18*	0.73**
	(0.39)	(0.34)	(0.098)	(0.33)
Constant	0.67**	1.87***	0.97***	-1.03***
	(0.32)	(0.28)	(0.092)	(0.30)
Observations	1,279	1,121	1,121	1,121
R-squared	0.047	0.048		

Source: Authors' calculation on SHIW 2010–2012 data

9. Pension expectations and reality

Authors: MassimoStefano Baldini[•], Carlo Mazzaferro** and Paolo Onofri***

In this chapter we describe how information on the future of the public pension system has evolved among Italian workers, using data from the Survey of Household Income and Wealth (SHIW) from 2000 to 2012. The expectations on both the future level of the replacement ratio (i.e., the ratio between the first pension benefit and the last wage) and of the retirement age are used here to estimate the expected level of the future public pension benefit for workers in the survey. Subsequently we compute the "pension error", defined as the difference between the expected value and the "statutory" value of the pension benefit, the second variable defined as the pension benefit level computed, at the expected retirement age, on the basis of the pension rule that was in force in the year of the survey. We study the distribution of the pension error among social and demographic categories of the survey population and its evolution over time. Using then the expected value of the pension benefit, together with information on life expectancy at retirement, we construct a measure of net and gross social security wealth. Finally we study the degree of substitutability of this variable with respect to private wealth.

We find that in time there has been a shift from a general overestimation of the generosity of the future pension towards a greater tendency to underestimate it, particularly because many do not realize that the retirement age will continuously be postponed with increasing life expectancy. At the end of a turbulent period of reforms, many workers still are not able to predict correctly the level of their pension benefit or their correct retirement age, in particular in the last few years, also due to the effects of the economic crisis. However, individuals seem to react to the expected reduction in the social security wealth by increasing private wealth, confirming the existence of a significant degree of substitutability between the two types of wealth.

9.1 Data

Since 2000 individuals participating to the SHIW survey of the Bank of Italy have been asked to answer two questions regarding their future pension, namely: (i) "At what age do you expect to retire?", and (ii) "What will be the percentage of your first year pension benefit with respect to earnings gained the year before retirement?". Using these two pieces of information we implement a procedure first proposed by Jappelli (1995) to compute the expected value of the pension benefit at the age of retirement for those workers in the survey who responded positively both to the first and to the second question.

The sample has around 20,000 observations per annum for a total of 143,882 observations over the whole period. Among these observations we first select those who classify themselves as dependent workers or as self-employed (50,699 observations). We then drop all observations that did not respond to both the selected questions about the expected retirement age and replacement ratio (9,020 observations). Some other adjustments were necessary before starting to compute the expected value of future pension benefits. In particular we drop from the sample all individuals who declared they had not previously paid pay-roll taxes to a pension scheme (1,767 observations) and those older than 70 (167 observations). Finally we adjusted the expected retirement age, imposing that it cannot be lower than 57 and greater than 70 (441 changes made). After all these adjustments we end up with a sample of 31,665 dependent workers and 8,080 self-employed.

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Table 9.1 reports the total population of the survey, the number of dependent workers and self-employed and the number of those that are selected for further investigation.

Table 9.1 – Number of selected individuals

Year	Total	Dependent	Selected Dep	Self Employed	Selected SE
2000	22,336	6,147	5,232	1,795	1,428
2002	21,215	5,817	5,531	1,642	1,509
2004	20,659	5,792	5,520	1,526	1,371
2006	19,639	5,746	5,491	1,413	1,280
2008	19,989	5,800	3,668	1,336	877
2010	19,918	5,546	3,099	1,424	831
2012	20,126	5,383	33124	1,332	784

Source: Authors' elaborations on SHIW data.

Following this procedure we end up with a population that, as reported in Table 9.2, presents an important discontinuity compared with the year 2008. Indeed, starting from this year only individuals who were physically present at the interview are allowed to answer the two questions. This innovation was not neutral regarding the composition of the selected population, which appears to be older after 2008.

Table 9.2 – Average age of the original and of the selected population of workers

Year	Dep workers	Selected Dep Workers	Self employed	Selected Self Employed
2000	39.7	40.7	43.4	44.0
2002	40.2	40.2	44.2	44.3
2004	40.7	40.7	44.2	44.2
2006	41.4	41.4	44.7	44.8
2008	41.8	43.9	46.0	47.7
2010	43.0	45.4	47.0	49.2
2012	43.9	46.0	48.3	50.3

Source: Authors' elaborations on SHIW data.

The next steps describe the hypotheses used to estimate the expected value of pension benefits. First, we need to impute to each individual of the selected sample a value of his/her labour income gross of the income tax and of the part of the social security contribution that is paid by the worker. The SHIW survey contains only the information on net incomes, i.e. after the payment of the personal income tax, but for the computation of future pensions, we need the data on gross incomes. In order to overcome this shortcoming we moved to another survey of the Italian population, namely the SILC survey on households' living conditions, carried out every year by the Italian national statistical institute, which gathers data on both gross and net income. We have therefore performed a regression on the workers aged between 25 and 65 years in the SILC survey for the year 2012 (containing 2011 incomes) of gross income as a function of net income and a set of personal characteristics (age, gender, dependent or self-employed, education, number of children in the household, geographic area). Table 9.3 shows the results of the regression.

We use the coefficients estimated from this regression to impute to each SHIW observation a value for his/her gross income.

Table 9.3 – Regression results of gross income on the SILC survey

	Coef.	Std. Err.	t
Net income	1.551	0.003	502.54
Net income squared	0.00000035	0.00000001	26.02
Age	-5.647	25.647	-0.22
Age squared	0.164	0.290	0.57
Man	-12.484	60.978	-0.2
High school	211.175	66.341	3.18
Degree	1097.723	87.541	12.54
Employee	-994.470	68.446	-14.53
N. children 0–3	-325.869	83.271	-3.91
N. children 4–10	-352.799	54.967	-6.42
N. children 11–17	-394.831	57.183	-6.9
North	-48.065	67.768	-0.71
Centre	11.202	82.556	0.14
Constant	-2275.339	544.075	-4.18

Note: R2=0.97; N. obs. 18977

Source: Authors' elaborations on SHIW data.

We also computed on the pseudo panel of the SHIW (2000–2012) different rates of growth of lifetime earnings. To get these rates of growth, we split the sample of workers in the SHIW survey into six groups, based on the interaction between gender and three education levels (lower than high school, high school, degree). Then for each group we regress yearly gross income on age and its square, obtaining a life-cycle profile for earnings. For each individual of the sample, this fitted profile passes through the actual earning of the survey, at the corresponding age. Then we obtain the average growth rate of gross earnings for each group, and depending on the age compute the earning of the last year of work.

After all these steps we are able to estimate the expected value of the pension benefit in the first year after retirement for each individual in the sample (P_ex)$_i$ as:

$$P_i^{exp} = RR_i^{exp} * Y_i^{last} \qquad (1)$$

where
RR_i^{exp} is the individual expected replacement ratio for individual (i) reported in the survey
Y_i^{last} is the value of individuals' earning the year before retirement
The computation of Y_i^{last} is obtained as:

$$Y_i^{last} = Y_{i,t} * (1 + m_k)^{(ret_i - age_i)} \qquad (2)$$

where

$Y_{i, t}$ is the estimated gross earning of individual i at time t (the observation's year)

m_k is the group specific rate of growth of earning, k=1, 2,….,6

ret_i is the expected age at retirement for individual (i) in the year he/she is observed in the survey

age_i is the age of individual (i) in the year he/she is observed in the survey

In fact equation (2) projects forward the current value of the (estimated) gross earning for a number of years equal to the difference between the expected age of retirement reported in the survey and the current age of each individual. In doing so we assume that all individuals in the sample will not experience periods of unemployment. We also impose different growth rates of earnings, taking into account both gender and educational level (see above).

In order to compute the error in the pension computation we need to estimate the "statutory" value of the pension benefit for each individual in the sample and then compute the difference between the two levels of benefit. We introduce a number of (necessary) simplifications that allow us to reach our aim. In particular:

i.   The statutory pension benefit is computed at the expected retirement age.

ii.   We split our sample into three groups in order to take into account the different phasing in of the NDC system. In particular we distinguish, on the basis of the accrued seniority in 1995, the DB workers (i.e. those who in 1995 had at least 18 years of seniority at work); the mixed workers (i.e. those that in 1995 had less more than 0 years but less than 18 years of seniority at work) and the NDC workers (i.e. those that started to work after 1995).

iii.   We distinguish three occupational schemes: private dependent workers, public dependent workers and self-employed.

iv.   We assume that workers will not experience periods of unemployment.

v.   We compute the statutory pension benefit (P_i^{true}) according to the rules described in the appendix A.

For each individual in the sample we have then:

$$P_i^{error} = P_i^{true} - P_i^{exp} \qquad (3)$$

9.2 How Italian workers estimate their future pension benefits

As a starting point to interpret our results it is useful to describe the evolution of both the expected replacement ratio (RR) and of the expected retirement age. Results are presented in Table 9.4. Figures in the table tell us that workers in the sample substantially revised their expectations on the future of the public pension system: the expected RR decreased by about 10%, while the expected retirement age, during the same period, increased by 3.5 years. So at first glance it seems that, at least on average, the message that in the future the public pension system will not be as generous as it has been in the past is perceived by Italian workers who expect *both* to receive a lower pension benefit *and* to retire later.

Looking first at the expected RR it is worth noticing that its reduction is continuous through time. Starting from 72.5 per cent in 2000 this indicator reached the average value of 62.3 per cent twelve years later. The

reduction was steepest in the initial years of the period and from 2010 to 2012. As for the expected retirement age, differently from the RR, changes are more concentrated in the second part of the period. In particular from 2010 to 2012 the expected retirement age increases by 1.6 years, nearly half of the total changes.

Table 9.4 – Average value of the expected replacement ratio and of the expected retirement age, 2000–2012.

Year	Expected replacement ratio	Expected retirement age
2000	72.5% (19.9)	61.6 (3.8)
2002	69.0% (16.1)	61.9 (3.7)
2004	67.8% (16.0)	62.3 (3.6)
2006	65.6% (16.1)	62.2 (3.6)
2008	65.4% (15.5)	63.1 (3.5)
2010	64.3% (15.1)	63.5 (3.4)
2012	62.3% (15.9)	65.1 (3.3)
2012-2002	-10.2%	+3.5

Note: Standard deviation in parenthesis

Source: Authors' elaborations on SHIW data.

Tables 9.5 and 9.6 decompose changes in the expected replacement ratio and in the expected retirement age by different socio-economic subsamples of the population.

Even if the reduction in the ratio between first year pension and last year wage is common to all the socio-economic characteristics here considered, it is worthwhile noticing that some groups appear to be more affected than others. In particular the reduction is stronger among dependent workers than among self-employed; among future NDC pensioners than among future DB pensioners, among highly educated individuals than among individuals with first level education.

Table 9.5 – Expected replacement ratio by subsamples of the population. Percentage values. 2000–2012

Year	Priv dep	Pub dep	Self empl	Men	Wom	DB	MIX	NDC	FIR DEG	SEC DEG	HIGH DEG
2000	73.3	79.1	62.1	72.9	71.7	75.0	71.1	69.3	71.1	73.5	74.8
2002	69.7	75.3	59.6	69.2	68.7	71.9	67.9	66.2	68.0	70.0	69.9
2004	68.5	73.6	58.7	68.1	67.5	70.9	67.5	64.5	66.9	68.9	68.1
2006	65.6	71.7	57.8	66.0	65.2	71.0	64.9	62.3	65.5	65.7	66.1
2008	65.3	71.3	57.8	66.1	64.2	70.9	65.2	60.9	64.7	66.2	65.3
2010	64.7	70.2	56.4	65.2	63.2	70.4	65.2	59.6	64.2	64.9	63.5
2012	62.4	68.1	54.6	62.9	61.4	68.5	62.9	58.4	62.2	62.8	61.2
2012-2000	-10.9	-11.0	-7.5	-10	-10.3	-6.5	-8.2	-10.9	-8.9	-10.7	-13.6

Source: Authors' elaborations on SHIW data.

Table 9.6 – Expected retirement age by subsamples of the population. 2000–2012

Year	Priv dep	Pub dept	self emp	Men	Wom	DB	MIX	NDC	FIRST DEG	SEC DEG	HIGH DEG
2000	61.2	61.3	63.1	62.2	60.5	60.7	62.1	62.6	61.2	61.7	62.8
2002	61.6	61.5	63.0	62.6	60.7	61.0	62.3	62.7	61.5	62.0	63.0
2004	62.1	61.7	63.3	63.1	61.0	61.1	62.7	63.1	62.0	62.3	63.3
2006	62.1	61.6	63.4	62.9	61.2	61.3	62.3	63.0	62.0	62.2	63.1
2008	62.8	62.7	64.3	63.7	62.1	61.8	63.3	63.9	62.8	63.1	64.0
2010	63.2	63.3	64.9	64.0	62.9	62.3	63.4	64.4	63.0	63.6	64.7
2012	64.9	64.8	66.0	65.4	64.7	63.6	65.1	65.8	64.7	65.0	66.0
2012-2000	+3.7	+3.5	+2.9	+3.2	+4.2	+2.9	+3.0	+3.2	+3.5	+3.3	+3.2

Source: Authors' elaborations on SHIW data.

Also in the case of the expected retirement age, the change appears not uniformly spread among the population. In this case women and dependent workers expect the greatest increase in their retirement age.

In Table 9.7 we compare the "statutory" replacement ratio, defined as the ratio between P_i^{true} and the last gross wage Y_i^{last} for each individual in the sample, and the expected replacement ratio RR_i^{exp}, already presented and discussed above. In general terms we note a progressive convergence of the expected replacement ratio towards the statutory one. Remembering that we compute pension benefits at the expected retirement age and that this variable increases from 2000 to 2012, it is interesting to note that the reduction in the statutory replacement ratio over the years is not particularly pronounced and that from 2010 to 2012 (i.e. corresponding to the period that records the higher increase in the expected retirement age) the statutory replacement ratio grows from 59.4% to 62.7%.

Table 9.7 – "Statutory" and expected replacement ratio, given expected retirement age. 2000–2012

| Year	Statutory RR	Expected RR
2000	62.8%	72.5%
2002	61.9%	69.0%
2004	61.5%	67.8%
2006	59.6%	65.6%
2008	60.6%	65.4%
2010	59.4%	64.3%
2012	62.7%	62.3%

Source: Authors' elaborations on SHIW data.

The fact that in the last two years the expected replacement ratio decreases from 64.3% to 62.3% seems to suggest that workers, at least on average, did not correctly understand the positive relation between retirement age and replacement ratio.

Moving now to the error between expected and statutory pension, we compute its average absolute value over the whole sample as equal to 5,651 Euro at 2012 prices. The median value equals 3,408 Euro; 63.1% of observations report a positive (or zero) value, while 36.9% estimate a pension benefit which is smaller than

the statutory value. Remembering that the average value of the estimated pension benefits equals 22,929 Euro, the average percentage error is equal to 24.6%.

Figure 9.1 shows that there is, as expected, a positive relation between the sign of the error and the expected replacement ratio. The average value of errors is negative for very low values of the expected replacement ratios. It monotonically increases thereafter reaching a value round to zero for expected replacement ratios between 50% and 70%. For higher values of the expected replacement ratios the error becomes positive and quite large for values higher than 100%.

