IESS

Improving Effectiveness in Social Security

FINAL REPORT

MEF Dipartimento del Tesoro

INPS

FGB Fondazione Giacomo Brodolini

centre for economic & social Inclusion

IESS project is funded by the European Union Programme for Employment and Social Solidarity – PROGRESS (2007-2013). The information contained in this report reflects only the author's view. The European Commission shall not be considered in any way responsible for any use that can be made of the information it contains.

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EXECUTIVE SUMMARY

In the last decades, Italy, more than other European countries, has been subject to a generalized aging process that, over the medium and long term, is expected to have major consequences on the society, the economy and the public finances.

The increasing longevity of the population, being, among other things, a sign of well-being and increased quality of life, has been accompanied by a considerable drop in the fertility rate. In the medium term, such demographic patterns would lead, on the one hand, to a reduction of the working age population, only partially mitigated by an increase of expected migration and, on the other hand, to an increase in the elderly population with a heightened expectancy life at retirement.

From the point of view of the sustainability of public finances, the expected reduction of the population of working age is a factor that, most likely, will be bound to adversely affect the long-term economic potential growth and erode, in a structural way, the economic bases underpinning general taxation.

The increase in life expectancy of older people could lead to a general redistribution of public expenses with a steep increase in public spending for social security and health services and, at the same time, a possible reduction on education outlays producing a general impoverishment of human capital.

These processes, if not addressed in time, could lead, in a not too distant future, to structurally unsustainable public finances that could, in turn, result into a downsizing (or more dramatically in the discontinuation) of some social security benefits, such as health care and education that are currently universally guaranteed.

Against this backdrop, it has also to be recalled that the long, discontinuous and non-systematic process of reform which concerned the Italian pension system in the last 25 years or so, while being guided by the logic of emergency, was also able to curb the growing trend of pension spending so to maintain sound and sustainable public finances in the medium / long term, to sterilize the system with respect to the impact of aging and, at the same time, to correct some intergenerational inequities inherent to the excessive generosity of previous regimes.

This is true, in particular, with regard to the reform of 2011 (Law n. 241/2011, the so-called Fornero reform) which has foreseen: 1) the introduction of a Notional Defined Contribution regime for all workers whose career started in 1996 (and pro-rata for all the other workers); 2) an increase in the retirement age of women, envisaging a gradual alignment in 2018 with that of men; 3) the introduction of new pension income minimum thresholds to access both old age and seniority retirement; 4) the strengthening of the "automatic" link between statutory retirement age and contribution requirements and the evolution in life expectancy.

Thanks to all these parametric changes, the Italian pension system is currently designed to provide a response to the social and economic challenges posed by the aging of population. This view is also shared by the European Commission, which does not identify specific risks to the sustainability of Italy's pension system, despite the high initial level of spending relative to GDP.

Indeed, both the 2012 and the 2015 Ageing Report of the European Commission and Economic Policy Committee project that the Italian public pension expenditure as a ratio of GDP will not be higher in 2060 than in 2013, in spite the dramatic rise in the share of population aged 65 and over. In particular, according to the 2015 Ageing Report, in the period from 2013 to 2020, public pension spending should actually drop from 15.7 percent of GDP to 15.3 per cent. In later years, spending should slowly increase by a few percentage points to 15.8 percent of GDP in 2040 as a consequence of the retirement of the baby boom generations. Finally, in the decades following 2040, public pension outlays are expected to decline significantly so as to be in 2060, 1.9 percentage points of GDP lower that the 2013 level. Albeit from higher spending levels than in other European

countries, the Italian pension system seems to be able to contain better than elsewhere the trend of increased spending due to the natural aging of the population.

According to such projections, fiscal sustainability of the Italian pension system is not at risk. However, it may be argued that the reduction in pension expenditure over the coming decades, even if it produces gains in fiscal sustainability, will take place at the expense of the social adequacy of pension and social security benefits. This is only partly true.

The provisions of a Notional Defined Contribution regime together with the automatic linkage between life expectancy developments and statutory retirement ages are going to create incentives to work longer and contribute more over time. Such provisions are structurally designed to guarantee actuarial fairness. The European Commission data also show that, *vis-à-vis* other European countries, the replacement rate for Italy – i.e. the ratio between the first pension perceived and the last salary – is and will remain among the highest in the European Union also in 2060. The Italian pension system is among the few in Europe that are expected to guarantee over time the relative equivalence between the length of working life and the length of life spent in retirement. In other countries, increases in retirement age are often accompanied by proportionally shorter periods of quiescence or, given the same length of life spent in retirement, a drastic cut in pension benefits.

While fiscal sustainability and the social adequacy of the Italian pension system seem to have been secured, specific risk profiles may stem from labour market conditions characterized by fragmentation of careers (especially among women), socio-economic conditions and too high social mobility which may have negative effects on social adequacy. In such a framework, improving efficiency and effectiveness of social spending remains a key priority.

In addition, postponing retirement in line with the increases in pensionable ages, amongst other measures, could mitigate the reduction in replacement rates in most Member States, as longer careers result in better individual pension entitlements. Yet, the actual impact of this option will depend on the extent to which future cohorts, of women in particular, will be able to achieve fuller careers and on whether older workers will have sufficiently good health, skills and labour market opportunities to work longer and earn more pension rights. The impact of lower pensions from public schemes could also be offset or mitigated by increased entitlements from supplementary retirement savings.

In the near future, public resources will be increasingly narrower and measures addressing social issues and aimed at combating exclusion and poverty will be subject to tight budgetary constraints.

In this context, labor market reforms should create incentives in favour of less discontinued careers and in favour of more stable jobs. These conditions are also preliminary to the redirection of private savings into pension funds and to a faster development of supplementary pensions. When periods of unemployment and inactivity do occur, unemployment benefits should be designed to ensure an overall maintenance of income levels and, through imputed contributions, the preservation of adequate pension benefits especially for the most disadvantaged individuals and those at risk of interrupted careers.

Against this backdrop, this Report presents the final results of the project "Improving Effectiveness in Social Security" (IESS), funded by the European Commission, coordinated by the Italian Ministry of Economy and Finance (MEF) and, in particular, the Department of the Treasury, in cooperation with the National Social Security Body (INPS), Fondazione Giacomo Brodolini and the Centre for Economic and Social Inclusion (CESI). IESS follows up a previous project named "Innovative Datasets and Models for Improving Welfare Policies" and aims at providing innovative analytical tools to improve the effectiveness of public policy evaluation.

The purpose of the project was to assess the efficiency of the Italian public and private pension system in the short and long term, by measuring its financial sustainability, adequacy and social inclusion.

Once the main vulnerabilities and drawbacks were identified, the objective of the analysis was to put forward sound and swift technical solutions for policy makers.

The different analyses were conducted through cutting-edge tools highly updated with respect to the previous project, such as the T-DYMM microsimulation model developed by the Department of the Treasury, and the AD-SILC database.

AD-SILC is an unbalanced dataset which links individual socioeconomic data (such as education, marital status, number of children, etc.), collected by ISTAT through the SILC survey, with administrative data on individual occupational statuses and contribution histories of both workers and retirees, collected by INPS. The construction of AD-SILC, which has an enormous potential informative content and could be considered as an excellent example of cooperation between public agencies in the use and disclosure of relevant data to support policy decisions, is described in Chapter 1.

Based on AD-SILC historical data, Chapter 2 focuses on the Italian labour market features over the last decades providing descriptive evidence on earnings distribution and on workers' transitions across the various contractual arrangements. Furthermore, exploiting the longitudinal characteristics of the AD-SILC dataset, an analysis of the contribution accrual of workers who are subject to the Notional Defined Contribution scheme – i.e. those who entered the labour market later than 31/12/1995 – is also provided. This chapter shows that Italian labour market is not as rigid as commonly described because of the high estimated probability of changing working status and conditions. In addition, young cohorts are shown to have faced low contribution accrual rate with respect to the condition of a theoretical representative worker.

Given the relevance of life expectancy for social adequacy outcomes in a Notional Defined Contribution regime, Chapter 3 focuses on the relationship between mortality and individual characteristics using the AD-SILC dataset. New empirical evidence for Italy is provided on the basis of the so-called survival analysis. Measuring the instantaneous probability of death, given current information and socio-economic explicative variables, it is shown that better education, better work conditions and higher income all reduce the risk of mortality. By contrast, living in "poor" areas reduces the probability that the gains in longevity will be spent in good health conditions.

Chapter 4 presents a description of the features of the Italian pension system. A special focus is given to the long-lasting period of reforms that has characterized the public pensions system until the most recent and systematic reform undertaken through Law n. 241/2011 (the so-called Fornero reform) as well as to the challenges ahead. The features and the historical performance of the private complementary pension system are also described in details.

The microsimulation model T-DYMM 2.0 is presented in Chapter 5, which describes its new features *vis-à-vis* the former version developed for the previous project named "Innovative Datasets and Models for Improving Welfare Policies". Differently from the previous release, the underlying parameters of the model T-DYMM 2.0 are now all drawn from a set of econometric estimates carried out using the new and updated longitudinal dataset AD-SILC. In this respect, T-DYMM 2.0 simulates individuals' transitions over life cycle (births, deaths, marriages, educational achievements and labour market events) and analyses their condition at retirement without relying on external estimates. Beside this clear advantage, other important features of T-DYMM 2.0 *vis-à-vis* the previous version are: i) the new platform of the simulation, with a new user-friendly programming code (LIAM2); ii) the updated structure of the model and the characteristics of various sub-modules which for the first time include the new sub-module on private pension schemes.

Thanks to the use of the new and improved version of AD-SILC, econometric estimates based on logit models are used to derive all the initialization parameters for the microsimulation projections based on T-DYMM 2.0. Chapter 6 is entirely devoted to the presentation of such estimates, which provide information on the demographic and socioeconomic variables shaping the probability of: giving birth, attaining a certain level of education, getting married or divorced, working under specific contractual arrangements, gaining specific earnings and so on.

Results show that transitions among work statutes are quite frequent and that education is crucial to get better wages. In addition, past work experience increases the probability of being employed, getting better compensations and better (permanent) working conditions. Finally, specific family conditions (number of children, being married/single) may affect outcomes especially for female workers.