Figure 9.1 - Average errors and expected replacement ratio in the whole sample. Euro at 2012 prices
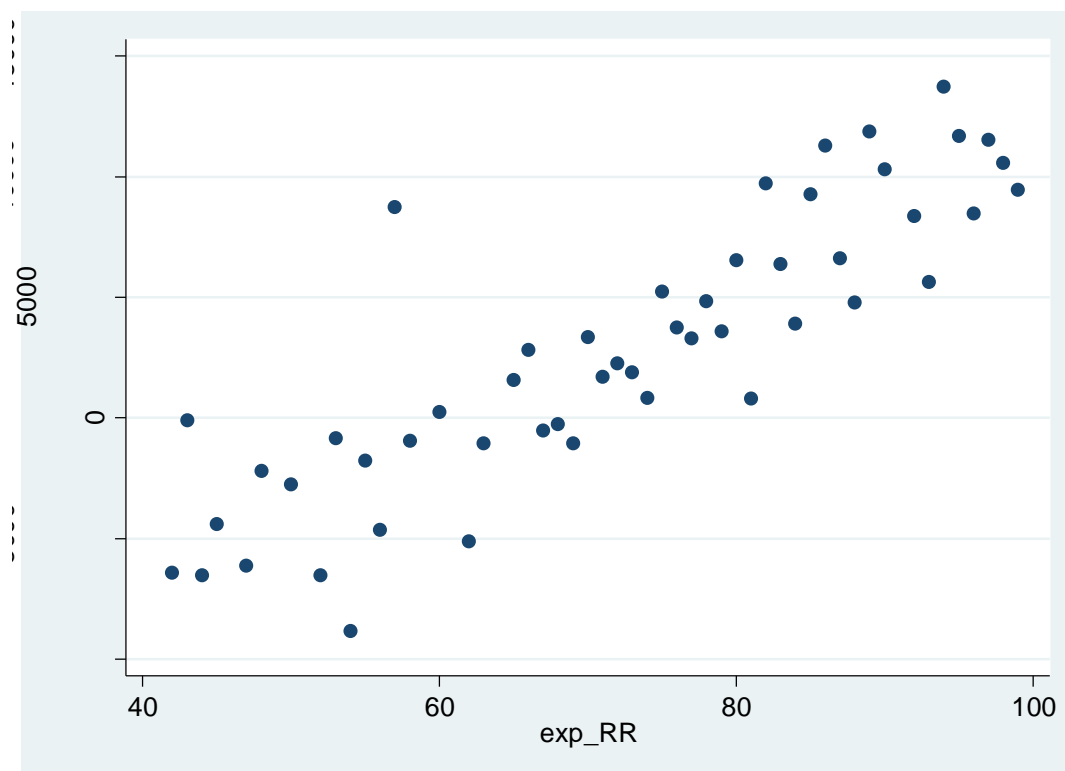
Figure 9.2 Average error by year (a) and by expected retirement age (b). Euro at 2012 prices
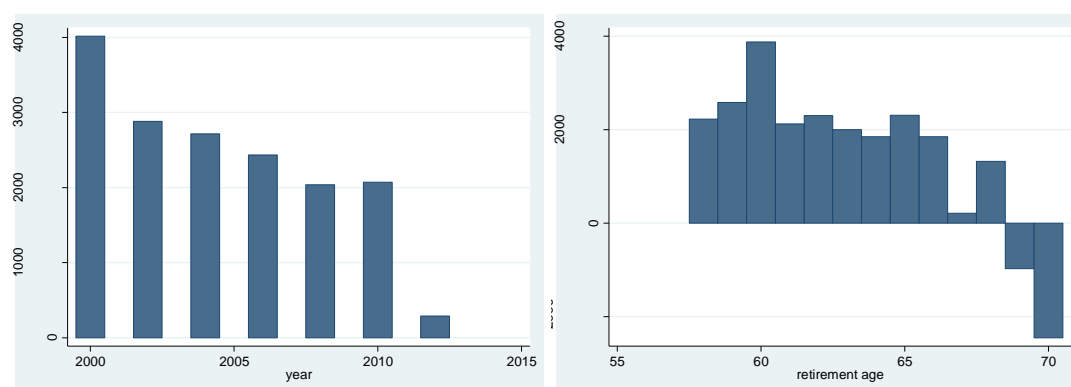
Figure 9.2a and 9.2b display respectively the time evolution of the average error in the computation of pension benefits and its relation with the expected retirement age. As for the part a) of the figure, it is clear the continuous downward adjustment of workers' expectations. Workers, on average, overestimate their future level of benefits until 2010, but they progressively become less and less confident on the adequacy of their future pension benefits. Interestingly part b) of the figure reports that individuals who expect to retire earlier than 66 have an estimated value of their pension benefit that is higher than the "true" one. On the opposite, as retirement age increases beyond this value the difference between the "true" and the expected value becomes on average negative. Figure 9.2a and 9.2b confirm our perception that the positive relation between the replacement ratio and the retirement age are still not completely understood by Italian workers.

Table 9.8 reports the evolution over the years of the average error for specific subsamples of the whole population.

Table 9.8 – Average error for subsamples of the population. 2000–2012

YEAR	PRIV DEP	PUB DEP	SEL EMPL	MEN	WOMEN	DB	MIXED	NDC	FIRST	SECOND	THIRD
2000	2,430	5,816	2,212	3,427	3,084	1,595	4,314	5,158	515	3,879	11,972
2002	1,174	4,436	1,350	1,828	2,378	-143	2,761	4,334	-313	2,642	9,670
2004	829	3,867	1,293	1,390	2,153	-697	2,160	3,941	-934	1,866	10,870
2006	195	4,469	541	759	2,157	-849	1,545	2,755	-876	1,200	8,705
2008	70	2,920	846	553	1,519	-891	922	2,480	-1,017	1,009	6,843
2010	-9	3,285	424	682	1,217	-1,309	1,122	1,982	-907	600	5,674
2012	-1,957	1,161	-894	1,072	-855	-2,000	-1,581	225	-2,148	-1,717	2,984

The downward trend in expectations is common to all subgroups. As for the level of the average error, it is interesting to notice that it is higher for those with a high level of education, those who will compute their pension benefit under the NDC system (i.e., younger workers), women and public dependent workers.

Average values however do not convey a complete picture of the phenomenon. In fact the errors distribution is very dispersed, as the figure 9.3 shows.

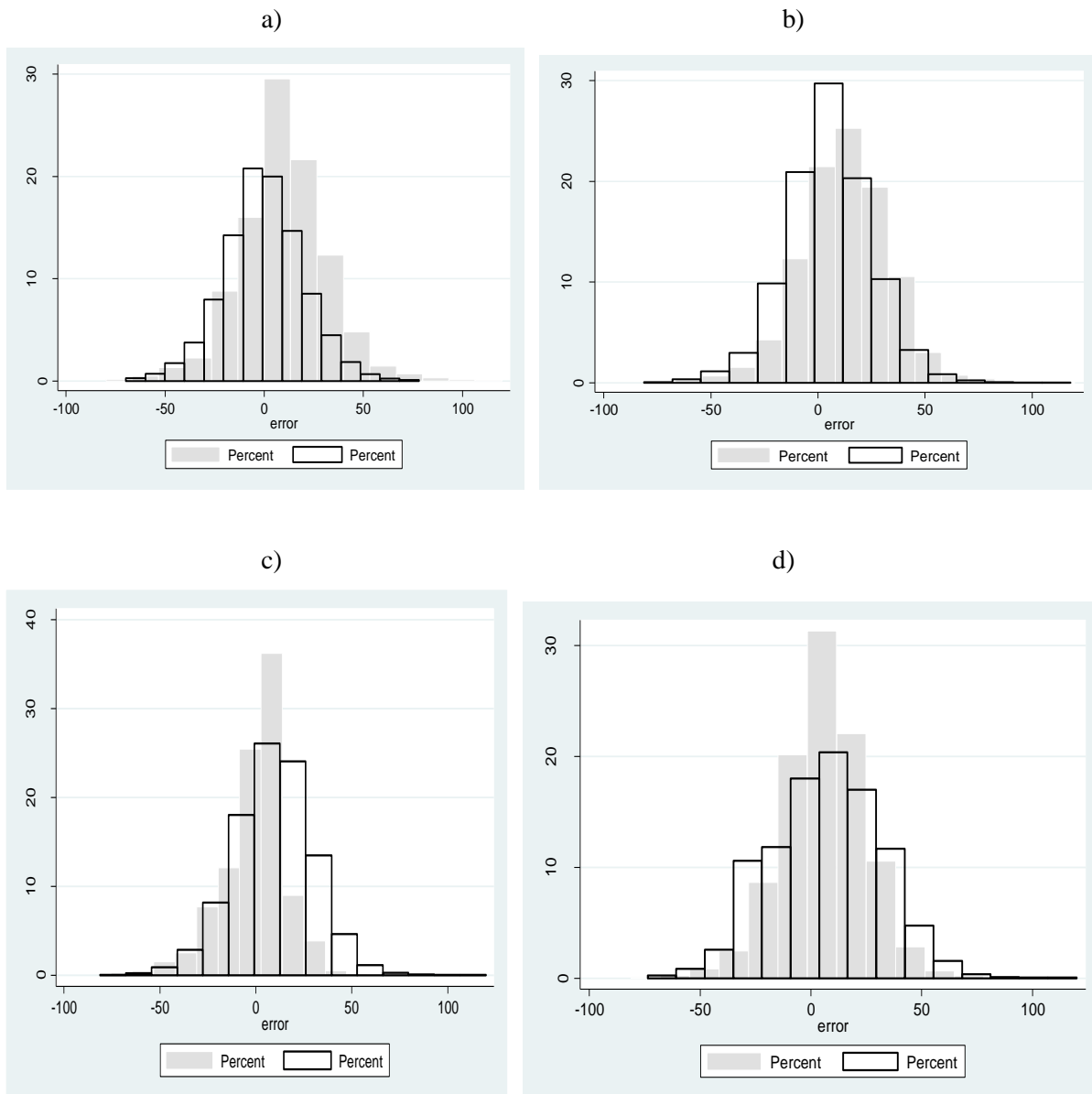Figure 9.3 - Errors distribution over the whole sample. Euro at 2012 prices.
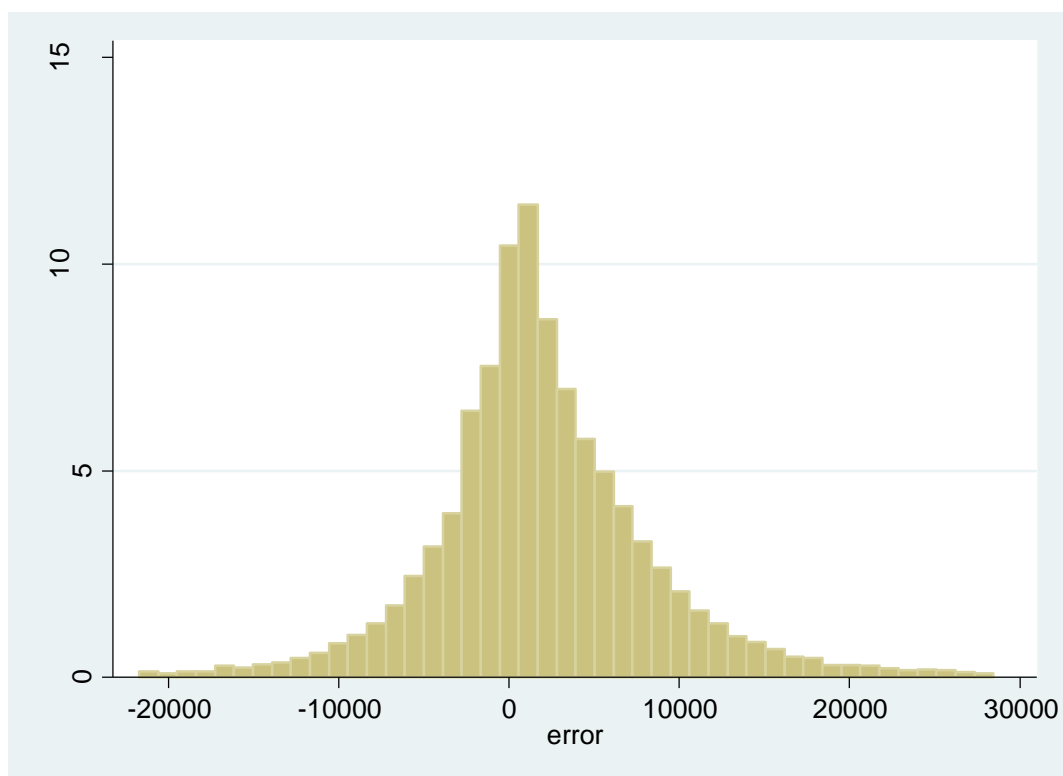
Source: Authors' elaborations on SHIW data.

Errors' distribution also changes through time and among different categories of workers as the following graphs show.

Figure 9.4 – Error distribution in the replacement ratio

Note: a) At the beginning (2000) (gray) and at the end (2012) (no color)
b) Among high level education (gray) and middle-low level (no color)
c) Among DB pensioners (gray) and mixed-NDC pensioners (no color)
d) Among dependent (gray) and self-employed (no color)

Source: Authors' elaborations on SHIW data.

In order to better understand the degree of understanding of the future of the pension system in the sample, we introduce three new variables.

The first variable approximates the ability of individuals to correctly predict the future level of their pension benefit. We split the sample into three groups according to the distance between the expected and the statutory pension benefit. The first group is composed of individuals whose pension error is in a bracket of +/- 10% with respect to the true value of the pension benefit. The second group is composed of individuals

whose pension error ranges from +- 10% to +/- 50% and finally the third group is composed of individuals whose pension error exceeds +/- 50%.

The second variable splits the sample between those who overestimate and those who underestimate their future level of pension benefit with respect to its statutory value . Finally, the third variable splits the sample between those who correctly predict their future retirement age and those who do not.

Table 9.9 displays the evolution of these variables over time. As for the ability to correctly predict the future level of the pension benefit things do not change dramatically: roughly 40% of the sample is in the first group and 60% is in the second. These results appear to be in line with other empirical investigations (Gustman and Steinmaier 2001, Bottazzi et al. 2006). The second variable shows that an increasing share of individuals start to be pessimist on the future of their pension benefits: those who underestimate its level grew from 30.4% in 2000 to 51.7% in 2012.The degree of pessimism is at its maximum in 2012, when for the first time the number of individuals who underestimate their future pension benefits exceed those who overestimate it. The macroeconomic and financial background might in this case contribute to explain the evolution of the expectations. As for retirement age, as already stressed, figures in the table show that an increasing share of the Italian workers is getting confused and did not catch the novelty introduced in the Italian pension law after 2010, that linked automatically retirement age to the lifetime expectations at 65.

Table 9.9 – Variables that measure the degree of comprehension of the public pension system. 2000–2012.

Year	Pension error < |0.25%|	Pension error > |0.25%|	Underestimate pension	Overestimate pension	Wrong retirement age	Right retirement age
2000	43.8%	56.2%	30.4%	69.6%	20.4%	79.6%
2002	38.8%	61.2%	34.4%	65.6%	16.5%	83.5%
2004	40.1%	59.9%	36.0%	64.1%	13.6%	86.4%
2006	43.4%	56.6%	37.4%	62.6%	15.0%	85.0%
2008	39.2%	60.8%	39.9%	60.2%	11.2%	88.8%
2010	39.8%	60.2%	39.4%	60.6%	43.4%	56.6%
2012	42.4%	57.6%	51.7%	48.3%	63.5%	36.5%

Source: Authors' elaborations on SHIW data.

In order to estimate the social and economic factors that contribute to determine the degree of comprehension of the pension system we run three probit regressions testing the probability of estimating correctly the future level of the pension benefit, the probability of overestimating the future pension benefits and the ability to correctly predict the retirement age. As explanatory variables we consider quintiles of (individual) income, the seniority at work approximated by the number of years an individual has contributed to his/her pension scheme, gender, occupational status (divided in private, public employee and self-employed), geographical area (north, centre, south), educational level (three degrees), a proxy of the pension regime to which each worker belongs (DB, mixed system and NDC system) and a set of time dummies.

Table 9.10 reports results of the estimation in terms of marginal effects.

Table 9.10 – Probit regressions on the three variables measuring the degree of understanding of the pension system

VARIABLES	Correctly understand pension benefit	Overestimate pension benefit	Correctly understand retirement age
dquint2	0.028***	0.075***	0.006
	(-0.009)	(-0.009)	(-0.007)
dquint3	0.032***	0.095***	0.005
	(-0.01)	(-0.01)	(-0.007)
dquint4	0.047***	0.126***	-0.021***
	(-0.01)	(-0.01)	(-0.008)
dquint5	0.030***	0.118***	-0.33***
	(-0.011)	(-0.011)	(-0.009)
Seniority	0.006***	-0.002***	0.002***
	(-0.001)	(-0.001)	(-0.001)
Male	0.055***	-0.086***	-0.021***
	(-0.006)	(-0.007)	(-0.005)
Public employee	-0.028***	0.146***	-0.043***
	(-0.007)	(-0.008)	(-0.007)
Self-employed	-0.190***	0.054***	0.055***
	(-0.006)	(-0.009)	(-0.006)
North	0.054***	-0.125***	0.0003
	(-0.007)	(-0.008)	(-0.006)
Centre	0.017*	-0.017*	-0.017**
	(-0.009)	(-0.01)	(-0.007)
Diploma	0.003	0.043***	0.011**
	(-0.007)	(-0.008)	(-0.006)
Degree	-0.071***	0.100***	0.035***
	(-0.009)	(-0.011)	(-0.008)
Mixed	-0.188***	0.147***	0.106***
	(-0.011)	(-0.013)	(-0.009)
NDC	-0.178***	0.173***	0.122***
	(-0.016)	(-0.02)	(-0.013)
2002	0.032***	-0.048***	0.033***
	(-0.01)	(-0.011)	(-0.007)
2004	0.024**	-0.075***	0.055***
	(-0.01)	(-0.011)	(-0.007)
2006	0.020**	-0.118***	0.011
	(-0.01)	(-0.012)	(-0.008)
2008	0.044***	-0.124***	0.076***
	(-0.012)	(-0.013)	(-0.008)
2010	0.059***	-0.228***	-0.279***
	(-0.014)	(-0.015)	(-0.012)
2012	-0.02	-0.393***	-0.481***
	(-0.016)	(-0.014)	(-0.012)
Observations	30,070	30,070	39,499
Pseudo R-squared	0.106	0.0851	0.122

Notes: Omitted variables: 1st quintile of income distribution, private-sector employee, living in the north, first level degree, defined benefit, year 2000.

Source: Authors' elaborations on SHIW data.

The position in the income distribution has a positive relation with the probability of both corectly estimating the future level of the pension benefit and of overestimating it. As individuals increase their seniority at work they improve their ability to predict both the level of the pension benefit and the retirement age. They also

reduce their optimism. Men are better than women at predicting the level of the pension benefit. They also tend to underestimate it. As for the occupational status, private dependent workers are better at estimating their future pension, whereas the self-employed seem better at predicting their retirement age correctly. Public dependent workers are more optimistic about the future level of their pension benefit. As the educational level increases workers tend to overestimate their future pension benefit, to be less able to predict it correctly and to be better at predicting their retirement age. Belonging to the NDC scheme (and therefore being younger) decreases the probability of computing the pension benefit correctly but increases the ability to predict retirement age. Finally, time seems to play an important role. In particular, as time passes individuals become more and more pessimistic about the future level of the pension benefit and less and less (in particular after 2010) able to correctly predict their retirement age. The increase in pessimism on future pensions may be due to the presence of the great recession, which could reduce expectations on living standards, and is consistent with the lower ability to predict the retirement age: many seem unaware that they will be obliged to retire later and, just for this fact, with a pension which will be greater than in the case of an earlier retirement.

9.3 Private wealth and social security wealth based on expected pension benefits: is there an offsetting effect?

The value of annuities expected from the (public) pension system constitutes a major part of total household wealth in Italy (Mazzaferro and Toso, 2009). Any analysis of the accumulation and distribution of wealth, and of its evolution over time, would therefore be misleading without its inclusion. In this paper we define social security wealth as the discounted sum of all expected future pension benefits. For each employed individual i observed at time t social security wealth is defined as:

$$SSWN_{t,i} = (1 + r)^{(t-p)} \sum_{k=p}^{p+d}(1 + r)^{(P-k)} \, P\_ex_i \quad (4)$$

where:

r is the discount/interest rate

P_ex_i is the pension benefit expected by individual i upon retirement

Yi is the gross income of individual i

p is the expected year of retirement of individual i,

d is the life expectancy at retirement of individual i, r is the discount rate,

m_k is the group specific real growth rate of earnings.

In our simulation r is equal to 1.5%; d is taken from the ISTAT dynamic population projection to 2060. The specific past earnings rates of growth are reported in the following table. Future yearly growth of earnings is fixed at 1%.

Table 9.12 – Specific growth rate of earnings.

…	Men	women
first	0.0049	0.053
second	0.0153	0.0115
third	0.028	0.017

Source: Authors' elaborations on SHIW data.

Table 9.13 reports the average value of the expected and the statutory social security wealth computed according to equation (4) as well as the net worth from 2000 to 2012.

Table 9.13 – Average value of the expected and the statutory social security wealth, and of net worth. Households with at least one employed individual.

Year	Expected SSW	Statutory SSW	w
2000	587,458	467,153	259,585
2002	599,376	479,188	259,774
2004	597,662	487,447	291,050
2006	591,787	483,584	317,101
2008	453,016	390,336	299,324
2010	406,610	350,148	312,570
2012	350,717	320,920	287,904

Source: Authors' elaborations on SHIW data. Thousands of Euro at 2012 prices.

The time evolution of the SSW variable is strongly influenced by the reform process of the last 12 years and from the nearly flat dynamics of labour income during the same period. On average, SSW decreased from 587,000 Euro in 2000 to 350,000 Euro in 2012. During the same period important facts also modified the level and the composition of the net worth of Italian workers, defined as the sum of real and financial wealth, net of any debts. Differently from the SSW, the net worth of households with at least one worker did not decrease in the observed period. Starting from an average value of 255,000 Euro in 2000, it was equal to 285,000 Euro in 2012. It reached a maximum of 310,000 Euro in 2010.

The next step is an estimation of the degree of substitution between social security wealth and net worth during the observed period.

Table 9.14 – Substitutability between net worth and SSW

	Total sample	Informed	Uninformed
SSW / Y	-0.335***	-0.384***	-0.292***
	(-22.89)	(-22.30)	(-10.82)
Age	0.184***	0.201***	0.135
	(4.69)	(4.56)	(1.83)
Age squared	-0.00148***	-0.00178***	-0.000825
	(-3.53)	(-3.83)	(-1.04)
Woman	0.0876	0.0614	0.108
	(0.86)	(0.56)	(0.54)
Public employee	0.693***	0.647***	0.755**
	(5.93)	(5.50)	(2.92)
Self-employed	3.087***	3.091***	3.072***
	(26.94)	(23.13)	(14.47)
High School	1.233***	1.149***	1.410***
	(12.42)	(11.12)	(6.88)
Degree	1.480***	1.535***	1.453***
	(10.14)	(9.45)	(5.31)
Mixed regime	-1.129***	-1.388***	-0.926***
	(-9.11)	(-10.21)	(-3.54)
NDC regime	-2.675***	-3.286***	-2.202***
	(-13.88)	(-13.99)	(-6.30)
Centre	0.830***	1.045***	0.448
	(7.24)	(8.68)	(1.92)
South	0.385***	0.269*	0.554**
	(3.56)	(2.34)	(2.58)
Year 2002	0.284	0.304	0.318
	(1.90)	(1.94)	(1.04)
Year 2004	0.911***	1.202***	0.529
	(6.10)	(7.52)	(1.79)
Year 2006	1.135***	1.384***	0.881**
	(7.37)	(8.33)	(2.92)
Year 2008	1.081***	1.203***	1.001**
	(6.49)	(6.90)	(2.87)
Year 2010	1.080***	1.145***	1.119**
	(6.16)	(6.22)	(3.07)
Year 2012	0.870***	1.108***	0.713
	(4.10)	(4.51)	(1.86)
Income	0.0000117***	0.0000124***	0.0000108***
	(8.28)	(7.45)	(4.40)
Constant	0.784	1.148	1.219
	(0.86)	(1.10)	(0.73)
N	15905	10005	5900
R^2	0.156	0.200	0.120

Source: Authors' elaborations on SHIW data.

Table 9.14 presents OLS estimation of the relationship between private wealth and SSW for households in the sample correctly. We drop from the sample all households where the head was not able to predict his/her retirement age. The dependent variable is the wealth/income ratio. We estimate the substitutability between the dependent variable and the SSW/income ratio, controlling for age, age squared, gender, employment dummies, pension regime dummies, education and regional dummies and time dummies.

In the total sample the degree of substitutability between private wealth and SSW is estimated at -0.335 with statistical significance at 1%. This result is consistent with findings of Bottazzi et al. (2006) who found a displacing effect of -0.28 in a regression where SHIW data in the period 1989–1991 were compared with data coming from the 2000–2002 SHIW surveys. There is therefore a substitution between these two forms of wealth, but the rate is significantly lower than 1. Increase in the expected retirement age might be an explanation of this result, since working longer implies, *ceteris paribus*, a reduction in saving for retirement. Wealth accumulation is positively related to age. It is also higher for public employees and for the self-employed, as well as for middle and highly educated individuals. A negative relationship with the dependent variable is displayed for individuals in the mixed and in the NDC system.

We finally split the sample between informed and uninformed, defined respectively as those households where the head has a pension error smaller or higher than 25%. As the table shows, the offsetting effect between private wealth and SSW is greater for the informed (-0.392) than for the uninformed (-0.296). This result displays the crucial importance of knowledge in pension policies. Individuals who are informed of both on retirement age and on their future pension benefit's level seem more prepared to respond to changes in the future arrangement of the public pension system.

10. Conclusions

The 2011 pension reform accelerated the phasing in of the NDC system within the Italian social security system. Being approved in a period of financial stress it also introduced a series of adjunctive eligibility conditions on age and seniority with the aim of substantially increasing the average retirement age both in the short and in the medium long run.

Researchers in strand 1 of this project developed two different microsimulation models to estimate the impact of this reform on the adequacy and on the intergenerational fairness of the Italian pension system. Together with these tools other ancillary works studied important aspects such as the relation between information and retirement decision and pension computation and absenteeism, which contribute to determine the real effectiveness of a pension reform.

A common result of the research carried on within the strand is that in the following years the age of retirement is expected to increase substantially. Moving from the current value of 61–62 years the average retirement age will continuously increase during the next decades and it will reach 69–70 year in 2060, thanks also to the automatic link of all age and seniority conditions to life expectancy at retirement.

In a probabilistic background like that used in CERPSIM3 the picture that emerges from simulations is from many points of view comforting. The combination of a high contribution rate (33% of the gross wage for the main Italian pension scheme) and a high legal retirement age (over 66 from 2018 and increasing thereafter) produces, as expected, relatively high replacement ratios for future pensioners. At the same time the speeding up of the phasing in of the NDC rule also improves the intergenerational fairness of the system as a whole. Some points still appear to be somehow problematic and probably deserve attention from policy makers and possibly future policy interventions. The first regards the adequacy of the system for those individuals who are not represented by the model of the "typical" worker (i.e. a male employed worker with a long and uninterrupted working career): among these, the self-employed, women and individuals in the lower part of the income distribution are the more important to consider. The second problem, which is also considered in strand 2 of the project, is the unbalanced (now but also in the future) composition of the Italian 'pension portfolio', where the funded component is still underdeveloped.

Moving to a behavioural model like ITALISSIMO the research team was able to underline the role of second-order effects in the evaluation of the pension reform. In particular, given the idea that individual economic decisions in saving formation and labour supply are taken with the aim to maintain constant, as much as possible, the level of consumption, some policy exercises were run to study the impact of some features of the 2011 reform. Results show that having time to react (i.e. the age of individuals/families when the reform is approved) is an important ingredient to understand the strength of an individual's reaction. Moreover the model shows that saving formation and labour supply are often perceived as substitutes: for example, if individuals/families are forced to work longer (as in the reformed scenario) then they react by leaving lifetime consumption more or less constant and decreasing saving and wealth accumulation with respect to the pre-reform scenario. The same qualitative results emerge from a simulation where the public pension saving is substantially reduced. Finally removing all constraints and eligibility conditions in the age and seniority to gain the right to retire produces an important reduction in the average retirement age which is compensated with a faster decumulation of private wealth. The main policy message that emerges from these simulations, apart from the specific results, is that in evaluating the effectiveness of a policy, especially when it has long-term effects, one should be aware of the possible reactions of individuals to the policy itself. In the specific case examined here this would mean that an important component of the effectiveness of the pension reform will depend on the private wealth accumulation and distribution.

Individuals/families however can correctly react to a policy when they are well informed on the likely effects of the policy itself. Two ancillary works of this strand studied this important point with respect to the knowledge on changes in the retirement age that occurred from 2010 to 2012, the first, and to the measurement of the pension error, defined as the difference between a computed and an expected value of the pension benefit in the period 2000–2012, the second. Both works analyse the social and economic conditions that seem to be more correlated with correct information of the likely future evolution of pension rules in Italy. Specifically it emerges that some subgroups of the population (self-employed, women, and young workers among others) are more likely to misunderstand their future pension benefit and/or their future retirement age. Somewhat surprisingly, education level does not appear to play a role in this context. On the other hand, it emerges that the macroeconomic context, especially the deepening of the financial crisis from 2010 to 2012, plays an important role in shaping expectations about the future generosity.

Finally, our work also documents the emergence of negative collateral effects of radical pension reforms. In particular, in our work we did find evidence of a reaction of women, especially if grandmothers, to the increase in the age and seniority requirements to access retirement. Working grandmothers appear more inclined to have recourse to sick-leave when obliged by the reform to postpone retirement. Indeed, it seems that sick-leave appears to be the last resort solution to enable them to cope with heavy caring duties towards grandchildren while continuing to work. Given this evidence, our final point is that the success of a pension reform depends on many factors including appropriate matching welfare policies – such as an improvement of care facilities addressed to alleviating the family chores that still heavily fall on women – that can substitute for the improper roles previously covered by the pension systems.

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Appendix 1 – The microsimulation model CeRPSIM3

The microsimulation model is designed to analyse the distributional features embedded in the Italian pension system during its transition from a DB system to an NDC system. It is composed of two main modules: the population and the pension module.

The cohort population module

This module includes a demographic section and a labour market section, which simulate all the main life events of individuals. Individuals' transitions across different states (marital status, labour status, etc.) are conditioned on individual socioeconomic characteristics and are modelled throughout a Monte Carlo procedure, that is, they are evaluated by performing a random draw from a uniform distribution and comparing it to the relevant probability taken from available sociodemographic surveys or from national statistics data. If the value of the draw is higher than the sample probability, the individual changes his status; if not, the individual remains in the initial state.

Once individuals are born, their lives evolve according to various routines which determine the day and month of birth, gender, region of residence, performance in the labour market, family status, and survival. We illustrate these routines in turn after briefly describing the data sources used.

Data sources

Transition probabilities are drawn from the national statistics (*Istituto Nazionale di Statistica*, ISTAT) data and from two national micro datasets: the Bank of Italy's Survey of Household Income and Wealth (SHIW) and a sample of administrative data drawn from the main social security scheme (Istituto Nazionale di Previdenza Sociale, INPS) archive, the file LoSai (Longitudinal Sample INPS).

The INPS archive officially records the complete earnings and contribution histories of all participants, that is, employees in the private sector and some categories of self-employed (craftsmen, tradesmen, and farmers). The available sample is formed by all individuals born on the first and the ninth of each month of any year — so that the theoretical sample frequency is 24:365 — and reports employment spells until 2012. The archive contains very rich information about the earnings histories of the workers, recording spells of unemployment, sickness, as well as labour income earned each year.

As typical with administrative data, demographic information is, on the other hand, less rich: the sample records the date and province of birth of the worker, as well as gender. No information about family status is available, nor about the education level of the worker. For this reason we complement it with information contained in the SHIW, which is run about every two years since 1989 to 2012 on a representative sample of about 8,000 Italian households.

Life-invariant characteristics

At the beginning of the simulation of each cohort, a user-set number of individuals aged 0 are created. The *life-invariant characteristics* routine randomly assigns each individual a date of birth, gender, and region of residence through a Monte Carlo procedure. In each cohort the date of birth is uniformly distributed through the year: this feature of the program allows to accurately model the moment when a worker is eligible to claim a pension benefit. Gender and region of residence are randomly assigned according to the gender and the regional distribution of newborn in the year 2013 (ISTAT website, www.demo.istat.it, 2013).

Table A1. Gender and region of residence incidence.

Newborn males incidence		51.30%
Dwelling place incidence		
	North	45.88%
	Centre	19.57%
	South	34.55%

Source: Istat, www.demo.istat.it, year 2013.