Chapter 7 presents the main findings of the T-DYMM 2.0 baseline simulations up to 2060, both with reference to labour market (wage and employment) and to pension projections. Being aligned to 2015 Ageing Working Group projections, the results of the microsimulations show a steep increase in retirement age both for men and women, coupled to a very slow, though steady, transition to the Notional Defined Contribution regime. In terms of adequacy analysis, the model shows that the replacement rate of the generations affected by the Fornero reform will remain substantially constant over time, despite the progressive ageing of the population. The lowest pensions will keep their levels and there will be a progressive redistribution phenomenon between the richest and poorest pensioners. The introduction of private pension plans has a great impact on replacement rates over time but, overall, it increases inequality as it favors richer pensioners.

Chapter 8 illustrates how the projections of the baseline scenario would change following positive and negative shocks on productivity and employment and a shock on yields for private pensions. A special focus is devoted to a positive shock on fertility rates (high fertility scenario). In this case, higher fertility rates would translate into higher GDP growth because of the enlargement in the labour force. The social adequacy of the pension system will increase, but only over the medium to long term.

The results of some specific policy scenarios are presented in Chapter 9. Such scenarios simulate: 1) the impact on pension adequacy of the unemployment benefits reforms recently implemented in Italy through the Jobs Act; 2) the impact of flexibility in retirement stemming from the introduction of incentives to prolong/shorten working lives. As far as the first policy scenario is concerned, the evidence of T-DYMM shows that the replacement rate of unemployment benefits resulting from the Jobs Act reform will benefit more people with a lower income compared to what could have been expected on the basis of previous legislation. As far as the impact of flexibility is concerned, results show that this would favour men and people with stable career rather than helping workers with discontinuous employment histories.

Finally, Chapter 10 provides a survey of the empirical literature on the macroeconomic effect of ageing on labour productivity and on the possible pension reform options to minimize the deadweight costs and to enhance growth.

In conclusion, the fiscal sustainability and social adequacy of a pension system are two sides of the same coin. The international evidence and models at our disposal show that the Italian pension system, despite the legislation adopted under emergency condition, is currently able to guarantee the sustainability of the system and its social adequacy. The focus should now be placed on the efficiency in social spending and on the optimal development of the labour market.

1. A NEW VERSION OF THE AD-SILC DATASET: DESIGN AND FEATURES

The current project, "Improving Effectiveness in Social Security" (henceforth, IESS), has been launched in May 2014 to provide innovative analytical tools to increase the effectiveness of public policy evaluation in the fields of labour market analysis, labour income distribution, public and private social security programs and retirement behaviour.

The activities carried out in the IESS project largely stem from the work carried out in a previous project with similar features, titled "Innovative Datasets and Models for Improving Welfare Policies". The latter had the goal of developing:

1. a unique and innovative dataset – called "Administrative SILC", henceforth AD-SILC – by matching longitudinal information from several administrative archives gathered by INPS (National Institute of Social Security) with survey data collected by ISTAT (National Institute of Statistics);

2. a dynamic microsimulation model (henceforth, DMSM) – called T-DYMM (Treasury Dynamic Microsimulation Model) – to simulate the evolution of a cross-sectional sample representative of the Italian population, with both individuals and households as units of analysis.

More in detail, in order to build the initial version of the AD-SILC database, very detailed micro-data coming from the 2005 cross-sectional wave of the IT-SILC survey, i.e. the Italian database of the European Union Survey on Income and Living Conditions (EU-SILC), have been merged with information collected in many administrative archives managed by INPS. Since the beginning of each individual career, such administrative records provide granular information about various characteristics of private and public employees, self-employed, recipients of unemployment benefits and retired workers.

Given this framework, in the previous project, the AD-SILC dataset was employed to analyse the Italian labour market performances in the last decades at the individual level. A particular focus was given to the dynamic of earnings distribution, to the individual transitions among the various working statuses and to the adequacy of contributions accrued by cohorts of workers belonging to the new Notional Defined Contribution (NDC) pension scheme.

Furthermore, the database AD-SILC was crucial in developing the first version of the micro-simulation model T-DYMM, since it contains all the relevant information for the computation of future pension benefits as well as the information to simulate labour market dynamics and demographic processes.

Against this background, the present IESS project aims at improving both tools – the AD-SILC database and the T-DYMM microsimulation model – by making them more suitable for the purpose of policy assessment. Accordingly, concerning the AD-SILC database, the focus of the IESS project is on:

iii. updating the micro-data collected in the administrative archives up until the end of 2013, in order to assess the impact of the current crisis on working careers and lives after retirement;

iv. adding new variables, available in the administrative datasets, to those already included in the initial version of AD-SILC, providing for instance additional information on the characteristics of the jobs carried out by "parasubordinate" workers[1], further details on single contractual arrangements (e.g. apprenticeship

1 In 1996, INPS created a specific fund called *Gestione Separata* for "dependent" self-employed workers, e.g. professionals who do not pay to their association's specific fund, project workers (so called *co.co.pro*) and co-workers (so called *co.co.co*). In other terms, parasubordinate workers represent a specific subgroup of the so-called "atypical workers" (workers who are neither employees nor self-employed who contribute to

vis-à-vis other kinds of contracts based on work and training) and on the kind of unemployment benefit received (e.g. mobility allowances, unemployment benefits under ordinary or reduced requirements);

v. increasing the sample size for the purpose of microsimulation. The current setting includes all individuals interviewed in all the SILC waves from 2004 to 2012, while the previous sample size only considered the 2005 wave.

The next section presents the main advantages of the new AD-SILC database. The first and the second versions of the dataset are compared in order to highlight the improvements achieved so far. The third section describes the contents of the two data sources employed to build AD-SILC, providing a description of the main variables that are merged in the new dataset. Section 4 outlines the merging procedure and the structure of the new dataset, also providing some preliminary descriptive statistics about the data. Section 5 concludes.

1.1 THE ADVANTAGES AND LIMITS OF THE AD-SILC DATASET: A COMPARISON BETWEEN THE ORIGINAL AND THE EXTENDED VERSION OF THE DATASET

Assessing individual working histories, and in particular their transitions among different working statuses, requires both the availability of a longitudinal micro dataset – i.e. the same individual has to be observed for many years – and detailed information about socio-economic characteristics of each worker. Currently, longitudinal information are provided by two different sources:

- Administrative datasets (INPS archives) in which single records are usually collected following legal obligations for the purpose of carrying out various non-statistical programs such as, in the case of INPS data, to administer entitlements such as pensions.
- Survey datasets (SILC) which are based on a predefined panel of individuals who are asked to answer a questionnaire concerning their social/economic status.

Both sources have some pros and cons. Administrative datasets present a wide coverage (sometimes they collect information about the whole reference universe) and a very long time span. Administrative archives have records on individuals from the moment they enrol into the group of interest (e.g. he/she becomes a private employee or an unemployment benefit recipient). However, these archives only usually collect information relevant for the given administrative task, therefore they may not record crucial information needed to analyse labour market issues in depth. For instance, in the INPS archives, employees are followed for the whole working life, but individual educational attainments and marriage statuses are not recorded, so the main determinants of workers' outcomes cannot be estimated.

On the contrary, surveys record several individual characteristics, but they are usually cross-sectional or follow workers only for a short time span and often have a very limited sample size. For instance, the EU-SILC dataset is based on a rotation scheme where individuals are followed for four years at most.

In this context, the first version of the AD-SILC dataset, by merging the SILC survey data collected by ISTAT with administrative information provided by INPS, overcame some of the drawbacks of the aforementioned sources. More specifically, in the previous version of AD-SILC, micro-data from the survey IT-SILC 2005 had been merged with several variables collected by INPS, providing retrospective information at the individual level from the beginning of the working life of each individual up to 2009.

Vis-à-vis the existing datasets, the first version of AD-SILC provided substantial improvements under several respects:

- individual time variant variables regarding working conditions for the whole working career (collected in administrative archives) and individual time invariant characteristics and time variant features (surveyed

funds other than INPS).

by IT-SILC in 2005; e.g. educational attainment, parental education and occupation, marital status, family composition, citizenship) were merged for the first time;

- thanks to the information collected in the Registers of Active People and Retirees carried out by INPS, variables concerning all typologies of jobs, including when the worker receives an unemployment benefit or a sickness/maternity allowance were registered at the individual basis. Consequently, all kinds of workers' transitions could be observed. When the individual is not surveyed in a year it means that he/she has been inactive or has been an informal worker for the whole year;
- information at the firm level (e.g. detailed sector and firm's size, both at the unit and the holding level) were collected jointly in the underlying datasets, offering the possibility to match employers' and employees' characteristics with more precision than what was been possible using only survey data, where employers' characteristics are inferred mostly indirectly and with lower detail, through workers' responses.

Nonetheless, the previous version of the AD-SILC dataset still presents some drawbacks stemming from the weaknesses of the underlying sources. For instance, as longitudinal information comes from the administrative source of the dataset (e.g. INPS archives), it refers only to individuals paying contributions to INPS, hence excluding the relevant evidence coming from individuals who, for some reasons, do not belong to the labour force (at least formally). It gives (longitudinal) information only about job careers, hence excluding relevant individual characteristics. Concerning the survey source (IT-SILC 2005), the data only refers to the 2005 wave. Such a feature imposes a significant limit on the representativeness of the sample in AD-SILC and it precludes the possibility to observe potential changes in individual conditions, such as marital status, childbirths and education attainments.

The new version of the AD-SILC dataset, built in the context of the IESS project, overcomes some of the drawbacks of the previous setting, by exploiting the longitudinal design of IT-SILC through the use of multiples waves of the survey. Indeed, adding more survey waves significantly enlarges the sample size, thus allowing to thoroughly investigate characteristics of the reference population that were not graspable before. In particular, with the new specification of the AD-SILC database, it is now possible to study by means of robust techniques the dynamics followed by smaller and specific subgroups of the Italian labour force. Furthermore, being updated up to 2013/2014, the new version of AD-SILC allows to analyse in a comprehensive way the weaknesses engendered by the current macroeconomic crisis and its impact on labour market dynamics and labour income distribution. Finally, using the new longitudinal IT-SILC database allows to observe changes in individual statuses – other than those strictly linked to the labour market – that took place during the time interval spanned by the different waves of IT-SILC (e.g. transitions from single to married, from married to divorced, childbirths and further education attainments, thus allowing to estimate such demographic changes). Moreover, employment and contract transitions can be analysed in relation to changes occurred in the family structure and/or the education level.

In conclusion, the new version of the dataset on one side strengthens the results already obtained with the previous "shorter" version of AD-SILC and, on the other side, greatly expands the possibilities to carry out detailed researches on individual dynamics in the labour market. Consequently, it also enlarges the scope of the dynamic micro-simulations run by means of T-DYMM.

1.2 STRUCTURE AND VARIABLES OF IT-SILC AND OF ITALIAN ADMINISTRATIVE DATASETS

The AD-SILC dataset has been built by merging longitudinal data collected from several administrative archives. To this aim, INPS archives, including all individuals belonging to a specific group such as, for instance, private employees or professionals, have been merged with the survey micro-data IT-SILC, the Italian version of the EU country-specific survey EU-SILC. In the first version of AD-SILC, as already mentioned, only cross-sectional data of IT-SILC 2005 have been used, while eight more waves (data collected in IT-SILC in the 2004-2012 period) have been added in the current version of the dataset.

This procedure has allowed to link rich information about individual backgrounds gathered in IT-SILC with information about working histories collected in the administrative archives from the beginning of working lives up until 2013/2014.

IT-SILC is the Italian database of the European Union Survey on Income and Living Conditions (EU-SILC), which has been developed as a flexible yet comparable instrument for the follow-up and monitoring of poverty and social exclusion at the EU and national levels. In general, EU-SILC covers data and data sources of various types: cross-sectional and longitudinal, household-level and person-level. It collects economic and social characteristics from registers and from surveys, from new and existing national sources.

The sample design of IT-SILC is based on a two-stage procedure. For each region, municipalities are clustered into auto-representative (with larger population size) and not auto-representative (smaller size) ones. For the first group, households are systematically drawn from the register office records. For the latter group, instead, households are selected randomly after a specific sample of municipalities is chosen.

Similarly to the European version, the scheme of IT-SILC envisages two components: a cross-sectional one and a longitudinal one. In particular, a rotational panel is set, in which a new sample of households and persons is introduced each year to replace a quarter of the existing sample[2]. Table 1.1 illustrates the rotation scheme of a four-year panel adopted for IT-SILC[3]. For example, in the case of the wave surveyed in time T+3, the sample group D is interviewed for the fourth time (D4), E for the third time (E3), F for the second time (F2), while G is introduced for the first time in the dataset (G1).

TABLE 1.1: THE ROTATION SAMPLE SCHEME OF A FOUR-YEAR PANEL DATASET

TIME	YEAR	A	B	C	D	E	F	G	H	I	J	K	L
T	2004	A4	B3	C2	D1								
T+1	2005		B4	C3	D2	E1							
T+2	2006			C4	D3	E2	F1						
T+3	2007				D4	E3	F2	G1					
T+4	2008					E4	F3	G2	H1				
T+5	2009						F4	G3	H2	I1			
T+6	2010							G4	H3	I2	J1		
T+7	2011								H4	I3	J2	K1	
T+8	2012									I4	J3	K2	L1

Therefore, the cross-sectional sample is composed by the union of four samples, each belonging to its specific wave, where a quarter of the households participate to the survey for the first time, a quarter of the households participate for the second time, a quarter for the third time and a quarter for the fourth (and last) time. Each quarter of households is therefore followed for four consecutive years. Indeed, the first group of households that was actually followed for four years is group D, that started being interviewed in 2004 and was surveyed for the last time in 2007. In the case of Italy, the first survey to be launched, IT-SILC 2004, is composed of 32.000 households in total and around 8.000 households in each longitudinal sample. For the second wave, relative to 2005, the sample size comprises ¾ of the households surveyed in IT-SILC 2004 (B4, C3 and D2 in Table 1.1) and 8.000 households of maiden selection (E1 in Table 1.1).

So far, as illustrated in Table 1.1, six sample groups (D, E, F, G, H, I) have been followed for four years (the maximum time span), two sample groups (C and J) for three years, two sample groups (B and K) for two years, and finally, two sample groups (A and L) appear as cross-sectional samples. In addition, only the (cross-sectional) waves between 2007 and 2009 contain (longitudinal) sample groups for which a full panel is present.

2 This scheme is equivalent to the rotating panel design (Duncan et al, 1989).

3 ISTAT has adopted a panel of four years for IT-SILC, which is the minimum duration requested by Eurostat. Other EU datasets enclose a six-year panel.

Another important feature of IT-SILC is the large number of collected variables. Four types of data are involved: (i) variables measured at the household level; (ii) information on household size and composition and basic characteristics of household members; (iii) income and other more complex indicators measured at the personal level, but aggregated to construct household-level variables (which may then be ascribed to each member for analysis); and (iv) more complex non-income or 'social' variables collected and analysed at the personal level. The information gathered in each wave refers to two distinct time periods: some variables refer to the time of selection (e.g. year t), and others, among which income, to the preceding year (e.g. year t-1).

For more clarity, it is useful to look at the scheme provided by Graf et al. (2011), which depicts the main features of the variables, as follows:

- Kind of data:

A. *If the variable is a household variable, it is either:*

   1. Basic data (basic household data including degree of urbanisation);
   2. Income (total household income and gross income components at household level);
   3. Social exclusion (non-monetary household deprivation indicators, including struggle in making ends meet, extent of debt and enforced lack of basic amenities);
   4. Labour information (childcare);
   5. Housing (dwelling type, tenure status and housing conditions, amenities in dwelling and housing costs).

B. *If the variable is a person variable, it is either:*

   1. Basic data (basic personal data and demographic data);
   2. Education (education level, year of attainment, whether currently enrolled in education processes);
   3. Labour information (basic labour information on current activity status and on current main job, including information on last main job for unemployed, basic information on activity status during income reference period, total number of hours worked on current second/third ... jobs, detailed labour information, activity history and calendar of activities);
   4. Health (health status and chronic illness or condition and access to health care);
   5. Income (net and gross personal income, total and components at personal level).

- Type of variable: cross-sectional or longitudinal;
- Reference period (constant, current, income reference period, last twelve months, since last year, working life and childcare reference period);
- Unit (household, household member, former household member, selected respondent and household members aged 16 and over).

Against this backdrop, IT-SILC provides a wide range of variables about individual backgrounds that can be linked to administrative datasets, thus enriching their representativeness of Italian workers.

In order to build the AD-SILC dataset, various administrative archives provided by INPS have been employed, and additional information was collected on individuals who do not pay contributions to INPS funds, e.g. public employees and self-employed workers enrolled in private funds managed by their professional associations. These datasets, and the variables included, do not substantially differ from those used for the previous version of AD-SILC, and are the following:

- EC_INPS: collecting information about all workers paying contributions to INPS funds (e.g. private

employees, farmers, dealers, artisans, parasubordinate workers and professionals with no private fund managed by their associations) up to 2014.

The reference unit in EC_INPS is the individual's employment relationship in the year; this means that individuals that have more than one employment relationship in a year (or perceive both salaries and unemployment benefits, maternity or sickness allowances) present more than one record per year.

In EC_INPS, the following variables are recorded each year: age; year of birth and death; sex; State and Province of birth; date of start and end of every employment relationship and of every period receiving unemployment benefits or sickness/maternity allowances; number of weekly contributions referred to each employment relationship or number of weeks during which benefits/allowances are paid; fiscal code of the firm (in case of private employees); Province where the individual works; annual gross wage for every employment relationship and amount of welfare benefits; specific INPS funds to which the individual pays his/her contributions (this variables allow to distinguish private employees from parasubordinate, farmers, craftsmen and dealers); type of contributions paid to INPS, that allows to distinguish periods spent as workers from periods spent receiving unemployment benefits and sickness/maternity allowances; workers' position, that allows to distinguish amongst managers, white-collars, blue-collars, apprentices and, since 1998, amongst part-time/full-time and fixed-term/open-ended employment arrangements.

In the previous version of AD-SILC an additional archive (EC_NOINPS) was present for those workers not enrolled in INPS funds, e.g. public employees and professionals enrolled in private funds managed by their associations (lawyers, architects, dentists, psychologists, etc.). At present, EC_NOINPS is integrated in EC_INPS, forming a single archive for active workers (henceforth, *Register of Active Workers*).

- AZ_INPS: collecting firms' characteristics up to 2013/2014. This dataset can be merged to EC_INPS by using the fiscal code of the firm as key. The variables recorded for each year in this archive are the following: the detailed sector of the firm (classified through 3 digits ATECO); the business structure of the firm (distinguishing among single firms and companies with a parent-subsidiary relation); the number of workers of the holding and of the local unit of the firm.
- PENSIONI: collecting information on people receiving pension benefits for the period 2005-2013. We shall refer to it as the *Register of Retirees*. The following variables are recorded: sex; age; date of death; date of retirement; monthly gross amount of the pension benefit; region of residence; professional status before retirement (e.g. employee or self-employed); seniority at retirement (weeks of contributions accrued); typology of pension benefit (allowing a distinction among old-age/early-retirement, survivor, invalidity and social pensions).

In its current framework, the database AD-SILC is functional to the utilisation of the dynamic micro-simulation model T-DYMM, aimed at evaluating the adequacy of the Italian pension system. Consequently, information on supplementary pension plans is crucial. In this regard, IT-SILC provides useful variables by specifically asking respondents to indicate whether they have paid voluntary contributions to financial institutions for private pension plans and what the respective amounts were[4]. As reported in Table 1.2[5], only a small part of the sample aged 16-80 paid voluntary contribution for supplementary pension schemes in the 2003-2011 period, and the share has reduced over the years. On the other hand, focusing on employees alone, the percentage share of contributors to private pension plans has increased over the years, especially in the last two years of survey.

4 Questions are referred to the year preceding the survey year.

5 Values reported in the first row are calculated on the basis of the following question of IT-SILC: "PENSIT: In year t-1, did you pay any voluntary contributions to banks, insurance or financial institutions for individual private pension plans?" Values reported in the second row refer to the following question: "CONVOL: In year t-1, were any voluntary contributions withheld from your pay-check and deposited to a company pension fund?"