Mortality

In each time period every individual enters the mortality subroutine, which determines whether that individual will survive or not in the simulated time period on the basis of gender-specific mortality tables. Individuals who are predicted to die in the simulated year still enter all subsequent routines until the cycle for the year in progress is completed. Afterwards, they are recorded as dead and are no longer taken into account in the population routines.

All our simulations are based on mortality tables provided by ISTAT. We use historical data from 1974 to 2010 and official ISTAT projections from 2011 to 2065. From 2065 on, mortality rates are kept constant.

Education

In the program, individuals are forced into school until they turn 16 (that is, they complete compulsory education) and they cannot start contributing into the pension system before then. Compulsory school age increased along years. However, according to SHIW data, the fraction of individuals starting to work before the age of 16 is low even for the cohort born in 1955.

After completion of compulsory schooling, the individual decides whether to continue studying or not. The routine models this decision as a random process and the probabilities of getting a higher degree or a university degree are derived from the SHIW data. Frequencies are allowed to vary according to gender and region of residence (north, centre, or south).

We do not account for school dropouts and once an individual decides to start a cycle of study, he or she completes it. This hypothesis is forced by SHIW data, which only report the highest educational degree achieved by each individual. Individuals who choose not to continue studying and individuals who complete their college enter the participation routine[49].

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[49] Postgraduate education in Italy is still quite limited and is not modelled.

Table A2. Education level by gender, region, and cohort (percentage).

	Males			Females		
	North	Centre	South	North	Centre	South
Cohort 1940-1959						
Compulsory school	52.6	55.2	62.8	60.6	62.7	69.4
High school	36.7	35.0	27.7	30.1	27.4	22.8
College	10.7	9.8	9.5	9.3	9.9	7.8
Cohort 1960-1979						
Compulsory school	38.4	37.7	49.6	32.6	33.5	47.9
High school	47.9	48.1	38.4	50.8	49.3	36.8
College	13.7	14.3	12.0	16.6	17.2	15.3

Source: our elaborations on SHIW data 1991-2010

Participation

When individuals choose to no longer be students (or are forced to quit school by the program because they are university graduates), they decide whether or not to enter the labour force. This decision is modelled as a once and for all choice: if an individual decides to enter the labour force, that individual will remain active in the labour market until retirement (or death), possibly facing spells of unemployment. On the other hand, if an individual decides not to enter the labour force, he or she will remain forever out of it.

Participation rates are specific for cohorts (born before and after 1970), gender, and region. In particular, we take the participation rate for the age class 25-34 in two different calendar years, 1993 and in 2010, from the Labour Force Survey (ISTAT), and treat the first one as the participation rate of the cohorts born before 1970 and the second one as the participation rate of the cohorts born after that date. The participation rates are reported in table A4.

Table A3. Participation rates by cohort, gender, and region (percentage).

	Men			Women		
	North	Centre	South	North	Centre	South
Cohorts born in 1970 or before	0.954	0.949	0.919	0.687	0.632	0.434
Cohorts born after 1970	0.925	0.889	0.917	0.779	0.687	0.460

Source: our elaborations on ISTAT data, Labour Force Survey, various years.

First job

An individual joining the labour force for the first time enters the first-job routine. According to the observed probabilities, the individual can succeed in finding a first job in the current year. If a job is not found, the individual is recorded as not employed and will re-enter this routine in the following time periods. The probability of finding a first occupation is drawn from SHIW data for the only cohort for which we have enough data to compute the relevant probabilities (individuals born between 1970 and 1979). We assume the same probabilities apply to all cohorts. The probabilities also vary according to age class (younger or older than 24 years), gender, and region of residence (north, centre, and south). As the probabilities vary according to age class, we implicitly take into account the education level (college graduates enter the labour force after they turn 24).

Table A4. Probability of unemployment conditional on looking for a first job (percentage).

Males	Younger than 24 years	24 years or older
Cohort 70-79		
North	9.2	5.3
Centre	24.9	13.3
South	51.2	32.2
Females	Younger than 24 years	24 years or older
Cohort 70-79		
North	18.0	6.8
Centre	27.9	16.5
South	66.5	47.8

Source: our elaborations on SHIW data 1989-2010.

Kind of employment and social security scheme

Once an individual finds an occupation, he or she is randomly assigned to a social security scheme and a professional qualification. These characteristics do not change throughout the individual's lifetime.

The assignment of the social security scheme proceeds in two steps: A first random draw determines to which of three main schemes the worker belongs: private sector employees, or self-employed. The relevant probabilities, computed from the SHIW data, vary according to region of residence (north, centre, or south), education level (mandatory school, high school, or university degree), gender, and cohort (born before or after 1960).

A second random draw determines the social security sub-scheme to which the self-employed worker belongs: craftsman (61 percent if males, 40 percent if females) or tradesman (39 percent if males, 60 percent if females). The appropriate frequencies are computed for each gender using our administrative data sample.

A third random draw determines, where relevant, whether the individual is white collar or blue collar, conditional on being a private sector employee. Individuals who start working before age 18 are registered as blue collar, individuals who start working after that age have a probability of 35 percent of being blue collar.[50] These frequencies are computed from the administrative data without any further sub-grouping.

Number of weeks

Conditional on having a job and on the number of weeks worked in the previous year, this routine determines the number of weeks worked.

We compute sample frequencies for private employees. To do so, we take two steps: We first discretize the number of weeks worked each year in our administrative panel into six classes (0, 1-13, 14-26, 27-39, 40-47, 48-52) and then we compute transition probabilities for each age class (16-24, 25-34 and 35-64) and for each region (north, centre, and south).

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[50] According to both administrative data and the SHIW sample, blue collar workers are about 70 percent of all workers employed in the private sector, irrespective of their age at entry into the labour market.

For the self-employed, we assume that, conditional on working, they work 52 weeks per year[51]. Using our administrative sample, we compute the probabilities of being unemployed conditional on the past year's employment status. These probabilities vary according to age (in classes), gender, and region of residence[52].

Earnings

Earnings profiles are estimated on administrative data separately for private sector and self-employed workers, men and women, white and blue collar[53].

The estimated equation, as stated in the main text is:

$$\ln y_{it} = x_{it}\beta + \gamma_i + \varepsilon_{it}$$
$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

$$\ln y_{it} = x_{it}\beta + \gamma_i + \varepsilon_{it}$$
$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

$$\gamma_i \sim (0, \sigma_\gamma^2); \quad \eta_{it} \sim (0, \sigma_\eta^2)$$

where x_{it} is a vector of individual characteristics, including a constant, a polynomial in age (third degree for self-employed, fourth degree for employees), cohort dummies (cohorts 1935, 1945, 1955, 1965, 1975), regional dummies (north, centre, south), and time dummies, which are assumed to sum to zero and be orthogonal to a time trend. Ln y_{it} are the logarithm of earnings for full time workers working a full year, expressed at 2010 prices. The estimated coefficients are reported in tables A6 and A7.

The unobserved component is assumed to be the sum of a random effect (γ_i) which does not vary over time and is uncorrelated with the explanatory variables included in the equation, plus an AR(1) component with parameter ρ. In the microsimulation model, each individual is given an average log earnings profile for his or her age and group (defined by cohort, gender, region, and occupation) plus an error term formed by the sum of the two unobserved components. The first one is drawn from a normal distribution with variance σ_γ^2 at the beginning of active life and it permanently shifts up or down the average profile for the individual to whom it refers. The second component, which is also individual specific and varies over time, is formed by the shock from the previous period times the autoregressive parameter ρ plus an error term drawn from a normal distribution with variance σ_η^2.

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[51] According to our administrative data, the fraction of self-employed working less than a full year is negligible and we do not model it.
[52] The probability of being employed conditional on being unemployed in the previous year varies only according to age class and gender.
[53] The self-employed are further differentiated into craftsmen and tradesmen.

Table A5. Estimated Coefficients for log-income profiles

	Men			Women		
	Blue collar	White collar	Self-employed	Blue collar	White collar	Self-employed
Age	0.201873	0.138882	0.02948	0.103233	0.1107746	0.002049
Age^2 /10	-0.00637	-0.00305	-0.00014	-0.0043	-0.00340846	0.000305
Age^3 /100	9.64E-05	3.86E-05	-6.78E-07	8.83E-05	6.02E-05	-2.73E-06
Age^4 /1000	-5.51E-07	-2.17E-07		-6.34E-07	-4.10E-07	
Constant	7.381727	7.920373	8.835824	8.473592	8.383372	9.245498
North	0.203177	0.201374	0.223784	0.164581	0.240599	0.142439
Centre	0.140626	0.152709	0.164712	0.124945	0.191567	0.109449
South	0	0	0	0	0	0
Born in 1935	-0.40038	-0.5244	-0.37894	-0.80243	-0.68071	-0.38645
Born in 1945	-0.23434	-0.35535	-0.24867	-0.48498	-0.50368	-0.234
Born in 1955	-0.17549	-0.23372	-0.17033	-0.26276	-0.37672	-0.1383
Born in 1965	-0.1196	-0.12842	-0.06603	-0.13353	-0.21208	-0.03874
Born in 1975	-0.064	-0.09335	-0.01393	-0.00513	-0.08584	0.013576
Born in 1985	0	0	0	0	0	0
Craftsmen			-0.03688			0.011514
N	8,704,608	3,868,698	4,300,649	2,687,639	2,854,982	1,794,531

Source: Authors' calculations, based on LoSai (Longitudinal Sample INPS). Note: all coefficients are statistically significant at the 0.1% level.

Table A6. Estimates for unobserved error components.

	Men			Women		
	Blue collar	White collar	Self-employed	Blue collar	White collar	Self-employed
ρ	0.540733	0.69937	0.544281	0.393984	0.406608	0.544307
σ_η	0.296131	0.372813	0.349698	0.430697	0.365474	0.29045
σ_γ	0.176466	0.156546	0.294566	0.289615	0.230275	0.253327

Source: Authors' calculations, based on LoSai (Longitudinal Sample INPS)

Marital status

In this routine individuals are recorded as children (as opposed to heads of households) until they finish their schooling years. When they are between 14 and 50 years of age, provided they are no longer students, they may get married according to the gender- and age-specific probabilities derived from Istat data 2013. Conditional on being married, an individual faces the possibility of becoming divorced (probabilities also

derived from Istat 2013 data) or widowed according to the mortality table used in the program. It should be noted that we do not explicitly model the spouse or his or her income. Marital status becomes relevant, however, when computing individual social security wealth.

The pension module

The pension module is a very detailed module able to compute pensionable earnings and contributions paid, check the eligibility requirements, and compute the pension benefit for a number of schemes and for different regimes. Pension benefits of the first and second pillars are computed for individuals who retire from the year 2010 onwards.

The program is able to replicate the pre-2011 reform system as well as the 2011 reform, which further tightened eligibility requirements and introduced an NDC pro-rata benefit formula for all workers from 2012 onwards.

The schemes covered, as already mentioned, are private sector employees and the self-employed, the latter categorized into craftsmen and tradesmen. These schemes greatly differed in eligibility rules, payroll taxes and the computation of benefits until the 1995 reform imposed uniformity. The equalising process, which has been gradual, is at present almost complete. Differences in the definition of pensionable earnings (or income) and in payroll tax rates are nonetheless also maintained in the future.

This module further computes for each individual the present value of payroll taxes paid during the whole working life and the present value of the pension benefits to be received. These two quantities are the building blocks of the Present Value Ratio (PVR), used in the analysis to assess intergenerational redistribution.

The second-pillar module

We also model participation in the second pillar. Since June 2007 a tacit approval mechanism is in place, i.e. the severance payment flows of private employees (6.91 of their gross wages) are automatically redirected to the complementary pension schemes, unless the worker explicitly denies it. Despite this, adhesion rates to the second pillar are still very low, reaching in 2012 only the 25.5 per cent of the total working population (Commissione di Vigilanza sui Fondi Pensione data, 2013).

In our simulations, we model participation in the second pillar pension system simply assuming that either no-one participates or all workers participate. In particular, in the latter case, we assumed that all private workers and self-employed automatically transfer 6.91 percent of their gross earnings to pension funds from 2007 onwards.

Appendix 2 – ITALISSIMO: A structural dynamic microsimulation model for Italy

The ITAlian Lifetime Income and Saving Simulation MOdel (ITALISSIMO) is a dynamic programming model of household sector savings and labour supply decisions for Italy. The decision unit of the model is the benefit unit, defined as a single adult or partner couple and their dependent children. ITALISSIMO considers the evolving circumstances of a sample of reference adults and their benefit units, organised into annual snap-shots during the life-course. Allocations within benefit units are ignored. Decisions regarding consumption, labour supply, and pension scheme participation are endogenous, and are assumed to be made to maximise expected lifetime utility, given a benefit unit's prevailing circumstances, its preference relation, and beliefs regarding the future. Preferences are described by a nested Constant Elasticity of Substitution utility function. Expectations are substantively-rational, in the sense that they are either perfectly consistent with, or specified to approximate, the intertemporal processes that govern individual characteristics. The model assumes a small open economy (appropriate for Italy), for which rates of return to labour and capital are exogenously given.

Heterogeneous circumstances of reference adults are limited to the following fourteen characteristics:

- year of birth of reference adult
- age of reference adult
- relationship status
- dependent children
- student status
- education status
- labour class (self-employment / public-sector employee / private-sector employee)
- wage potential
- public pension wealth
- private pension wealth
- accrued rights to severance payment (Trattamento di Fine Rapporto)
- timing of pension access
- non-pension wealth
- survival of reference adult

Seven of the characteristics listed here are considered to be uncertain and uninsurable from one year to the next when evaluating expected lifetime utility (relationship status, dependent children, student status, education status, labour class, wage potential, and time of death). This specification for the model was carefully selected to ensure adequate margins for empirical identification of unobserved preference parameters. Including year of birth in the list of heterogeneous benefit unit characteristics introduces the overlapping generations framework that is necessary to reflect the circumstances of a population cross-section. Age, wage potential, measures of wealth, and survival are all centrally important for any empirical analysis of savings and labour supply. Past experience with similar analytical frameworks has also emphasised the importance of relationship status when seeking to capture labour supply and consumption decisions. Finally, as discussed in Section 5, education status and pension scheme participation decisions feature in the empirical identification strategy employed in this paper. The remainder of this section describes key features of the model. Technical details can be found in Lucchino and van de Ven (2013).

1.1 Preference relation

Expected lifetime utility of reference adult i at age a is described by the time separable function:

$$U_{i,a} = \frac{1}{1-\gamma} \left\{ u\left(\frac{c_{i,a}}{\theta_{i,a}}, l_{i,a}\right)^{1-\gamma} \right.$$
$$\left. + E_a\left[\sum_{j=a+1}^{A} \delta^{j-a}\left(\phi_{j-a,a}^{b} u\left(\frac{c_{i,j}}{\theta_{i,j}}, l_{i,j}\right)^{1-\gamma}\right) + \left(1 - \phi_{j-a,a}^{b}\right)\zeta B_{i,j}^{1-\gamma}\right] \right\} \qquad (1a)$$

$$u\left(\frac{c_{i,a}}{\theta_{i,a}}, l_{i,a}\right) = \left(\left(\frac{c_{i,a}}{\theta_{i,a}}\right)^{(1-1/\varepsilon)} + a^{1/\varepsilon} l_{i,a}^{(1-1/\varepsilon)}\right)^{\frac{1}{1-1/\varepsilon}} \qquad (1b)$$

Observable characteristics of the preference relation are $\phi_{j-a,a}^{b}$ the probability that a reference adult with birth year b will survive to age j given survival to age a; $c_{i,a} \in R^+$ discretionary composite (non-durable) consumption; $l_{i,a} \in [0,1]$ the proportion of benefit unit time spent in leisure; $\theta_{i,a} \in R^+$ adult equivalent size based on the "revised" or "modified" OECD scale; and $B_{i,a} \in R^+$ the legacy that reference adult from benefit unit i would leave if they died at age a. Unobserved preference parameters are $\gamma > 0$ the (constant) coefficient of relative risk aversion; δ an exponential discount factor; ζ the "warm-glow" model of bequests; $\varepsilon > 0$ the (intra-temporal) elasticity of substitution between equivalised consumption ($c_{i,a}/\theta_{i,a}$) and leisure ($l_{i,a}$); and $\alpha > 0$ the utility price of leisure. E_a is the expectations operator and A is the maximum age that any individual may survive to.