TABLE 1.2: SHARE OF POPULATION (EMPLOYEES) WHO PAID CONTRIBUTIONS TO SUPPLEMENTARY PENSION PLANS (% VALUES)

survey year	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*average*
population (aged 16-80)	7.4	6.9	6.1	5.5	5.3	5.1	4.8	5.2	3.6	5.5
only employees	6.2	6.1	6.2	7.4	9.2	9.2	9.7	14.5	15.9	**9.45**

Source: elaborations on IT-SILC data

1.3 THE PROCEDURES FOR BUILDING THE AD-SILC DATASET

As in the case of the first version of AD-SILC, the merging procedure between administrative and survey data has been carried out according to the rules regulating the SISTAN, the Italian National Statistical System that comprises both INPS and ISTAT. These rules state that Institutions members of SISTAN are allowed to exchange among themselves statistical information, including sensible data for research purposes. Hence, the merging procedure started with the official request by INPS to receive the SISTAN version of IT-SILC, i.e. the one including "fiscal codes", unique keys characterizing all residents in Italy.

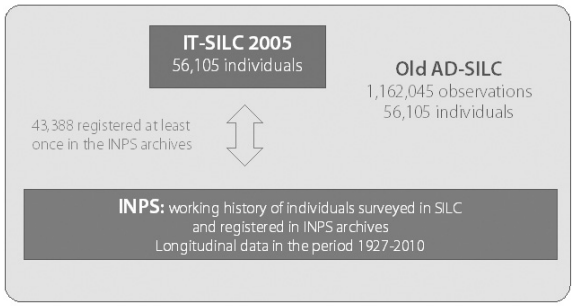
Employing the fiscal codes of all individuals sampled in IT-SILC, INPS drew out all available records from the three aforementioned archives (EC_INPS, AZ_INPS and PENSIONI) on those individuals. Once the records had been drawn out, INPS blanked the fiscal codes for privacy reasons, replacing them with an individual identification key (common for INPS and IT-SILC). Hence, by means of the identification key, the administrative archives were merged in a single very large administrative dataset. Then, information recorded by IT-SILC was added to the variables recorded by administrative archives for all individuals that had been registered by INPS in their lifetimes. Once the merging procedure had been completed, the very long retrospective panel AD-SILC – where individual data is recorded from the entry in the labour market up to 2013/2014 – was ready[6].

The following figure illustrates the previous and the current design of AD-SILC.

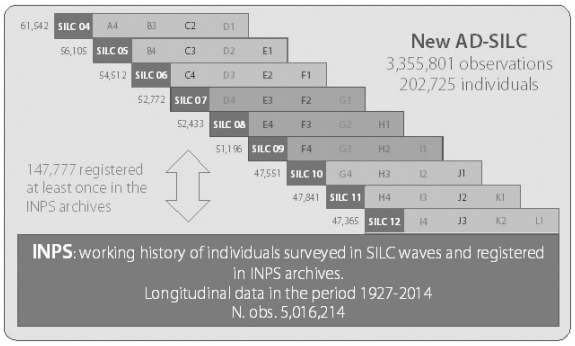
The updated version of the AD-SILC dataset is almost four times larger than its old version. Furthermore, its longitudinal scheme comes from both data sources: retrospective and forward-looking data about individuals' working conditions carried out by INPS, and longitudinal data about individuals' and households' socio-economic characteristics collected in IT-SILC. As a result, the sample size of the current AD-SILC dataset amounts to 202,725 individuals corresponding to 3,355,801 annual observations.

FIGURE 1.1: STRUCTURE OF THE OLD AND NEW VERSIONS OF AD-SILC

a.



b.



6 AD-SILC is an unbalanced panel because, by definition, individuals are followed for a different number of years.

More specifically, as drawn from the INPS archives, observations about working and/or pension history amount to 5,016,185 records, referred to 147,777 individuals recorded at least once in an administrative archive. The rest of the individuals present in AD-SILC are only surveyed in IT-SILC but are not present in the administrative archives (e.g. children and people who have never been active and are not receiving any pension benefit). The number of observations recorded in the INPS archives each year is shown in Table 1.3.

TABLE 1.3: NUMBER OF OBSERVATIONS IN AD-SILC BY YEAR

year	values	%	year	values	%	year	**values**	**%**
1927	1	0	**1958**	16,243	0.32	**1988**	82,574	1.65
1928	1	0	**1959**	18,690	0.37	**1989**	85,015	1.69
1930	1	0	**1960**	20,839	0.42	**1990**	101,189	2.02
1931	5	0	**1961**	23,362	0.47	**1991**	91,403	1.82
1932	8	0	**1962**	24,952	0.5	**1992**	92,759	1.85
1933	11	0	**1963**	27,298	0.54	**1993**	87,667	1.75
1934	19	0	**1964**	28,057	0.56	**1994**	87,329	1.74
1935	19	0	**1965**	30,617	0.61	**1995**	90,505	1.8
1936	30	0	**1966**	32,630	0.65	**1996**	93,696	1.87
1937	44	0	**1967**	34,850	0.69	**1997**	90,413	1.8
1938	68	0	**1968**	37,020	0.74	**1998**	91,348	1.82
1939	115	0	**1969**	38,906	0.78	**1999**	93,567	1.87
1940	150	0	**1970**	40,555	0.81	**2000**	97,867	1.95
1941	215	0	**1971**	42,272	0.84	**2001**	101,153	2.02
1942	280	0.01	**1972**	47,380	0.94	**2002**	103,956	2.07
1943	430	0.01	**1973**	50,929	1.02	**2003**	104,828	2.09
1944	444	0.01	**1974**	61,668	1.23	**2004**	107,879	2.15
1945	504	0.01	**1975**	58,933	1.17	**2005**	187,750	3.74
1946	579	0.01	**1976**	63,230	1.26	**2006**	191,693	3.82
1947	732	0.01	**1977**	63,094	1.26	**2007**	200,453	4
1948	937	0.02	**1978**	65,735	1.31	**2008**	201,853	4.02
1949	1214	0.02	**1979**	68,376	1.36	**2009**	203,223	4.05
1950	1,662	0.03	**1980**	71,120	1.42	**2010**	203,211	4.05
1951	2,200	0.04	**1981**	74,285	1.48	**2011**	207,814	4.14
1952	3,385	0.07	**1982**	75,184	1.5	**2012**	198,690	3.96
1953	3,850	0.08	**1983**	74,970	1.49	**2013**	176,506	3.52
1954	5,017	0.1	**1984**	75,292	1.5	**2014**	86,393	1.72
1955	6,525	0.13	**1985**	80,429	1.6			
1956	7,879	0.16	**1986**	78,457	1.56			
1957	14,165	0.28	**1987**	79,588	1.59	**Total**	**5,016,185**	**100**

Source: elaborations on AD-SILC data

It has to be highlighted that the administrative archives record all the employment relationships within the year. If individuals change job or contribution typology during the year, they will register multiple records in the INPS archive for that year. Therefore, individuals often have more than one observation every year, so that the total number of observations exceeds the number of individuals surveyed each year. Compressing all of

the annual information in a single record per year, the total number of individual observations reduces to 3,302,401[7]. Their distribution up until 2014 is shown in Table 1.4.

TABLE 1.4: NUMBER OF INDIVIDUALS IN AD-SILC BY YEAR

year	values	%	year	values	%	year	values	%
1927	1	0	**1958**	11,763	0.36	**1988**	58,417	1.77
1928	1	0	**1959**	13,500	0.41	**1989**	59,369	1.8
1930	1	0	**1960**	14,860	0.45	**1990**	60,215	1.82
1931	3	0	**1961**	16,481	0.5	**1991**	61,005	1.85
1932	5	0	**1962**	17,960	0.54	**1992**	61,257	1.85
1933	8	0	**1963**	19,217	0.58	**1993**	60,027	1.82
1934	12	0	**1964**	19,862	0.6	**1994**	59,817	1.81
1935	11	0	**1965**	21,768	0.66	**1995**	60,065	1.82
1936	19	0	**1966**	23,264	0.7	**1996**	62,071	1.88
1937	28	0	**1967**	24,678	0.75	**1997**	62,859	1.9
1938	39	0	**1968**	26,057	0.79	**1998**	63,771	1.93
1939	65	0	**1969**	27,489	0.83	**1999**	65,438	1.98
1940	97	0	**1970**	28,981	0.88	**2000**	67,132	2.03
1941	129	0	**1971**	31,017	0.94	**2001**	68,817	2.08
1942	162	0	**1972**	34,182	1.04	**2002**	70,736	2.14
1943	232	0.01	**1973**	36,874	1.12	**2003**	71,718	2.17
1944	277	0.01	**1974**	41,881	1.27	**2004**	72,214	2.19
1945	312	0.01	**1975**	43,115	1.31	**2005**	113,591	3.44
1946	385	0.01	**1976**	45,130	1.37	**2006**	115,776	3.51
1947	498	0.02	**1977**	46,109	1.4	**2007**	118,453	3.59
1948	634	0.02	**1978**	48,532	1.47	**2008**	119,909	3.63
1949	877	0.03	**1979**	50,052	1.52	**2009**	119,775	3.63
1950	1,196	0.04	**1980**	52,005	1.57	**2010**	119,849	3.63
1951	1,597	0.05	**1981**	52,960	1.6	**2011**	119,743	3.63
1952	2,113	0.06	**1982**	52,844	1.6	**2012**	117,205	3.55
1953	2,732	0.08	**1983**	53,322	1.61	**2013**	107,031	3.24
1954	3,539	0.11	**1984**	53,343	1.62	**2014**	57,257	1.73
1955	4,402	0.13	**1985**	54,294	1.64			
1956	5,350	0.16	**1986**	55,274	1.67			
1957	10,447	0.32	**1987**	56,898	1.72	**Total**	**3,302,401**	**100**

Source: elaborations on AD-SILC data

The data reported in Table 1.3 and Table 1.4 refer to the overall sample (surveyed in IT-SILC) extracted from the administrative archives. Therefore, individuals are matched either in the EC_INPS or in the PENSIONI archive (depending on whether they are active or retired workers). Indeed, the large increase in the number of observations from 2005 is due to the fact that information provided by the Register of Retirees is only available from that date and up until 2013. However, because the archive also includes retrospective variables – e.g. date of the retirement, previous job category (employee or self-employed), seniority at retirement –, it provides rel-

7 The sample size reaches 3,355,801 observations when all the people surveyed by IT-SILC but not registered in INPS are also included (Figure 1.1).

evant information for years prior to 2005 as well. The total number of observations in the Register of Retirees amounts to 627,087 records, corresponding to 61,165 individuals. Conversely, 4,389,136 observations, referred to 136,914 individuals, are recorded in the Register of Active Workers.