1.2 The wealth constraint

Equation (1) is maximised, subject to an age-specific credit constraint imposed on non-pension wealth, $w_{i,a} > D_a$ for reference adult i at age a. Non-pension wealth is a net figure measured over all assets and liabilities of a benefit unit, excluding assets held in pensions and own businesses. The model abstracts from the peculiarities of housing assets that have been the explored elsewhere (e.g. Flavin & Nakagawa, 2008, Attanasio *et al.*, 2013). D_a is set equal to minus the discounted present value of the minimum potential future income stream up to the age a.

Intertemporal variation of $w_{i,a}$ is, in most periods, described by the simple accounting identity:

$$w_{i,a} = w_{i,a-1} - c_{i,a-1} + \tau_{i,a-1} \qquad (2)$$

where τ denotes disposable income net of non-discretionary expenditure. There are only two contexts that depart from equation (2). At the time a benefit unit first accesses its pension wealth, it may be eligible for to receive a tax-free lump-sum addition to its non-pension wealth; see Section 2.5 and 2.6. Alternatively, if a reference adult experiences a marriage transition prior to state pension age, then non-pension wealth is assumed to double in response to a new marriage, and to halve in response to a marital dissolution (it is unaffected by marital transitions from state pension age). The second of these effects is designed to account for the influence of divorce on $w_{i,a}$.

The tax function assumed for the model is represented by:

$$\tau_{i,a} = \tau\left(l_{i,a}, x_{i,a}, n_{i,a}, es_{i,a}, n_{i,a}^c, r_{i,a}w_{i,a}, pc_{i,a}, b\right)$$

which depends on labour supply $(1 - l_{i,a})$; private non-capital income, $x_{i,a}$; the number and age of adults, $n_{i,a}$, a; the labour class of the adults, $se_{i,a}$; the number of dependent children, $n_{i,a}^c$; the return to non-pension wealth, $r_{i,a}w_{i,a}$ (which is negative when $w_{i,a} < 0$); private pension contributions, $pc_{i,a}$; and birth year, b.

Non-capital income $x_{i,a}$ is equal to labour income $g_{i,a}$ plus pension annuity income. Non-capital income is split between adult benefit unit members to reflect the taxation of individual incomes in Italy.

The interest rate, $r_{i,a}$, is treated differently depending on and whether $w_{i,a}$ indicates net investment assets or net debts. Where $w_{i,a}$ is (weakly) positive, then the interest rate is assumed to vary by age a and time t; $r_{a,t}^I$. Age variation of r^I allows the model to accommodate important age-specific shifts in benefit unit portfolio allocations, and time variation allows it to reflect fluctuations in the macroeconomy. When $w_{i,a}$ is (strictly) negative, then the interest rate is designed to vary from $r_{a,t}^{D-}$ at low measures of debt to $r_{a,t}^{D+}$ when debt exceeds the value of working full time for one period.

$$r_{i,a}^s = \begin{cases} r_{a,t}^I & if \ w_{i,a} \geq 0 \\ r_t^{D-} + (r_t^{D+} - r_t^{D-})\min\left\{\dfrac{-w_{i,a}}{g_{i,a}^{ft}}, 1\right\}, r_l^D < r_u^D & if \ w_{i,a} < 0 \end{cases} \tag{4}$$

Specifying $r_{a,t}^{D-} < r_{a,t}^{D+}$ reflects a so-called "soft-credit" constraint in which interest charges increase with loan size.

Although all three of the interest rates referred to above are time variable, benefit units are assumed to ignore this aspect of variation when evaluating their expectations (see Lucchino & van de Ven, 2013b, for more information). This stylisation helps to ensure that the model is computationally feasible.

1.3 Employment status

Employment status is modelled at the benefit unit level in common with the approach taken to simulate labour incomes. In each simulated period, reference adults of working age and their spouses are jointly assigned to one of the following mutually exclusive labour classes: self-employed; private sector employee; public sector employee. Transitions between the labour classes are uncertain from one period to the next, with the probability of change depending on the reference person's age, education and their status in the previous period (see Section 4.3 for more detail).

Each labour class is distinguished by three characteristics: the probabilities governing labour transitions (both into other classes and involuntary unemployment, see Sections 2.4 and 4.3); wage parameters (see Section 6); and pension contribution rates (see Section 4.5).

1.4 Labour income dynamics

Wages are modelled at the benefit unit level, and are described by:

$$g_{i,a} = \lambda_{i,a}^{emp} \lambda_{i,a}^0 \lambda_{i,a}^{ret} h_{i,a} \tag{6}$$

where $h_{i,a}$ defines benefit unit i's latent wage at age a, λ^{emp} adjusts for (endogenous) labour supply decisions, $\lambda_{i,a}^o$ is an adjustment factor to allow for uncertain wage offers, and λ^{ret} is the impact on earnings of accessing pension wealth.

Three labour supply options are considered for each adult benefit unit member, representing full-time, part-time and non-employment. $l_{i,a}$ is a decreasing function of labour supply, and the wage factor $\lambda_{i,a}^{emp}$ is an increasing function of labour supply; $\lambda_{i,a}^{emp} = 1$ when all adult members are employed full-time.

$\lambda_{i,a}^o$ is included to allow for involuntary unemployment of the highest adult wage earner in each benefit unit. When the highest wage earner is identified as not receiving a wage offer, then $\lambda_{i,a}^o$ adjusts to ensure that $g_{i,a}$ is independent of their labour supply decision, implying non-employment where labour supply incurs a leisure penalty. Receipt of wage offers is stochastic and uncertain between years, with the probability depending only upon age and education status (see Section 4.3). Importantly, the probability of involuntary unemployment is allowed to depend on whether the individual was unemployed in the preceding year.

Access to pension wealth is assumed to incur a wage penalty for all subsequent periods of the life-course, represented by the wage factor $\lambda_{i,a}^{ret}$. The wage penalty defined by λ^{ret} is useful to match the model to rates of retirement described by survey data.

Latent wages, h

Latent wages are assumed to follow the stochastic process described by the equation:

$$log\left(\frac{h_{i,a}}{m_{i,a}}\right) = \psi_{i,a-1} log\left(\frac{h_{i,a-1}}{m_{i,a-1}}\right) + w_{i,a-1} \qquad (7)$$

$$m_{i,a} = m\left(n_{i,a}, ed_{i,a}, es_{i,a}, a, b_i\right) \qquad (8)$$

$$\psi_{i,a} = \psi\left(n_{i,a}\right) \qquad (9)$$

$$w_{i,a} \sim N\left(0, \sigma_w^2\left(n_{i,a}, ed_{i,a} semp_{i,a},\right)\right) \qquad (10)$$

where the parameters $m(.)$ account for wage growth (and depend on relationship status $n_{i,a}$, education $ed_{i,a}$, labour class $es_{i,a}$; age a, and birth year a), $\psi(.)$ accounts for time persistence in earnings, and $\omega_{i,a}$ is an identically and independently distributed benefit unit specific disturbance term. The variance σ_ω^2 is defined as a function of relationship status, education, and employee/self-employed status.

Equation (7) is a parsimonious specification that has been explored at length in the wider empirical literature. Nevertheless, the form of equation (7) differs from much of the related literature by its omission of transitory shocks. In the current context, transitory wage shocks are represented by the wage offers λ^o included in equation (6).

1.5 Public Pensions

Public pensions are modelled at the benefit unit level and are designed to reflect in broad terms the planned future of public schemes in Italy as of 2012. This modelling approach reflects the intended focus of ITALISSIMO, as a tool for considering the implications of prospective policy counterfactuals.

All employees and self-employed workers are considered to accumulate rights to a single Notional Defined Contribution (NDC) public pension scheme. Public pension rights evolve according to the following formulae:

$$P_{DC} = D_R.MC$$

$$MC = \sum_{t=a}^{R} \alpha_t w_t (1+g)^{R-t}$$

$$D_R = \left\{ \sum_{t=0}^{T-R} [(1-\beta)\varphi_{R+t,R} + \beta\varphi'_{R+t,R}](1+g)^{-t} \right\}^{-1}$$

P_{DC} is the pension received from retirement age R. MC is the accumulated pension pot. a is the age of entry into the workforce, α_t is the contribution rate. Mandatory contribution rates to the State pension system can be allowed to vary between dependent employees, and self-employed. w_t is the pensionable wage, g is the nominal growth rate of GDP. D_R is the annuity rate (inverse of annuity price). The annuity rates assumed for analysis are calculated with reference to the survival rates assumed for individual birth cohorts, an assumed return to capital, and an assumed transaction cost levied at the time of purchase. T is the maximum possible age. $\varphi_{R+t,R}$ is the probability of an individual surviving to age $R+t$ given survival to age R, and $\varphi'_{R+t,R}$ is the joint mortality probability of a couple (the probability that both members of the couple are dead) assuming that each individual has a spouse aged R at the time that they retire. β is the proportion of pension wealth used to purchase a joint life annuity, with the remainder used to purchase a single life annuity.

A large share of the active population in 2012 will have accrued public pension entitlements under the previous Defined Benefit scheme. This will be in relation to their contributions made before 1996 or 2012 depending on the number of years of contributions they had accumulated in 1996. To limit the computational complexity of the model, these rights are not explicitly modelled. Rather they are accounted for in the form of equivalent NDC rights. Specifically, the model loads in an additional vector describing the Defined Benefit rights held by each individual in 2012, measured in terms of fractions of final salary. These rights are converted internally by the model into NDC equivalents by means of reduced form forward simulations, and based on an assumed retirement age, and a given period for the calculation of pensionable final salary.

Access to public pensions is subject to minimum thresholds on age and the value of the pension annuity. The model allows for three such combinations of age and monetary minimum values. The model also allows for a fraction of pension wealth to be taken as a lump-sum, and can allow this to be tax free. The remainder of pension wealth is used to purchase an inflation adjusted life annuity.

1.6 Private Pensions

Private pensions are modelled as NDC schemes in a similar fashion to public pensions. In contrast to public pensions, however, contribution rates to private pensions can be endogenous. In each year, a benefit unit with earnings exceeding a minimum threshold, g_l^P, can choose whether to make fresh contributions to its pension scheme. If a benefit unit chooses to contribute to its private pension, then a fixed share of its total pre-tax labour income, π^P, is added to its accumulated pension fund. Contributing benefit units may also receive an employer contribution to their pension fund, which is specified as a fixed share of pre-tax labour income, π_{ec}^P. Eligible employer contributions to a benefit unit's pension fund in any given year are lost if the benefit unit chooses not to contribute to its scheme in the respective year. Wealth held in a private pension fund, $w_{i,a}^P$ is assumed to be illiquid until the time the pension is accessed, and attracts a fixed rate of return r^P. Access to private pension wealth is assumed to occur at the same time as access to public pension wealth, and is generally subject to the same terms and conditions as discussed in the last paragraph of Section 2.5. The principal exception is that different fractions of private and public pension wealth can be used to purchase a life-annuity. Computing times are reduced substantially, however, if private and public pensions are considered to be subject to the same rates of return, and the same fractions used to purchase annuities.

In most periods prior to pension access, private pension wealth follows the accounting identity:

$$w_{i,a}^P = r^P w_{i,a-1}^P + (\pi^P + \pi_{ec}^P)g_{i,a-1}\lambda_{i,a-1}^P \qquad (5)$$

where $\lambda_{i,a-1}^P$ is an indicator variable, equal to one if the benefit unit of reference adult i at age $a-1$ contributes to its pension, and zero otherwise. The only departures from equation (5) are following

relationship transitions, where relationship formation doubles pension wealth and relationship dissolution halves it.

1.7 Trattamento di fine Rapporto (TFR)

The Trattamento di fine Rapporto (TFR) can be defined in one of three forms: 1) a simple addition to gross wages (to avoid computational burden, but capture the fact that associated wealth can be accessed prior to retirement); 2) an addition to private pensions (to avoid computational burden, but capture the role of the TFR as an addition to the public and private pensions referred to above); 3) as social insurance against the risk of unemployment. It is also possible to omit the TFR entirely from the simulations.

Only employees are eligible to contribute to the TFR, and it is possible to limit the scheme to apply only to employees in the private sector. Any employee with wages in excess of a lower bound is assumed to contribute a fixed share of their wages, up to a wage cap into the TFR scheme.

If the TFR is modelled as an addition to gross wages, then the value of contributions to the TFR is calculated and added to labour income before any other income-dependent characteristic included in the model (including taxes, benefits, pensions) is evaluated.

If the TFR is modelled as an addition to the pensions described in Section 2.6, then associated contributions are added to both gross wages and private pension contributions. After TFR contributions are added to private pension wealth, they are assumed to be indistinguishable from other private pension wealth. This option is only available if private pensions are included in the model.

If the TFR is modelled as social insurance against the risk of unemployment, then the contributions of the primary wage earner of a benefit unit are paid into a dedicated TFR notional account. The contributions of a spouse are either paid into private pensions – if these are included for analysis – or into gross wages. The notional account for the TFR grows at a fixed (real) rate per annum. The entire balance of the TFR notional account is transferred into liquid wealth when an individual passes into non-employment, either due to receipt of a low wage offer or an active leisure decision.

1.8 Allowing for benefit unit demographics

Benefit unit demographics in the model refers to three factors: survival of reference adults; the relationship status of reference adults; and the allowance made for dependent children.

Modelling survival

The model focuses upon survival with respect to reference adults only; the mortality of the spouses of reference adults is aggregated with divorce to obtain the probabilities of a relationship dissolution (discussed below). Survival in the model is governed by age and year specific mortality rates, which are commonly reported components of official life-tables.

Modelling relationship status

A relationship is defined as a cohabiting partnership (including formal marriages and civil partnerships). The relationship status of each reference adult in each prospective year is considered to be uncertain. The transition probabilities that govern relationship transitions depend upon a reference adult's existing relationship status, their education, age, and birth year. These probabilities are stored in a series of transition matrices, each cell of which refers to a discrete relationship/education/age/birth year combination.

Modelling children

The model takes explicit account of the number and age of dependent children of reference adults. The birth of dependent children is assumed to be uncertain in the model, and described by transition probabilities that vary by the age, birth year, relationship status, and previously born children of a reference adult. These transition probabilities are stored in a series of transition matrices, in common with the approach used to model relationship status (described above). Having been born into a benefit unit, children are assumed to remain dependants until an exogenously defined age of maturity. A child may, however, depart the modelled benefit unit prior to attaining maturity, if the reference adult experiences a relationship dissolution (to account for the influence of divorce).

The model is made computationally feasible by limiting child birth to three child birth-ages, set equal to 20, 29 and 37. Realistic benefit unit sizes are accommodated by allowing up to two children to be born at each child birth age. Restricting the number of ages at which a child can be born in the model raises a thorny problem regarding identification of the transition probabilities that are used to describe fertility risks. The model calculates the required probabilities internally, based upon the assumed birth ages and fertility rates reported at a highly disaggregated level. This approach has been adopted both because statistical agencies tend to publish data at the disaggregated (annual age band) level, and because it facilitates associated sensitivity analyses to be conducted around the number and precise birth ages assumed.

2. Survey Data

### 2.1 The reference population cross-section

The model inputs detailed microdata on the circumstances of the population in the reference year, to provide a starting point for backwards and forwards simulation. We use the Bank of Italy's Survey on Italian Household Income and Wealth (SHIW) in 2012 (for detailed information, see Bank of Italy, 2014). This consists of a sample covering 8,136 households composed of 20,022 individuals, interviewed between January and August 2013 in relation to their circumstances in 2012. The questionnaire covers information on demographic characteristics of the household, occupation, education, individual income and, importantly, household wealth. This section focuses the main changes applied to the data to make it compatible with the model.

Defining the unit of analysis

The model's unit of analysis is the benefit unit, defined as an adult, their spouse if present, and any dependent children. The SHIW households defined as all the individuals living in the same dwelling as of December 2012. As this is a broader unit of analysis than the one used in the model, we constructed benefit unit variable onto the SHIW data.

We identify benefit units by applying the following operations. Firstly, we define all individuals under the age of 20 as being dependent children. Implicitly, we are assuming that individual economic choices become subject to autonomous life-cycle optimisation behaviour from the age of 20. Our goal is to split the economically independent individuals from the dependent ones. The choice of the age of 20 is coherent with the employment rate we observe in the data, as illustrated in the following figure. The red line represents the split between under and over 20 years. As shown in the figure, employment rate at 20 years old start to be non-negligible.

Figure 3.1: Employment rate from 16 to 24 years old.

Employment rate among 16-24 years old individuals
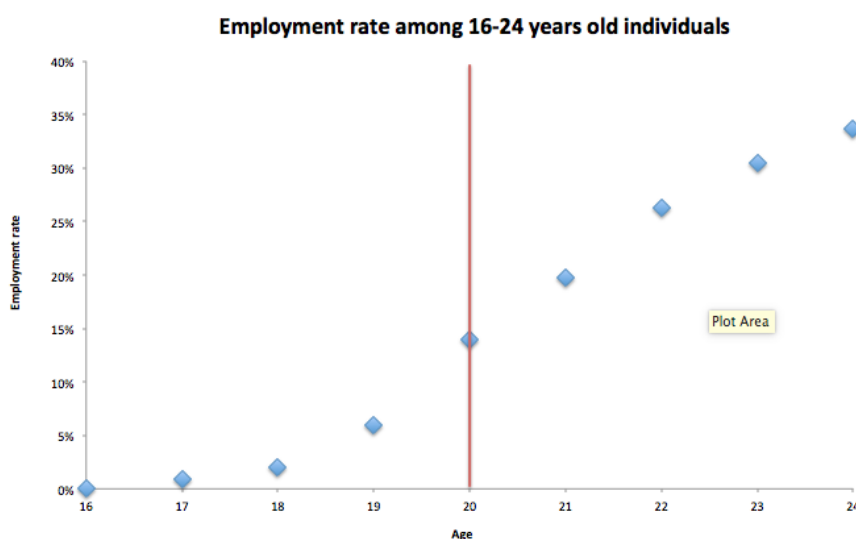
All such children are assigned to their parents. With the available information on the dwelling parental relationship in few cases were not possible to identify the parents of the children. We defined that children as the reference person's children[54]. Observations in relation to dependent children are then dropped[55]. Secondly, any adult (aged 20 or over) who is not defined as household head or his/her partner in the SHIW becomes the head of a new benefit unit[56]. Accordingly, each benefit unit is composed by one or two adults. We end up with a new dataset of 11,436 benefit units. 3,300 new benefit units have been generated.

In the following Table we reported some relevant descriptive statistics in order to underline the principal differences between the original and the modified dataset. The mean age of the head of the household decreases, as well as the marriage rate, the employment rate and the mean wage. Since the definition of "child" changed and all the individuals older than 20 form a new household, the mean child age decreases from 17 to 10. Due to the household split also the mean number of household components decreases.

Married people compose 6% of the new households. When the available information on the relationship status allows it, the new household includes also the partner of the new head of the household. 368 married individuals were splitted out from the original household: this means 184 couples. With the available information were possible to recognise 154 out of 184 couples. The remaining individual becomes the head of 60 new households.

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[54] It is not possible to identify the parents of the children in 163 cases, i.e. the 4,86% of the children in the sample.

[55] This implies dropping 62 households where the household head as under 20 years old.

[56] There are only 4 cases where it is possible to identify these adults are forming a couples distinct from that of the household head. Given the rarity of these case, we treat them like all other cases and they become the heads of 8 new households.

Table 3.1: Descriptive statistics of the household structure after and before the changes.

	Original households	Newly created households	Original household after the split	Final dataset
Number of households	8,136	3,300	8,136	11,436
Mean age of the household head (H.H.)	56	35	56	50
Mean kids' age	17	-	10	10
Mean number of household components	2.47	1.02	2.10	1.55
H.H. employment rate	48%	39%	48%	43%
H.H. net mean income (in Euro at 2012 prices)	17,910	12,957	17,910	15,988
H.H. marriage rate	59%	6%	59%	31%
H.H. Mean wealth	118,533	11,240	118,533	81,920

Apportioning household wealth

Household net wealth in the original dataset is composed by real assets, financial assets and by financial liabilities. The wealth is recorded at the household level: with the available information the wealth is split at the individual level since the model requires estimates of wealth at the benefit unit level.

90% of wealth in the sample is composed by real assets, 16% by financial assets and 6% by financial liabilities. Financial assets and liabilities are recorded at the household level and there is no way to attribute it to a specific individual. These values were arbitrarily attributed to the head of the household and his/her spouse dividing the value between the partners in two equal parts (if the spouse it is present, otherwise it were totally attributed to the head of the household).

Real assets are the most relevant wealth component in the household. It includes the family home, other real estate, firms and valuables.

These are:

i. Household's residence: value of the house, share owned by the household, and which household members own the dwelling (but not the share owned by each of them).
ii. Other houses, premises, or agricultural or non-agricultural land: their value, the share owned by the household, and the owners in the household (but not the share owned by each of them).

iii.   Valuables, means of transport, furniture/furnishings/household appliances: values at the household level.
iv.   Self-employed workers: value of the business if it would be sold, and the owners.
v.   Family business: share of the business owned by the household and its value.
vi.   Family business working shareholders/partner: share owned by each household member and its value.

The model requires the wealth to be at the benefit unit level but on SHIW the real assets are often attributed to more than one individual in the household. We draw a rule to split the real asset values between individuals. The value of real assets are attributed to each individual in the household in the following way. When the owners of the real asset are known, but not the share owned by each of them, the value is split equally between the owners. This was done for the real assets in points (i) and (ii). When the owners are not known, the value is split uniformly between the household head and his/her partner: this was done for real assets in points (iii) and (v). The real assets in the categories (iv) and (vi) were already reported at the individual level. However, even in these cases, the majority of wealth is owned by the head of the household and his/her partner. This suggests that the approach chosen for other categories of wealth may not be very far from actual patterns of ownership. About 10% of the entire wealth is attributed to individuals different from the head of the household and his/her spouse.

Imputing earning potential

As discussed in Section 2.4, the model requires a value for latent wages, that is, the potential earnings should an individual chose to work. This requires carrying out two operations. Firstly, as we only observe earnings for employed individuals, we need to impute potential earnings for the remaining part of the population using reduced-form regressions. The empirical challenge here is that, of course, individuals for whom earnings are not observed are a selected sample of the populations. We therefore address this using a Heckman model where we estimate both a selection and a wage equation. Secondly, because the SHIW earnings data are net of the income tax, both observed and imputed earnings have been grossed-up by mean of an econometric procedure described below. This section covers the imputation of missing earnings, and the net to gross of income tax conversion is covered in the next section.

We run four separate regressions, two for men and two for women, under and over 50 years old. The specifications adopted for this analysis were constrained only by the information reported by the SHIW. This approach allows a good degree of flexibility in the estimation. Tables 3.2 and 3.3 presents the regression results.

Table 3.2: Wage estimated parameters, Heckman regression.

	Under 50				Over 50			
	Females		Males		Females		Males	
Part-time work	-0,5724	***	-0,7137	***	-0,6726	***	-0,8647	***
Age	0,287	**	-0,1551		0,555	***	-0,0716	
Age^2	-0,0038	**	0,0019		-0,0046	***	0,0004	
Attained education:								
primary	0		0		0		0	
lower secondary	3,5539		-3,7889		10,8638	**	0,4453	
vocational secondary	3,2845		-3,0527		-0,6069		-17,6308	**
upper secondary	3,403		-4,5643	*	8,5783		-3,6593	
university degree	3,4525		-4,112		13,1514	**	-13,5875	***
primary * age	0		0		0		0	
lower secondary * age	-0,2228		0,1792		-0,3595	**	-0,0394	
vocational secondary * age	-0,2049		0,1343		0,0614		0,589	**
upper secondary * age	-0,2034		0,2225		-0,2477		0,137	
university degree * age	-0,2134		0,1967		-0,4086	**	0,479	***
primary * age_sq	0		0		0		0	
lower secondary * age_sq	0,0032	*	-0,002		0,003	**	0,0006	
vocational secondary * age_sq	0,003		-0,0013		-0,0008		-0,0048	**
upper secondary * age_sq	0,003		-0,0025		0,0018		-0,0012	
university degree * age_sq	0,0033	*	-0,002		0,0033	**	-0,004	***
Constant	4,3907	*	12,6366	***	-7,1062	*	12,4238	***
Observations	2973		2888		4723		3909	

Note: age_sq=age squared; * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01

Table 3.3: Selection estimated parameters, Heckman regression.

	Under 50				Over 50			
	Females		Males		Females		Males	
Age	-0,0007		0,0127		0,08		-0,2124	
Age^2	0,0004		0,0001		-0,0014		0,0008	
Attained education:								
primary	0		0		0		0	
lower secondary	0,1952		-1,9303		0,3958		-14,2556	
vocational secondary	2,5528		-1,3367		2,4536		14,395	
upper secondary	0,6807		-2,2065		-38,9606	***	8,9316	
university degree	-0,9536		-0,5187		14,1032		4,1899	
primary * age	0		0		0		0	
lower secondary * age	0,0396		0,1648		-0,0091		0,5051	
vocational secondary * age	-0,0664		0,1424		-0,0079		-0,4081	
upper secondary * age	0,0186		0,1994		1,4356	***	-0,2744	
university degree * age	0,1039		0,0646		-0,345		-0,117	
primary * age_sq	0		0		0		0	
lower secondary * age_sq	-0,0008		-0,0026		0,0001		-0,0044	*
vocational secondary * age_sq	0,0004		-0,0024		-0,0005		0,0029	
upper secondary * age_sq	-0,0004		-0,0033		-0,0129	***	0,0021	
university degree * age_sq	-0,0012		-0,0009		0,0022		0,001	
No kids	0		0		0		0	
1 kid	-0,3202	***	0,004		-0,2534	*	0,2939	**
2 kids	-0,5008	***	0,012		-0,3237		-0,2991	
3 kids	-0,9493	***	0,2594		-1,3091	**	0,2842	
4 kids	-1,3962	***	5,8567		-4,1167		-8,9876	
5 kids	-3,4787		5,9729		6,9181		-5,3189	
Disabled	-6,2863		-7,8618		-0,9152	***	-1,6201	***
Occupation of the H.H.:								
not-employed	0		0		0		0	
blue-collar worker	3,0716	***	3,3901	***	2,5619	***	2,6174	***
office worker or teacher	3,5024	***	3,8451	***	2,8508	***	2,692	***
manager	3,1418	***	3,8484	***	2,2113	***	3,308	***
self-employed	-4,0863		-		-0,3112		1,0129	***
Student	-0,6801	***	-0,6071	**	-		-	
Partner earn 0	2,0155	***	2,1772	***	1,7445	***	-	
Geographical area:								
North-east	0		0		0		0	
North-west	-0,0066		-0,2592		0,0431		0,1727	
Centre	0,0291		-0,2529		-0,2024	*	0,0763	
South	-0,7543	***	-0,6246	***	-0,6091	***	0,1343	
Islands	-0,7824	***	-0,4252	***	-0,5905	***	0,2325	*
Married	-1,325	***	-0,3385	**	-1,3049	***	-0,0959	
Own accommodation	0,2514	***	0,2913	**	-0,0285		-0,0198	
Constant	-2,3176		-2,3165		-1,5797		7,9014	
Lambda	-0,3978	***	-0,547	***	-0,0771	**	-0,1988	***
Observations	2973		2888		4723		3909	

Note: age_sq=age squared; * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01

To verify if the earnings estimation works properly, we compare the observed earnings with the estimated ones for the group of employed individuals. How is illustrated in Figure 3.2.Tthe two values are very similar across the most of the distribution.

Figure 3.2: Mean estimated and observed net earnings
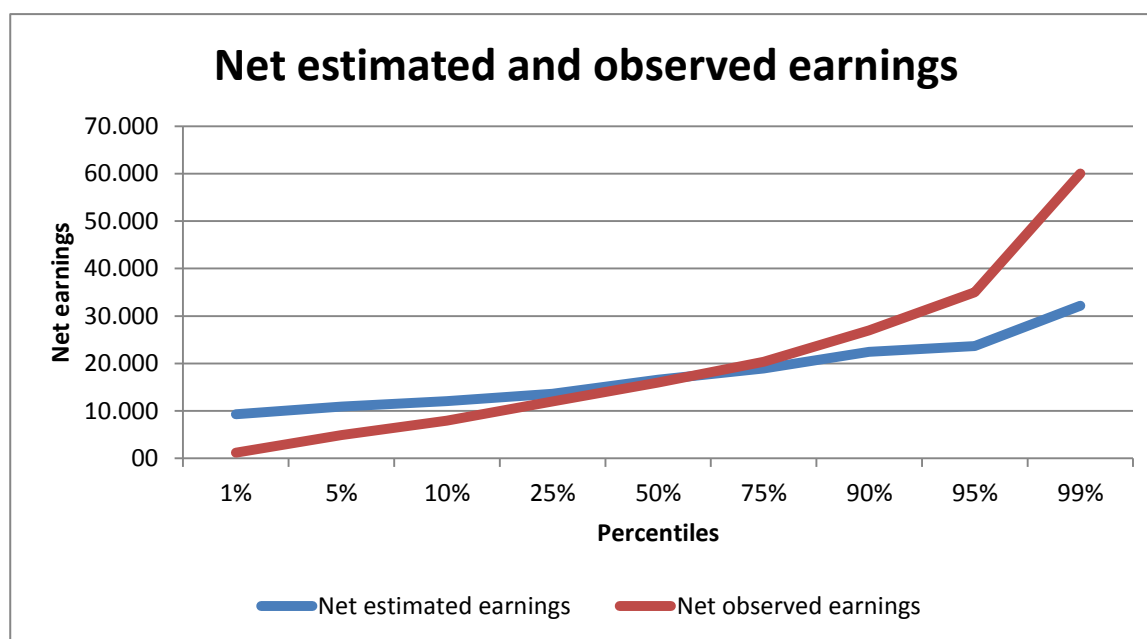
Gross earnings

SHIW provides information on individual net earnings but not on gross earnings. The model requires gross earnings to be inputted, meaning both observed and imputed net earnings need to be transformed into gross values. The Italian Survey of Income and Living Conditions (IT-SILC), contains high-quality gross earnings whose values are derived from administrative data. The procedure adopted to grossing-up the SHIW earnings involved estimating the relation between the gross earnings and the net earnings (including also a set of controls) on IT-SILC data. The obtained parameters are then used to calculate the gross earnings on SHIW starting from the net earnings and using the same set of controls. We calculate the parameters using the IT-SILC workers aged between 25 and 65. The set of personal characteristics includes age, gender, employee or self-employed status, level of education, number of children in the household and geographic area.

In Table 3.3, we compare the SHIW and IT-SILC net and the gross earnings. Comparing the earnings is useful to identify any substantial difference between the observed gross earnings in IT-SILC and the estimated gross earnings in SHIW. The table also reports observed net earnings. This is useful to understand if the discrepancy could be attributed to the estimation methods, or to differences observed in the original net earnings between the two datasets.

In general we can conclude that the method used to estimate the gross earnings is sufficiently reliable. The medians and the means are similar, and the values in the central part of the distribution are generally pretty similar. The extremes of the distribution present some differences. However, these are also present when comparing net earnings, suggesting these differences arise in the original datasets rather than the imputation method.

Table 3.4- Gross and net earnings by gender and source.

| Percentiles | Males | | Females | | Males | | Females | |
| | Net wage | | Net wage | | Gross wage | | Gross wage | |
	SHIW	IT-SILC	SHIW	IT-SILC	SHIW	IT-SILC	SHIW	IT-SILC
10	7,000	5,225	5,000	2,865	9,650	6,737	6,812	4,085
25	12,000	12,549	9,000	8,039	17,960	16,256	13,420	9,520
50	16,000	18,569	14,000	14,293	25,489	24,949	21,261	18,450
75	21,000	25,477	18,000	20,032	34,777	35,799	29,110	27,353
90	29,000	33,732	22,500	26,171	49,064	51,036	38,136	37,685
Mean	18,157	20,600	14,399	15,114	30,073	29,417	23,238	29,417

Note: All the values are expressed on 2012 euro. SHIW refers to the 2012 observed earnings while IT-SILC refers to the 2011 earnings.

Imputing pension wealth

The SHIW does not report directly information on public pension wealth held by individuals. This section describes the approach taken to impute this variable on to the reference cross section.