Most part of the surveyed persons are only present in the Register of Active Workers as they result active, or in any event not retired, by their last record in the administrative archives. However, since AD-SILC is a retrospective panel database, it provides information on the entire working history for already retired workers too. As a consequence, a significant number of individuals are present in both registers. Finally, some individuals present in the Register of Retirees have never paid any contributions in their lives (most of them receive invalidity or survivor's pensions). They are 10,854, and almost 70 percent of them are women.

1.4 USE OF THE AD-SILC DATASET

The database AD-SILC can be employed in several ways. As already specified, the data provided by the INPS archives refer to every employment relationship, whereas distinct observations for periods of maternity, sickness, temporary interruption of work (in particular, periods registered in *Cassa Integrazione Guadagni*), unemployment benefits are present. Consequently, analyses of transitions from one status to the other and, more importantly, in different periods within the same year are possible, as well as detailed study of earnings evolution and accumulation of contributions. Likewise, AD-SILC can be used to derive estimates on the probability of death on the basis of socioeconomic variables (see Chapter 3), as well as changes in individuals' conditions such as educational attainment, marital status, childbirths. Since the sample size is significantly enlarged, the present version of AD-SILC allows examining specific subgroups and categories of workers without losing robustness and consistency of the results.

For the purposes of the IESS project, AD-SILC has been employed for four main purposes: *i*) analyses of past and present Italian labour market dynamics; *ii*) estimations of the parameters needed for the different modules that constitute the T-DYMM model; *iii*) micro-simulations to assess the adequacy of the Italian pension system and estimate the impact of fiscal policy changes; *iv*) estimations on mortality.

In each of these fields, a specific configuration of the dataset has been carried out. It has to be recalled that various records per year are often present in the administrative archives. However, for our purposes, data have to be annualized. To this end, data have been aggregated so as to have one single annual record including all relevant information relative to the given year. For instance, for the scopes in *i*), data are annualised considering working conditions occurred at the end of the year[8]. For the analyses falling under point *ii*), data have been annualised aggregating the single observations registered in a given year into one single annual record, based on the prevalent job a worker has held in that year, while still preserving important information such as the total annual amount of weeks of contribution, total earnings, etc. Therefore, we do not refer to a particular time (month, week or day) of the year but we retrace the predominant condition of the individual in a given year.

Furthermore, for the purposes of *i*), *ii*) and *iv*) we make use of the entire dataset (i.e. including all SILC waves, from 2004 to 2012), while as starting population for our micro-simulations (point *iii*) we only use one part of the dataset – the subsample referred to the IT-SILC wave 2011, merging it with the INPS records. In this way, the year 2011 represents the starting point of the simulation, with a sample that is representative of the Italian population in that year. The dataset used for this purpose is cross-sectional, yet integrated with retrospective information about working conditions, acquired work experience, total number of years of contribution, etc.

Two reasons have guided the choice of 2011 as baseline year for T-DYMM simulations. First, the information on public workers in the INPS archives is not reliable after 2011. In addition, 2011 was the year of the last major reform of the pension system in Italy (the so-called "Fornero Reform", see Chapter 4). By choosing 2011 as the baseline year, we allow the possibility to implement policy scenarios where the previous legislation is kept in force.

8 If an individual is not present in the register for most of the time in a given year, but recorded as an employee in December, then the individual will be considered as an employee for that year. Conversely, if an individual has worked and paid contributions for several months during a year but is not recorded in December, then he/she will result not employed that year.

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2.WORKERS' VULNERABILITY IN ITALY: DESCRIPTIVE EVIDENCE ON EARNINGS DISTRIBUTION, WORKERS' TRANSITIONS AND PENSION PROSPECTS

In this chapter, we provide the main descriptive evidences on workers' careers using the information collected in the AD-SILC dataset. As already stated, the main aim of the IESS project is studying the pension prospects of individuals enrolled in the Notional Defined Contribution (NDC) scheme in order to compute the distribution of future pensions and assess their adequacy.

In NDC pension schemes, benefit levels depend on the contributions accrued during the working life, i.e. on the success of the entire working career (see Chapter 4). In other terms, NDC pension systems mirror individual outcomes in the labour market. Therefore, the observation of such outcomes in the labour market is crucial in order to assess the role played by the main determinants of possible pension inadequacy risks, i.e. low wage levels and intermittent working careers.

To this aim, in this chapter we focus on the Italian labour market features over the last decades and provide descriptive evidence on earnings distribution (Paragraph 2.1) and on workers' transitions across the various contractual arrangements (Paragraph 2.2). Lastly, we exploit the longitudinal characteristics of the AD-SILC dataset and focus on the first cohorts of workers enrolled in the NDC scheme – i.e. those who entered the labour market later than 31/12/1995 – in order to measure the contribution accrual in the initial phase of their careers (Paragraph 2.3).

2.1 EARNINGS DISTRIBUTION TRENDS IN ITALY SINCE THE '90S

The AD-SILC dataset is very well suited for analysing the trend of income distribution in the last decades, because, as explained in the previous chapter, the administrative archives on which it is based record gross earnings (i.e. gross of personal income taxes and employee's contributions) paid out for each employment relationship experienced during a year.

Each worker can have more than one employment relationship in a year, lasting a different number of weeks, and can earn labour income from different sources (e.g. from private employment and self-employment). In order to assess the trend of earnings' distribution we have then summed incomes received by individuals in a given year from each specific source.

The earnings distribution for workers aged 15-64 can be properly observed from 1996, since in years prior to 1996 the representativeness of older workers in our retrospective panel is somehow biased[9]. In addition, 1996 is the year of foundation of the *Gestione Separata*, the specific public pension fund managed by INPS to which parasubordinate workers and professionals who are not entitled to enrol to the private fund managed by their professional association are obliged to pay contributions[10].

9 The IT-SILC waves the AD-SILC sample is composed of are representative of the Italian population in the 2004-2012 period. Therefore, for example, the 1990 cross-sectional sample extracted from AD-SILC would not be representative of the Italian population of older workers, whose probability to be sampled in IT-SILC would be low.

10 Individuals working as parasubordinate before 1996 were not obliged to pay contributions. Hence, prior to that date, their labour incomes were not recorded in administrative archives.

Therefore, in this Paragraph we show the evolution of earnings distribution for Italy in the 1996-2013 period – distinguishing by source of earnings –, taking into account individuals aged 15-64 who earn a positive income. In some analyses, we limit our attention to the subsample aged 25-54 in order to extend our examination to the 1990-2013 period. In all analyses, we convert nominal earnings into real earnings at constant prices (2015 as the base year) using the consumer price index.

We first analyse the trend of mean incomes from the different sources (Paragraph 2.1.1). It has to be highlighted that the comparison of incomes coming from the different sources is hampered by the fact that incomes from self-employment – i.e. merchants, craftsmen and professionals in our dataset – recorded by administrative archives are not reliable due to several drawbacks, such as: i) incomes from self-employment are characterized by heavy underreporting; ii) incomes of self-employed workers in INPS administrative archives are top and down coded because floors and ceilings apply to the amount of the incomes on which pension contributions have to be paid (and administrative archives only report incomes recorded in contribution files)[11]. Therefore, we mainly focus on employees. In more detail, we investigate the evolution of earnings inequality looking at the trend of the various percentiles of the distribution (Paragraph 2.1.1), by computing the Gini index on gross earnings and measuring how many workers can be identified as "working poor" (Paragraph 2.1.2).

Afterwards, we study the evolution of labour incomes distinguishing individuals by education, gender, age and area of residence (Paragraph 2.1.3). Observing average incomes earned by individuals holding different characteristics means focusing on the so-called "between inequality", i.e. on mean differences by population subgroups (e.g. younger workers versus older ones, low skilled versus high skilled). It is also very interesting to compute the extent of inequality affecting individuals belonging to the same subgroup (the so-called "within inequality"). To this aim, by means of subgroup decompositions of inequality indexes and regression analyses, in Paragraph 2.1.3 we assess the role played by the between and within components as determinants of earnings inequality.

Finally, exploiting the longitudinal nature of our dataset, we carry out a simulation exercise on the impact of the economic crisis that started in 2008 on earnings inequality (Paragraph 2.1.4). The crisis could have indeed affected earnings inequality through two possible effects: "a price effect", i.e. changing earnings of workers lying in different parts of the distribution, and a "composition effect", i.e. influencing the risks to drop into unemployment. Because we only look at the earnings distribution among individuals earning a positive wage in a year – as is the usual practice –, we may not accurately assess the effect of unemployment spells that last over a year, thus underestimating a possible change in inequality due to the "composition effect". In order to consider such effect, we have focused on the subsample of those employed in 2008 who had not retired by 2013 and we have analysed the evolution of earnings distribution in this subsample in the years following 2008, including in the computation the "zero earners", i.e. those who are out of work for a whole year.