For individuals who have yet to retire, the total amount of (notional) saving in the NDC pension has been imputed by multiplying an individual's years of contributions by the current contribution amount. This procedure determines a proxy for the accrued pension wealth on the assumption that the growth rate of earnings and the return to NDC pension saving rate are equal. Earnings and the number of years of contributions are not observed in the dataset for those unemployed in the reference year. We estimate their accrued saving in NDC pensions by imputing years of contributions and using estimated potential earning derived as above.

For individuals who are already retired in the SHIW data, we impute an (notional) amount of NDC saving which is consistent with the level of pensions in payment. This is done by multiplying the annual value of pensions received by an annuity price that varies by age. The latter is estimated by the model on the basis of mortality rates for a cohort chosen to be broadly representative of retired individuals in 2012.

As discussed in Section 2.5, rights to Defined Benefit pensions for those who have yet to retire are converted internally by the model into NDC equivalents by means of reduced form forward simulations, and based on an assumed retirement age, and a given period for calculating final salary. This requires a variable describing the Defined Benefit rights held by each individual in 2012, measured in terms of fractions of final salary. This is not available in the SHIW. We firstly impute the share of each individuals' working-age lifetime they have spent under the Defined Benefit system using age and total years of contribution at 2012. Next, we multiply this by 0.7, which is an approximation of the final (theoretical) replacement ratio which an individual could have if completely under the DB system.

Finally, the model requires a variable indicating the value of the Trattamento di Fine Rapporto accumulated by each individual. We impute this multiplying the seniority at work by the yearly contribution paid by dependent workers into the TFR fund.

2.2 Historical microdata

The model requires a number of economic and demographic transition probabilities. For most of these, we resort to the historical database of the Survey of Household Income and Wealth (SHIW). This database consists of the pooled repeated cross-sections of the SHIW, with information harmonised across years. SHIW surveys started in 1977, but between 1977 and 1986 the age of the individuals was recorded in age groups of 5 year (e.g. 20-25, 25-30, etc.) and many essential information were not collected, as for example the civil status of the individuals or the education level that were collected only for the income-earners. While the first SHIW dates from 1977, we only use the historical series from 1986 to 2012 as previous waves did not contain all the information necessary for our analysis.

The dataset we adopted for our analysis includes 16 cross sections collected every 2 years.[57] 356,375 individuals have been interviewed in total. On average, each survey interviewed 7,934 households composed by 22,472 individuals. To construct the necessary model inputs, this pseudo-panel data must use the same definition of benefit unit as the model. This requires adapting the data as described within Section 3.1.

Applying the household definition needed from the model we obtain for each observed year a mean of 11,734 benefit units that includes 11,734 individuals. The missing individuals includes all the family components younger than 20 years old, that are dropped out from the sample as explained in section 3.1.

3. Exogenously Identified Model Parameters

3.1 Interest rates on non-pension wealth

Returns on the non-pension net wealth variable were calculated using data coming from the IMF International Financial Statistics database statistical sources. All data are computed for the period 1970-2012. Nominal returns on housing were computed using the historical series of housing prices disposable in the Informatore Immobiliare. Nominal returns to equities and long term interest rates are computed on the time series of the Global Financial Database for Italy. In particular, for long term interest rates we referred to the yield of the ten years Italian Treasury bond. Personal loans returns are taken from the Bank of Italy statistics database. All nominal interest rates were discounted for inflation using the deflator computed by the National Institute of Statistics (ISTAT).

3.2 Wage parameters

The specification of latent wages is defined as a random walk with drift, so that $\psi = 1$. Full-time employment of all adult benefit unit members is assumed to reduce benefit unit leisure time by 40%. This assumption is based upon the view that there are 16 hours available for allocation each day, and that full-time employment consumes nine hours per day, five days per week. As indicated by data from the Survey of income and Living Conditions (IT-SILC 2011), part-time employment is assumed to be equivalent to 70% of a full-time job, reducing both leisure time and earnings in the same proportion, $\lambda^{emp} = 0.7$

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[57] Exceptions on the survey timing happened in 1986-1987 and in 1995-1998. The data were collected in: 1986, 1987, 1989, 1991, 1993, 1995, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012.

3.3 Employment transitions and unemployment risk

Transition probabilities into and out of the mutually exclusive employment states (self-employed; private sector employee; public sector employee; unemployed) were estimated across consecutive waves of the Italian Labour Force Survey Panel Survey, spanning the period 1993 to 2012. We drop from the dataset people younger than 20 or older than 65 in order to take into account only working-age individuals. In the observed period, 19,721 of the 493,524 individuals in the sample changed their status. Table 4.3.1 reports the coefficients from a multinomial logit estimation of transitions across the selected states.

The same model is also used model transitions into and out of involuntary unemployment, which occurs in the model in the form of a low wage offer (see section 2.4). Our selected model takes an auto-regressive form, such that we can impose persistence in states. This is particularly important allowing the model to reflect the potentially sticky nature of unemployment over time. Transitions are also allowed to vary by age and educational status.

Table 4.3.1: Coefficients from a multinomial logit estimation on trasitions.

	E. pr.s. (1) (reference state)	Self-employed (2)		E. public sector (3)		Unemployed (4)	
Previous state							
Self employed	0	0,452	***	1,813	***	0,181	
E. p.s., non-graduate	0	-4,490	***	4,350	***	-0,330	***
E. p.s., graduate	0	-3,116	***	5,384	***	0,127	
E. pr.s., non-graduate	0	-6,657	***	-2,244	***	-2,539	***
E. pr.s., graduate	0	-6,250	***	-1,673	***	-2,966	***
Unemployed, non-graduate	0	-4,157	***	0,197	***	2,088	***
Unemployed, graduate	0	-3,134	***	1,496	***	2,053	***
Age	0	-0,015	*	0,065	***	-0,067	***
Age squared	0	0,000	***	-0,001	***	0,001	***
Year dummies 1994-2012	yes	yes		yes		yes	
Sample	493524	493524		493524		493524	

Note: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. E.pr.s.= Employee private sector; E.p.s= Employee public sector. Available years: from 1993 to 2012, except 2004.

The employment decision is also dependent on the level of non-discretionary childcare costs. The model assumes that child-care costs are incurred by any benefit unit with at least one dependent child, and where all adult benefit members work full-time. Based on ISTAT data, we set the price of childcare to be 25 euro per week per child.

3.4 Tax and benefits policy

Taxes and benefits are modelled to reflect a stylised version of the transfer system that applied in Italy in 2012. The program code adopted to simulate taxes and benefits in the model is based on the IRPEF (Imposta sul Reddito delle Persone Fisiche). Documentation for that tax year (REFERNCE) and can be obtained from the authors upon request. This section provides a brief overview of the elements in the tax module.

The first step consists of evaluating aggregate take-home pay from the taxable incomes of each adult member in the benefit unit. The taxation of employment, self-employment, and savings income under income tax (IRPEF) are accounted by the model. This accounts for roughly 95% of the aggregate income tax yield. All other incomes falling under income tax are not modelled.

The income tax calculation consists itself of a series of steps. Firstly, Contributions paid into public and private pension funds, as well as those paid into any Trattamento di Fine Rapporto (TFR) funds, are deducted from gross income to define taxable income (*Deduzioni*). The model allows to apply a cap to the amount of such contributions that can attract tax relief. Taxable income (with the exception of income from saving) is then taxed under a progressive tax schedule. This defines gross tax liability. This liability can be further reduced by a series of tax credits (*Detrazioni*). The model allows for *Detrazioni per tipologia di reddito* (Tax credit by income source), *Detrazioni per figli a carico* (Tax credit for dependent children), *Detrazione per conigue a carico* (Tax credit for dependent partner). Each of these is modelled following official rates and bands. The model also includes *Detrazione spese etc* (Tax expenditures). A detailed modelling of each of these expenditures goes beyond the scope of this model and is limited by data availability. We therefore take a reduced form approach by a modelling the total deductible amount as a flexible polynomial of taxable income. Net tax liability is calculated by reducing the gross tax liability by the sum of all tax credits one is eligible to. However, net tax liability cannot be negative. Savings income such as interest and dividends are taxed separately at a flat rate,

The next operation in the tax module is calculating benefit receipt. We include *Assegni familiari* (Family credits). Modelling these posed some significant challenges as the credit amounts do not appear to follow any systematic rule in relation to either the starting amount per children, the amount for each additional child or the taper rate and bands for each child. We therefore attempted to reduce the complexity and irregularity by adopting a limited number of stylised rules. Firstly, the full award was set to be equal to actual awards for families with 1 or 2 children, and set to an fixed average amount per child for families with 3 or more children. Credits are received in full up to a fixed income threshold and then tapered at rate which varies for 1, 2 and 3+ children but is constant over income levels.

The system of means tested support of pensioners in existence in 2012 is complex. A number of different benefits are in payment, mainly because some forms of support are no longer being offered to new claimants but remain in payment for existing claimants. The different forms of benefits are primarily distinguished in terms of the type of public pension received, and therefore closely related to the individual's cohort.

We model a stylised version of this support system, making the following considerations. Firstly, given the primary interest around future counterfactuals, we emphasised the accuracy in modelling the current and expected future system over that of the former system of support. This reflects the approach taken in modelling public pensions. Incidentally, that modelling choice ultimately rules out any differentiation of pension support according to public pension type received. Finally, we note that the generosity and underlying logic of most of the schemes in payment are very similar. These schemes are primarily forms of income top-ups up to a minimum income, subject to combinations of an age and means test. Our modelling therefore consists of the following two support schemes.

The *Assegno Sociale* (Pension credit) is modelled as topping up individual income up to a set amount per annum for individuals above State Pension age and whose income falls below this limit. In defining the

relevant income for this purpose, one third of any NDC pension in payment or of the maximum Assegno Sociale, whichever is lower, may be disregarded. ***In the case of couples, each individual can claim a separate Assegno Sociale, subject to eligibility requirements. The total household income must be less than a fixed threshold. As above, up to a third of NDC pensions in payment to either of the spouses can be deducted from the definition of income (up to the maximum of a third of the maximum Assegno Sociale itself).***

Individuals aged certain age or above are eligible for an *Incremento della maggiorazione sociale dei trattamenti minimi* (Supplement to Pension Credit). Eligible singles with an income below this threshold receive a top-up equal to the difference between the threshold and their income. Individuals in couple households are eligible for the Supplement if their joint income is below single threshold plus the amount guaranteed by the Assegno Sociale. As both partners will have an income at least equal to the Assegno Sociale, it follows that only one of the partners can claim the Supplement.

The model does not include the *Assicurazione Sociale per l'Impiego, ASPI* (Unemployment benefit). This is due to the fact that the ASPI is time-limited. Accounting for the length of time spent in unemployment would have substantially increased the complexity and computational burden of the model.

The model therefore omits an important form of support. However, setting aside the issue of the ASPI, a general feature of the welfare system in Italy is that many categories of individuals are not covered by any form of support. Examples are the self-employed or the long term unemployed and inactive. The model currently allows no form of support for these individuals, despite the fact that, in reality, individuals experiencing extreme hardship must ultimately find some form of support. To ensure the realism of the model simulations, it is desirable to find a way to proxy for this fact.

It has often been suggested that individuals at the risk of extreme financial depravation are prevented from experiencing this thanks to the support of extended family members. Our model allows for the possibility of proxying this type of behaviour. We model a 'benefit' which imposes that if the sum of income and wealth of each adult is below a given subsistence threshold, it is topped up to that threshold. The model allows for this threshold to vary by age. We set this to be 150 euros per week up to age 30; declining linearly to 50 euros per week at age 55 and remaining at that level after that. e

The model requires transfer policy to be described over an extensive time period. The evolution of benefit values and income thresholds are assumed to follow a constant growth rate. This was set to 1.5% per annum, reflecting trend real earnings growth. The key motivation for this assumption is that it ensures that the transfer system maintains pace with wages, omitting marginalisation of welfare provisions or extensive tax bracket creep.

3.5 Pensions and the Trattamento di Fine Rapporto

Both public and private pensions in the model depend upon six parameters: the rate of return to pension wealth rP, the minimum earnings threshold for pension contributions gPl , the rate of private contributions to pensions out of employment income _P , the rate of employer pension contributions _P ec, the return assumed for calculating the price of pension annuities, and the fixed capital charge associated with purchasing a pension annuity.

The growth rate of NDC pension wealth is set by law to track the growth in real GDP. This was set to 1.5% per annum in line with projections by the Ragioneria di Stato (Government Accounting Office). The same value was assumed for the capital return used for calculating the price of pension annuities. The capital charge for annutisation was set to 0% as this process is provided by the State. No minimum income is necessary to make contributions, and these are made on incomes up to €82,404 per annum.

Public and private employees pay contributions equal to 11% of pre-tax earnings, and their employers contribute and additional 22%. The self-employed pay a contribution rate of 24%

Private pensions are modelled using the same parameters applied to public pensions (Section 4.1). This was necessary to avoid excessive simulation run-times. In contrast to public pensions, however, the choice to contribute is endogenous. Contribution rates are set at 6.9% for the employee and 1% for the employer. This is in line with average contribution rates available from COVIP data and the widespread notion that the bulk of contributions to private pensions come from funds from the Trattamento di Fine Rapporto. Accordingly, we model the Trattamento di Fine Rapporto as an addition to gross wages.

Access to both public and private pensions are governed by the same regulations. Reflecting the 2011 reform, workers can retire in the model if they are aged 62 or above and have State pension entitlement equal to at least 2.8 times the level of the prevailing Pension Credit; or are aged 66 or above and have State pension entitlement equal to at least 1.5 times the Pension Credit; or are aged 70 or above. The above retirement ages are uprated in line with life expectancy.

3.6 Students

The statistics on university enrolment of Italian students are collected by Almalaurea and ISTAT.[58] Almalaurea is a consortium that includes 72 Italian universities and the Ministries of the Education, of the University and of the Research (MIUR) and constitutes a reference point for who studies arguments related to the university studies. We use these data to parameterise the evolution of student status in the model.

In Figure 4.6.1 are illustrated the statistics on the university enrolments and the drop-out rates. Within the students that completed the university studies, 42.1% of them do not continue to study after obtaining the bachelor degree, while the 57.9% of them obtain a master degree. In mean it takes 4.7 years to obtain the bachelor degree and 2.9 years to obtain the master degree. The drop-out rate for the students enrolled to an undergraduate program is 30%. This rate is calculated using Istat data on the university enrolments.[59]

Figure 4.6.1
University enrollment and drop-out rate.

Among graduated:	
Bachelor degree only	42.1%
Master degree	57.9%
Mean n of years for the bachelor degree	4.7
Mean n of years for the master degree	2.9
Drop out rate form undergraduate programs	30%

3.7 Demographics

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[58]For additional information see www.almalaurea.it and www.dati.istat.it

[59] Detailed information on the procedure used to calculate the drop-out rate are available from the autors upon request.

Three demographic characteristics were parameterised exogenously from the model structure: life expectancy; relationship status; and numbers of dependent children.

Life expectancy

The model requires age and birth-year specific survival rates to simulate the risk of mortality of reference adults. At the time of writing, the Italian National Institute of Statistics (ISTAT) reports period mortality rates for Italy that are distinguished by sex and age, at annual intervals between 1974 and 2065 inclusive, and between ages 0 and 120. The rates to 2010 are based on observed survival rates, and are projections thereafter. Three series of projections are reported by the ISTAT; a principal projection, a high life expectancy variant, and a low life expectancy variant. We focus on the principal projections here. We assume a maximum potential age of life of 130 years for the analysis. The age specific mortality rates reported by the ISTAT were extended beyond age 120, using a smooth sigmoidal function to equal 1.0 (certain death) at age 130. Furthermore, the time series dimension of the age specific-mortality rates reported by the ISTAT was extended to all age and year combinations feasible for any modelled birth cohort by assuming a constant exponential growth factor of 0.975 from the most approximate year described by the ISTAT data to exogenously assumed age and sex specific asymptotes for the distant past and future.