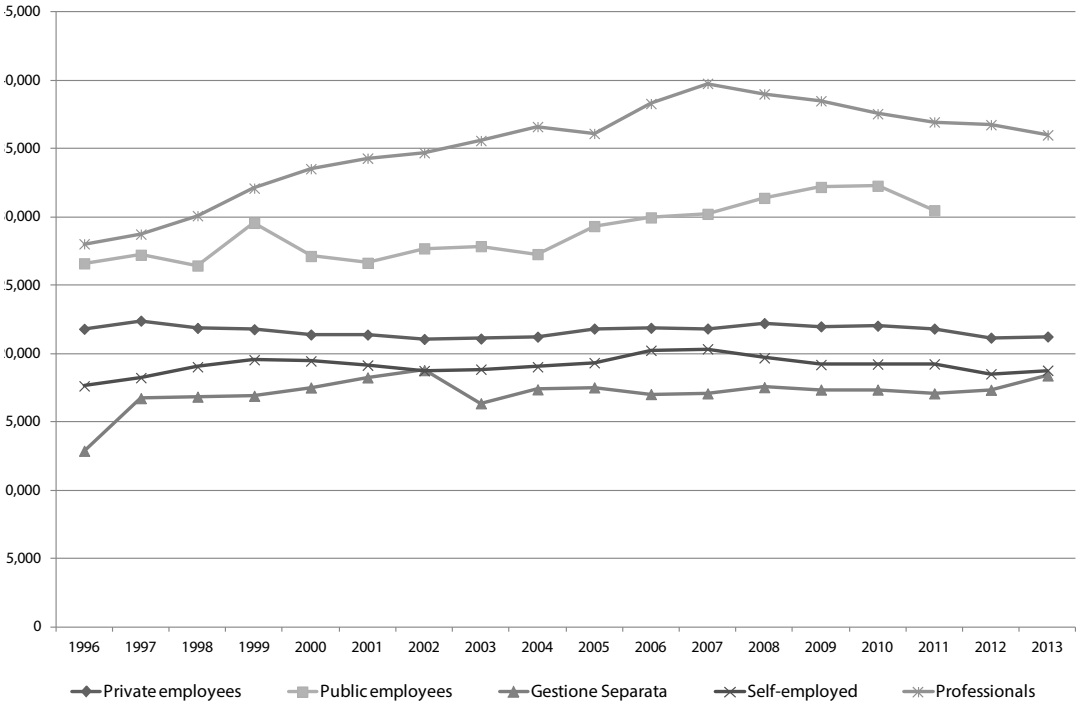
2.1.1 TREND OF MEAN EARNINGS AND OF THE MAIN PERCENTILES OF EARNINGS DISTRIBUTION

In real terms (i.e. at constant prices of 2015) private employees' mean yearly gross earning kept substantially constant in the 1996-2013 period, a slight increase is observed for public employees and a rather steep increase for professional workers (Figure 2.1)[12]. As expected, earnings of individuals enrolled in *Gestione Separata* are on average much lower than those earned by employees. However, it has to be stressed that parasubordinate workers are very heterogeneous, since within such category coexist a large share of low-paid workers (often subject to job interruptions during the year) and a minor share of "strong" workers (e.g. administrators and auditors).

11 A top code is in place for individuals enrolled in the new Notional Defined Contribution scheme (i.e. mostly the younger generations), because they do not pay contributions on the share of annual gross earnings that exceeds 100,324 € in 2015. Hence, earnings of individuals who have started working from 1996 are censored, with the result that the income distribution recorded in AD-SILC could differ from the real one. It is conceivable that this discrepancy would not be that significant, due to the very low number of young workers earning more than the income threshold set in the Notional Defined Contribution scheme. It should also be noted that, being it based on a sample survey, the dataset AD-SILC does not allow us to exactly inquire what happens within the top groups of the earnings distribution (i.e. the richest 1% or 0.1% workers).

12 The spike characterizing public employees' earnings in 1999 was due to a contractual renewal in the public sector – especially favouring managers – that established that a number of arrears would be paid in the same year. Note also that information about professionals' earnings can be plagued by coding used by private funds and by heavy underreporting.

FIGURE 2.1: TREND OF MEAN YEARLY GROSS EARNINGS (CONSTANT PRICES 2015)



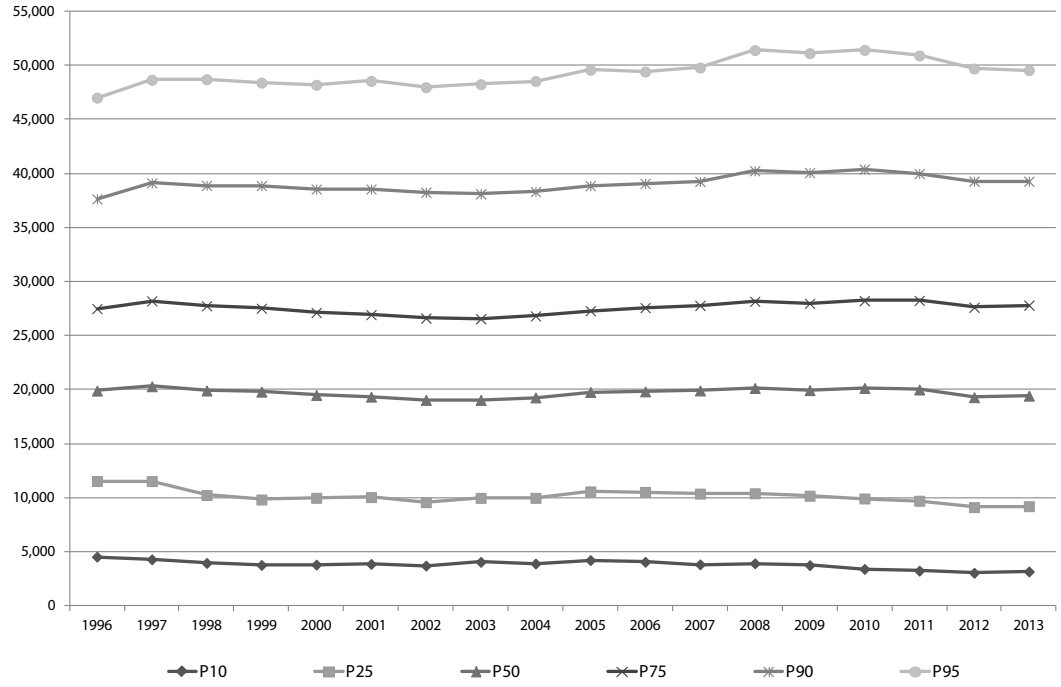
Source: elaborations on AD-SILC data

The gap between mean earnings from public and private employment increased during the examined period.

However, the lone observation of average annual earnings is not sufficient if one aims to understand income dynamics. Indeed, interesting results emerge when the time pattern of underlying percentiles of the earnings distribution of private and public employees is considered. Against this framework, it is visible how high-paid workers, mostly people over the 95th percentile, drove the average increase of public employees' earnings in real terms, whereas low and median earnings very slightly increased in the observation period (Figure 2.2)[13]. On the contrary, in the private sector no percentile was characterized by a clear increase, apart from a slight increase characterizing the 95th percentile since the mid of the 2000s (Figure 2.3). However, it has to be remarked that, by their nature, survey data do not allow to observe top-income trends, i.e. incomes earned by the richest 1% or 0.1% of the income distribution, whereas recent studies about Italy and developed countries agree on showing a huge increase of employment income earned by the richest workers.

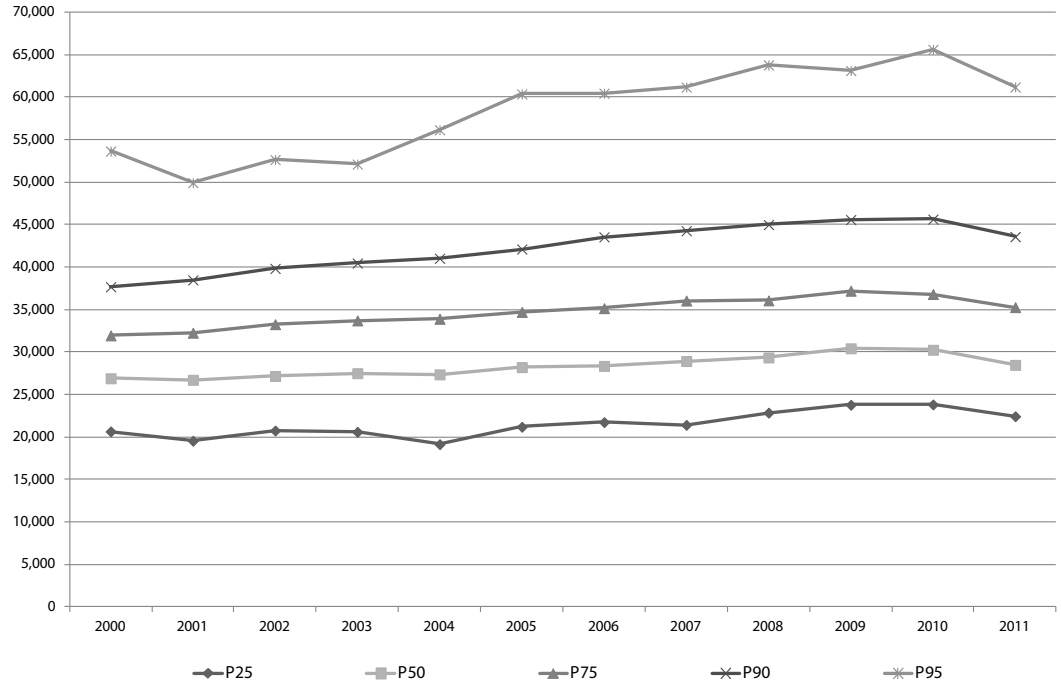
13 The striking increase of earnings by high-paid public employees could have also been driven by the new bargaining setting that emerged from the 1998 civil service reforms, which established that the local administrative units are free to choose their own pay policies within bounds determined by the first level of the collective bargaining.

FIGURE 2.2: PERCENTILES OF THE EARNINGS DISTRIBUTION: PUBLIC EMPLOYEES (CONSTANT PRICES 2015)



Source: elaborations on AD-SILC data

FIGURE 2.3: PERCENTILES OF THE EARNINGS DISTRIBUTION: PRIVATE EMPLOYEES (CONSTANT PRICES 2015)

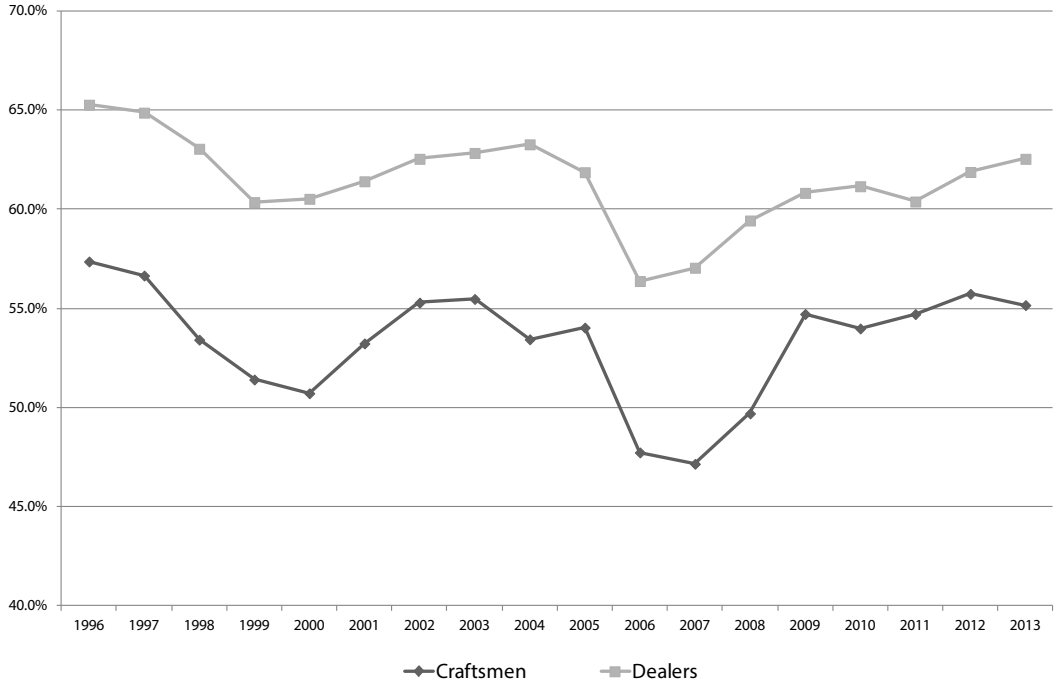


Source: elaborations on AD-SILC data

As already pointed out, administrative archives record gross earnings, i.e. the base on which pensions contributions are levied. In Italy, self-employed enrolled to INPS – i.e. merchants and artisans – up to 2011 were taxed at a 20% contribution rate, gradually increased in the subsequent years up to 24%. However, if their reported annual gross earnings are lower than a fixed threshold – amounting to 15.548 € in 2016 – they are obliged to pay a minimum contribution (i.e. apply the contribution rate on this threshold amount). Hence, for these categories, the earnings distribution observed in the INPS archives is not reliable because it is truncated in the low tail.

Furthermore, on top of the problems due to income truncation, the earnings distribution of merchants and artisans does not seem reliable due to an evident underreporting in the tax files. The observation of the data recorded in INPS administrative archives seems to confirm such bias, as shown by the share who yearly reports a labour income equal to the aforementioned minimum threshold (Figure 2.4), in 2013 amounting to 63% for merchants and to 55% for artisans.

FIGURE 2.4: TREND OF SELF-EMPLOYED WORKERS NOT PAYING TO INPS MORE THAN THE MINIMUM CONTRIBUTION



Source: elaborations on AD-SILC data

2.1.2 TREND OF INEQUALITY IN THE EARNINGS DISTRIBUTION

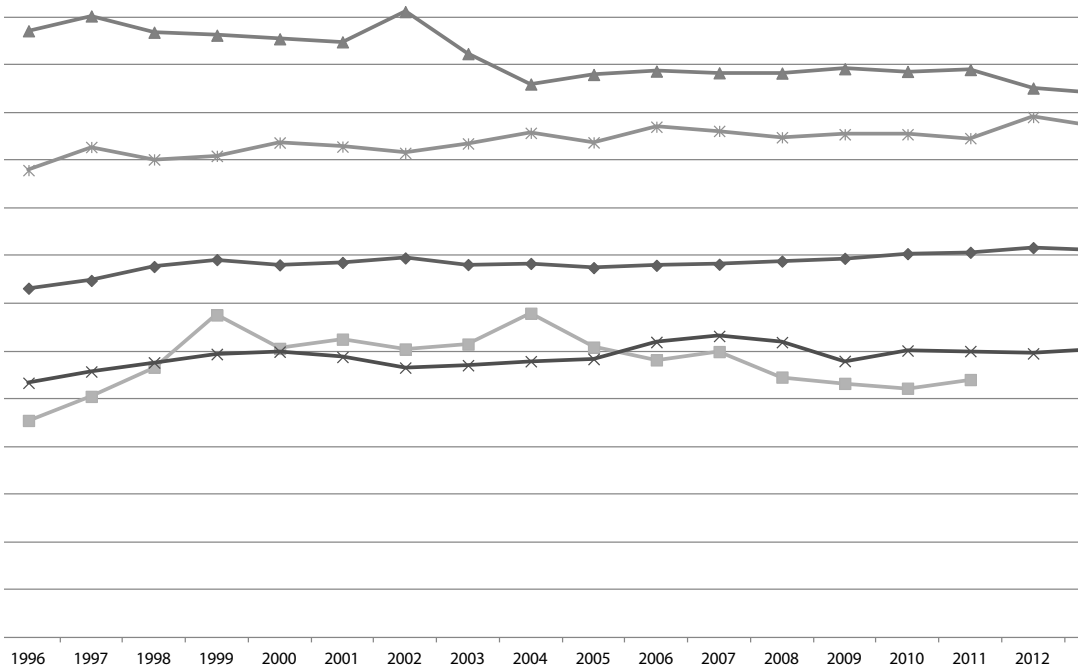
The different dynamics followed by private and public employees' annual gross earnings shown in Paragraph 2.1.1 clearly affects income inequality. The Gini index of inequality in the private sector has slightly increased since 1996 (starting from an already relatively high level), whereas in the public sector a sort of inverse U shaped trend has emerged because earnings inequality has increased up to a maximum value in 2004 and then decreased (Figure 2.5). As expected, the highest values of the Gini index characterize those enrolled in the *Gestione Separata*, due to the aforementioned heterogeneity of workers belonging to this group, and those working in the liberal professions. On the contrary, due to the homogenizing effect linked to the minimum income threshold discussed in the previous Paragraph, earnings inequality is lower within artisans and merchants than within private employees.

Interesting findings emerge when we focus on prime-aged workers, i.e. aged 25-54, who can be followed in our dataset from 1990 (Figure 2.6). As known, annual earnings are affected by hourly wages, by the number of months spent in work in a year (i.e. by the frequency of unemployment periods during the year) and by the number of working hours in a week (influenced by the spreading of part-time arrangements). In order to disentangle these aspects, we compare trends of annual earnings inequality with trends of weekly wages (i.e. depurating from the role played by unemployment spells) and for full-time workers only (i.e. also depurating from the role played by part-time arrangements). As expected, annual earnings inequality is higher than inequality of weekly wages and weekly wages inequality for full-timers only is even lower. However, an upward trend of the Gini index of inequality in the last two decades emerges in all cases, even if the highest increase of inequality happened in the second half of the '90s. Therefore, such upward trends suggest that the increase in earnings inequality could not be imputed only to the growth of atypical contractual arrangements (i.e. temporary and part-time contracts) because a growing inequality also emerges when weekly wages for full-time workers are concerned alone.

An increasing earnings inequality could also imply an increasing polarization of wages received by different individuals. An extreme form of polarization is represented by the existence of the so-called "working poor", i.e. very-low-paid workers. In this chapter, following the economic literature, we call "working poor" those workers who earn less than 60% of the median earnings and, limiting here our analysis to private employees aged 25-54, we consider the three aforementioned earnings concepts: annual earnings, weekly wages and weekly wages for full-timers.

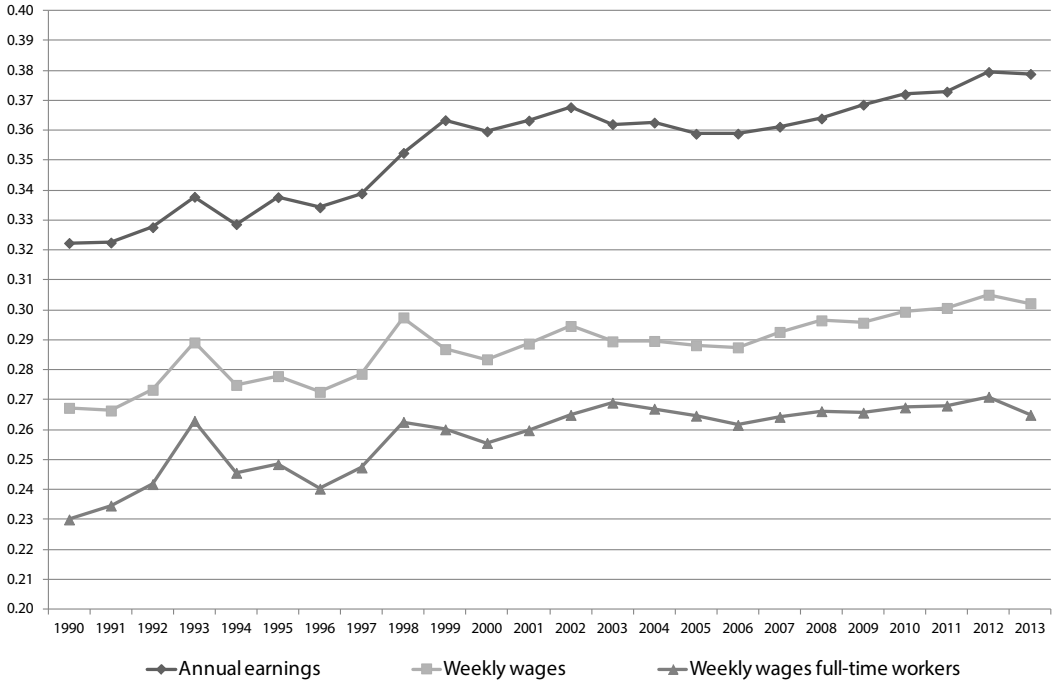
An impressive increasing trend of the share of workers who earn less than 60% of median annual earnings emerge from our analysis (Figure 2.7): the incidence of working poor share rose from 18% in 1990 to 28% in 2013. A similar upward trend also emerges when looking at weekly wages (thus depurating from unemployment risks): the incidence of working poverty computed using weekly wages as reference rose from 10% in 1990 to 16% in 2013. However, the increasing trend in working poverty seems related to the role played by part-time arrangements: indeed, when focusing on weekly wages of full time-workers only, the increase of the share of those earning less than 60% the median wage in the 1990-2013 period is smaller (from around 5% in 1990 to 8% in 2013).