The model specification does not distinguish reference adults by their gender. The gender specific mortality rates that are reported by the ISTAT were consequently combined into a single series based on implied gender weights. Consider, for example, the cohort born in 1960. Assuming zero migration and equal numbers of males and females at age 16, the gender specific mortality rates reported for this birth cohort by the ISTAT can be used to project the ratio of men to women through time. This ratio was used to obtain a weighted average of the gender specific mortality rates reported by the ISTAT for each modelled birth cohort. To avoid imposing unwarranted structure on the parameters, the mortality rates were stored in the form of a transition matrix, comprised of 111 rows (representing ages 20 to 130), and 91 columns (representing years 1974 to 2065, with two additional rows to represent the distant past and future). The transition probabilities used can be obtained from the authors upon request.

Relationship status

The model requires rates of marriage formation and dissolution by age, year, and education status. Data in this form was not available from public sources. We therefore estimate these rates by combining ISTAT and SHIW data as follows.

At the time of writing, the ISTAT reports historical data for the number of marriages in Italy by age, sex and calendar year at annual intervals between 2002 and 2012. Marriage dissolution in the model accounts for separation, divorce and death of a spouse. The ISTAT reports age and sex specific stock of married, separated and divorced individuals, and the number of widower and widow between 2002 and 2012. Those data are used to calculate the probability for the divorce dissolution for the years 2003 to 2012. These were then combined with mortality rates to obtain total martial dissolution rates.

We extrapolate this data and combine it with data from SHIW to obtain a full series of transition rates from 1986 to 2012. Firstly, we impute ISTAT data back to 1986 using a flexible polynomial in age and year. To facilitate the identification of the relevant parameters, we first assume that divorce rates do not differ by graduate status. This assumption has minimal consequences, as the rate of divorce is generally low in the data. We further assume that marriage rates do no differ by graduate status above the age of 60. Below the age of 60, we adjust marriage rates to match age, sex, education, and year specific proportions of the population that is married from the SHIW data. This delivers a full set of transition rates differentiated by age, sex, year and (partially) education between 1986 and 2012. An additional set of parameters for the distant past and future were set on the basis of values at each extreme of our sample. The gender specific

marital and marriage dissolution rates derived via the above procedure were aggregated into a gender neutral series in the same way as described above for mortality rates

Number of dependent children

The model requires fertility rates by age, year, relationship status, and number of previous births to simulate dependent children. Unfortunately these rates are not readily available for Italy, and so were constructed based on the historical SHIW dataset.

We first estimate raw fertility rates by age, year, relationship status, and number of previous births from the SHIW data between 1986 and 2012. Similarly, we estimate the fraction of women by age, year and relationship status having nonw, one, two or three or more children. Both these sets of data were smoothed to reduce the amount of noise driven by the small cell sizes. Combining these delivers a first set of fertility rates. Finally, we proportionally adjust these fertility rates to ensure that aggregate fertility rate by age and year matched corresponding official Total Fertility rates by age and year provided by ISTAT.

This delivers a full set of fertility rates differentiated by age, sex, year and number of previous children between 1986 and 2012. An additional set of parameters for the distant past and future where set on the basis of values at each extreme of our sample.

4. Calibrated Preference and Wage Parameters

Conceptually, the calibration of structural parameters involves adjusting unobserved model parameters to ensure that, conditional on parameters evaluated in the first stage, endogenous choices implied by the assumed theoretical framework best reflect real-world behaviour. This section describes the results from this second stage of the parameterisation.

The calibration therefore seeks to adjust remaining model parameters so that selected simulated moments implied by the structural model match to sample moments estimated from survey data. We identify these parameters by matching the model to moments evaluated on survey data reported for a single (reference) population cross-section: the Bank of Italy's Survey of Household Income and Wealth 2012.

1. The proportion of adult benefit unit members employed, by age and relationship status

2. The geometric mean of benefit unit gross earnings, by age and relationship status

3. The geometric mean of benefit unit disposable income, by age and relationship status

4. The geometric mean of benefit unit consumption, by age and relationship status

5. The proportion of benefit units reporting to contribute to private pensions, by age and relationship status.

This stage of the empirical analysis is commonly conducted either by manual calibration or optimisation of a loss function using an econometric criterion. The results reported here were obtained via series of manual adjustments of model parameters, guided by graphical representations and sums of squared errors for a set of age specific population moments, following the approach described by Sefton et al. (2008).

Table 6.1 Calibrated preference parameters

Relative risk aversion	1.675
Elasticity Consumption and Leisure (rho)	0.3
Utility price of leisure (singles)	1.6
Utility price of leisure (couples)	1.28
Discount Factor	0.959
Bequest motive: constant	0.2
Bequest motive: slope	5088.865
Experience effect (singles)	0.0425
Experience effect (couples)	0.0125

Our preferred parameter set is reported in Table 2. The calibrated value for the parameter are within the broad range identified by the associated literature, as discussed in Lucchino & van de Ven (2013).

Wage drift and the dispersion parameters were calibrated against historical SHIW data by projecting the reference population cross-section backward through time. The model includes a separate drift parameter for each age, year, education, relationship, and self-employment/public employee/private employee combination, so that a close match could be obtained to the associated sample moments. The drift parameters were adjusted to reflect geometric means of employment income, distinguished by age, year, relation-ship status, education status, and private employ/ public employ/ self-employed status reported by the SHIW between 1986 and 2012. We calibrated the associated earnings parameters to moments calculated for singles to age 60 and for couples to age 64, to omit issues associated with small sample effects at higher ages.

Given the large number of model parameters involved, this stage of the parameterisation was undertaken using an automated procedure repeated until the average absolute variation of parameters over ages for any year, education, and relationship combination fell below 5 percentage points. The large number of parameters involved make reporting here impractical, and associated statistics can therefore be obtained from the authors upon request.

Similarly, the variance parameters were adjusted to reflect age, year, and relationship specific variances of log employment income calculated from survey data. Unlike the drift parameters, however, only four parameters distinguish singles from couples, and graduates from non-graduates, to reflect the dispersion of employment income. These model parameters were adjusted manually.

Appendix 3 – Description of LoSAI sample (INPS)

INPS in figures can be summarized in four subset: insured workers (almost 20 million of private job positions), pensioners (almost 16 million of beneficiaries), temporary benefits (22.7 billion of euro of total expenditure for benefits on support of income, 10.4 billions of euro of total expenditure for social and welfare benefits), companies (1.4 million of registered companies).

A longitudinal sample of workers and pensioners is collected from all this sources in a ratio of about 1: 10,15 compared to the universe. The sample is organized in 7 datasets.

PERSONAL DATA

The dataset is composed by workers and pensioners registered in the administrative archives of the Institute, who were born on days 1 and 9 of any month and year of birth since 1900. Variables of the record are as follows: the current subject code, the historical subject code, gender, year of birth, year of death, if any, region of birth, region of residence. If a subject was only ever recorded with a single code, current and historical codes match, and the subject is represented by a single record; conversely, if the subject in the past has been registered with different codes, then it is present in the dataset with as many records as the codes attributable to her/him, shown in the historical subject code. The current dataset is updated to 31 December 2012 and consists of more than 9 million records.

EMPLOYEES

The dataset is composed by the annual record of wage and salaries collected for social security contribution purposes. Data are drawn by the declarations received by employers, concerning all working relations for which social security contribution is due to INPS to any title. Variables of the record are as follows: subject code, year of work, type of contract (working time, professional status, ecc.), social security contributions (amount paid, weeks useful for pension rights, ecc.), wages and salaries amount, job starting date, job ending date, active labour market policy, firm's code. The current dataset ranges from 1985 to 2012, and for each year consists of around 1 million records.

FIRMS

The dataset is composed by data on registered companies listed in the DM10 model (monthly declarations of salaries and contributions for social security purposes). Variables of the record are as follows: firm's code, company's code (a company can be organized in more than one firm), class of number of employees, statistical economic classification, year of reference.

INDIVIDUAL STATEMENTS

The dataset is composed by individual statements obtained by a procedure that reads and elaborates the full set of databases, and gives a summary as a result. The check of pension rights as well as the calculus of pension amount is based upon these individual statements. Variables of the record are as follows: subject code, period of contribution starting date, period of contribution ending date, contribution code,

days/weeks/months useful for pension right/calculus, professional status, wages and salaries amount, pension fund, firm's code. The current dataset is updated to 31 December 2012 and consists of more than 90 million records.

PARASUBORDINATI

The dataset refers to the so-called "parasubordinati" i.e. semi-independent workers which has been included under the manadatory social security system since 1996 (with, at that time, an amount of contributions equal to 10% of their income). "Parasubordinati" are classified as "professional" or "collaborators". For "professional" variables of the record are as follows: subject code, amount of contributions, year, flag 0/1 if a special contribution for maternity and disease allowances is paid. For "collaborators" variables of the record are as follows: subject code, subject code, employer code, year, month, activity code, contribution rate, amount of contributions. The current dataset is updated to 31 December 2012 and consists of less than 10 million records.

TEMPORARY BENEFITS

The dataset refers to three main benefits: Wage compensation (Cassa Integrazioni Guadagni - CIG) directly paid by INPS, Mobility allowance, Unemployment allowance. CIG is a social benefit for employees covering a temporary period of interruption or reduction of the firm activities. The interruption or reduction of the firm activities has to be related to temporary market events and cannot in any way be due to the will of neither employer nor employee. Variables of the record are as follows: subject code, year, number of hours compensated, amount paid, starting date of benefit, ending date of benefit. Mobility allowance is paid when the worker is dismissed (fired) but is still protected within a business plan of the firm, variables of the record are as follows: subject code, year, firing date, starting date of benefit, ending date of benefit. Unemployment allowance is a temporary payment for income integration when an employee is dismissed (fired) and is no more protected by mobility allowance. The payment is in charge of the Insurance Fund Against Unemployment, financed by employers' social contributions. Unemployment allowance is paid in several different schemes, then main common variables among all these schemes are as follows: subject code, year, firing date, starting date of benefit, ending date of benefit, amount paid. The current dataset is updated to 31 December 2012 and consists of around 2 million records.

PENSIONERS

The dataset is composed by data on all Italian pensions, and therefore refers to pensions paid by INPS as well as paid by other social security institutions. Namely, data are organized by year, in fact information refers to pensions paid at the 31 December of each year from 1985 to 2012. Variables of the record are as follows: subject code, year, type of pension (old-age, survivors, disability), amount paid, starting date.

Appendix 4 - Data on private pension system

Data on private pension system are based on the administrative datasets held by the Italian Pension Funds Supervisory Authority (COVIP). They come from all private pension funds/plans supervised by COVIP such as:

- Fondi pensione negoziali (Contractual pension funds): funds instituted after the Legislative Decree no. 124 of 1993. They are typically set up by collective bargaining btw employers' associations and trade unions at several levels. They support only occupational plans.

- Fondi pensione aperti (Open pension funds): funds instituted after the Legislative Decree no. 124 of 1993. They are promoted by banks, insurance companies, asset management companies. They support both occupational and personal plans.

- Fondi pensione preesistenti (Old pension funds): funds that were already operating before the Legislative Decree no. 421 of 1992. They support only occupational plans.

- Piani individuali pensionistici di tipo assicurativo –PIP (Insurance-based personal pension plans – PIPs): they are instituted after the Legislative Decree no. 252 of 2005. They are offered by insurance companies and they support only personal plans.

MEMBERSHIP

Membership data are collected by COVIP on an annual basis and have been provided from 1999 onwards by type of pension fund/plan, gender, age bracket (<25 years, 25-34, 35-44, 45-54, 55-64 and 65+), geographical area of residence (North-East, North-West, Centre, South and Islands) and professional status (private sector employees, public sector employees and self-employed). Participation rates to the private pension system have been calculated in terms of workforce by using ISTAT data.

CONTRIBUTION RATES

Contribution rates are referred to contractual pension funds and are based on the collective agreements between employers' associations and trade unions instituting the fund. For multi-sector pension funds, the range of contribution rates has been provided.

RATES OF RETURN

Rates of return have been provided by type of pension fund (contractual pension funds, open pension funds and PIPs) and of sub-fund (guaranteed sub-funds, bond sub-funds, balanced sub-funds, equity sub-funds) from 1999 onwards. For each type of fund/sub-fund, returns are calculated as the percent change of the capitalisation index where the performance of a single fund/sub-fund in the year n is weighted by the net asset value of that fund/sub-fund at the year n-1.

SYNTHETIC COST INDICATOR (SCI)

Synthetic cost indicator (SCI) is calculated for each pension fund according to a common methodology set by COVIP. It measures on annual basis how much the individual account of a pension fund's member is reduced by taking into account all costs and fees applied by the fund. The SCI is computed for 4 different participation periods (2, 5, 10 and 35 years).

Appendix A of chapter 6: Computation rules for the pension benefit

Below we describe the different rules prevailing under the DB, the mixed and the NDC schemes. The population in the model has been divided into three groups according to seniority in 1995: DB, mixed and NDC.

The computation rule for pension benefit of those workers who are under the DB system is summarized by the formula:

$$P_{DB}= r*(N_1 W_1 + N_2 W_2) \qquad (1)$$

where r is an accrual rate, N_1 and N_2 represent the years of contribution before and after 1992 respectively, W_1 and W_2 represent the pensionable earnings used for computing pension installment, for the contributions paid before and after 1992 respectively.

The terms r and W in the DB formula vary according to pension scheme and to the amount of pensionable earnings. In particular, W_1 is equal to the last yearly-earning for employees in the public sector; the average of the last five or ten pensionable yearly-earnings for those employed in the private sector and self-employed workers respectively. W_2 is the mean computed over the last ten years of positive earnings for public and private sector employees and over the last 15 years for self-employed workers. The accrual rate r is equal to 2% for the pensionable earnings bracket between 0 and 42,111 Euros (2009 prices) and it decreases with earnings level down progressively to a value of 1.1% for the pensionable earnings bracket over 55,976 Euros (2009 prices).

For workers under the mixed regime, the old age pension benefit is determined as the sum of two components:

$$P_{mixed}=P_A+P_B \qquad (2)$$

where the general rule for determining P_A is similar to the formula used in the DB regime for the contribution paid before 1995, while the second, P_B is computed according to a NDC rule on the contributions paid after 1995. Nevertheless, in the "mixed" regime the pensionable earnings for the contributions paid between 1992 and 1995 is determined differently, as the average yearly earnings indexed to 1% yearly rate according to a simple compounding rule. The P_B term of the mixed pension is figured according to the NDC rule of equation (3).

Old-age pension in the NDC system is computed as:

$$P_{NDC}=D_x * MC \qquad (3)$$

where D_X is a conversion factor that varies with retirement age (x) so as to guarantee a quasi-actuarial equity between the present value of paid contributions and the present value of expected pension benefits[60]. MC is

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[60] The conversion factor has been computed as the result of the following simplified formula:

the total of contributions accrued during the whole working life in proportion to gross earnings (33% for employees and 24% for self-employed), capitalized at the rate of growth of nominal GDP. The yearly contribution is computed as a share of the gross wage for employees and gross income for the self-employed. The contribution rate is set at 33% for employees and 24% for self-employed workers. A contributory cap is set at 91,507 Euros (2009 prices). At least five years of contributions are required to claim an old age pension if the corresponding pension instalment exceeds the amount of social allowance increased by 20%.

$$
D_X = \sum_{t=0}^{w-x-l} \frac{l_{x+t}^v}{l_x}(1+i)^{-t} + \beta \sum_{t=0}^{w-x-l}\left(\frac{l_{x+t}^v}{l_x}q_{x+t}^v a_{x+t+l}^F(1+i)^{-(t+1)}\right)
$$

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$$

found in Caselli et al (2003) where w is the maximum life span (set equal to 100 years); $\frac{l_{x+t}^v}{l_x}$ $\frac{l_{x+t}^v}{l_x}$ $\frac{l_{x+t}^v}{l_x}$ is the pensioner's probability at age x of being alive at age $x + t$; i is the annual real discount rate (set equal to 1.5 per cent, assumed to be equal to the long-run annual growth rate of Gross Domestic Product in real terms); β (set equal to 0.54 for a male pensioner and 0.42 for a female one) is the fraction of the pension paid out the surviving spouse (if there is any); q_{x+t}^v q_{x+t}^v q_{x+t}^v is the probability of dying between age $x + t$ and age $x + t + 1$; a_{x+t+l}^F a_{x+t+l}^F a_{x+t+l}^F is the expected present value of a real annuity of one dollar paid to the surviving spouse (if there is any) after the pensioner's death at age $x + t + 1$.