FIGURE 2.5: TREND OF THE GINI INDEX BY EMPLOYMENT CATEGORY



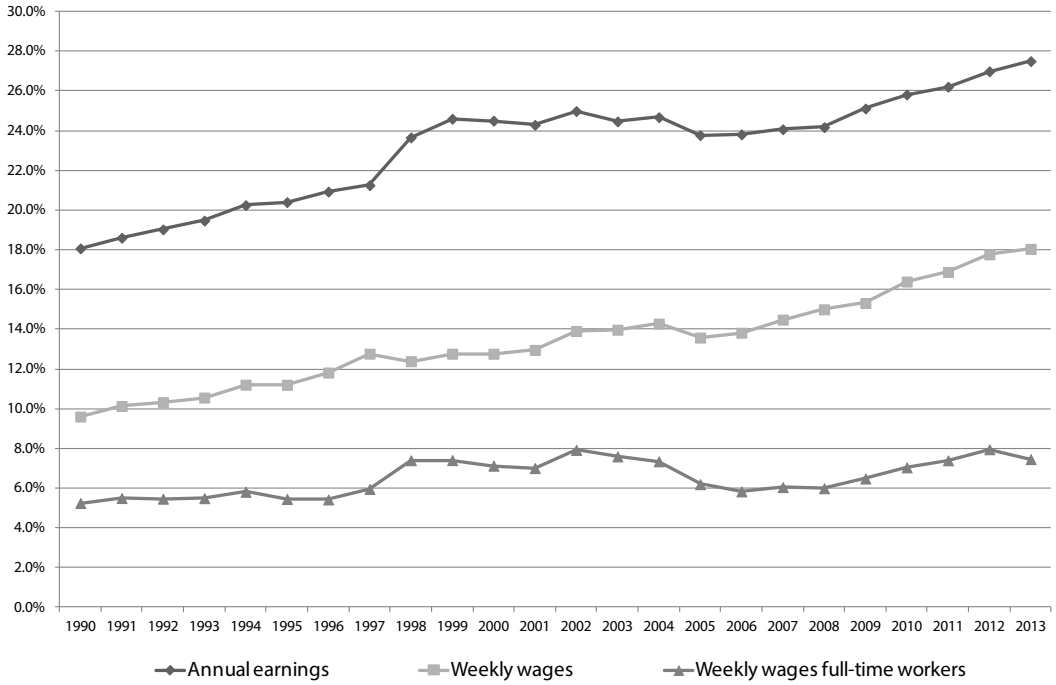
Source: elaborations on AD-SILC data

FIGURE 2.6: TREND OF THE GINI INDEX FOR PRIVATE EMPLOYEES (WORKERS AGED 25-54)



Source: elaborations on AD-SILC data

FIGURE 2.7: TREND OF THE SHARE OF WORKING POOR FOR PRIVATE EMPLOYEES (WORKERS AGED 25-54)



Source: elaborations on AD-SILC data

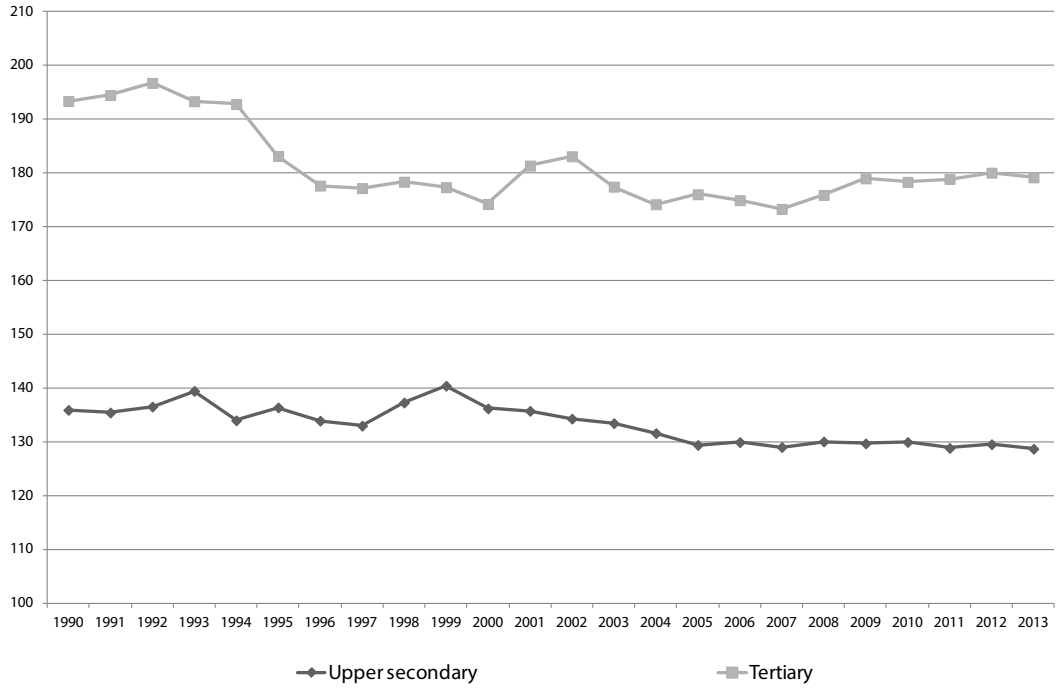
2.1.3 THE MAIN DETERMINANTS OF EARNINGS INEQUALITY

For what concerns earnings from private employment, it is very interesting to observe the evolution of average incomes by individual characteristics, namely education, age, geographical area of residence and gender.

The labour market has been subject to several structural changes in the last decades, such as globalization, technical change and new labour market institutions that have generally increased flexibility in hiring and firing. Inequality in employment incomes has been the object of a lively research activity, especially because of the steep increase in wage inequality and in wage "premiums" related to education achievements in the United States and other Anglo-Saxon countries since the early 1980s. One of the most prominent explanations for inequality trends in the last decades is related to skill-biased technical change, i.e. demand for skilled workers has increased more than its supply because of technological change, whereas the demand for low-skilled workers has decreased (and its offer has increased due to the globalization process). This would have engendered an increase of the wage gap between the low skilled and the high skilled and therefore a rise in earnings inequality[14].

In Italy, wage premiums by educational attainments – measured by the ratio between the average annual earning of tertiary graduates and the average annual earning of workers with at most a lower secondary degree – have actually reduced since 1990, especially in the first half of the '90s. This negates the possibility that a skill-biased technological change could be the reason behind the increasing levels of earnings inequality in Italy among private employees depicted in the previous Paragraph (Figure 2.8).

FIGURE 2.8: SKILL PREMIUMS IN ANNUAL EARNINGS. PRIVATE EMPLOYEES AGED 25-54. INDEX NUMBER, AT MOST LOWER SECONDARY=100

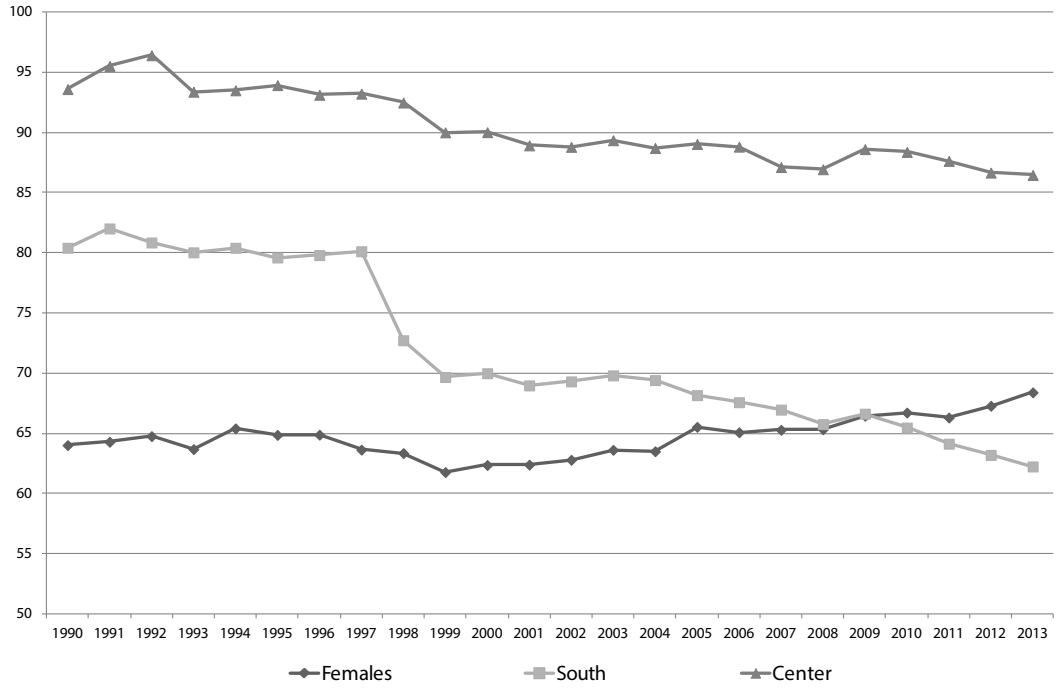


Source: elaborations on AD-SILC data

14 See, among the others, Acemoglu D. and D. Autor (2010), *Skills, Tasks and Technologies: Implications for Employment and Earnings*, in *Handbook of Labor Economics Volume 4,* O. Ashenfelter, D. Card (eds), Elsevier, Amsterdam; Bound J. and G. Johnson (1992), *Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations*, in «American Economic Review», vol. 82, pp. 371-92; Katz L., Murph K. (1992), *Changes in Relative Wages, 1963-87: Supply and Demand Factors*, in «Quarterly Journal of Economics», vol. 107, pp.35-78.

Conducting the analysis by age groups, a significant gap disadvantaging younger workers emerges in private employment even if the trends in mean earning gaps by age groups are roughly constant in the observation period (Figure 2.9).

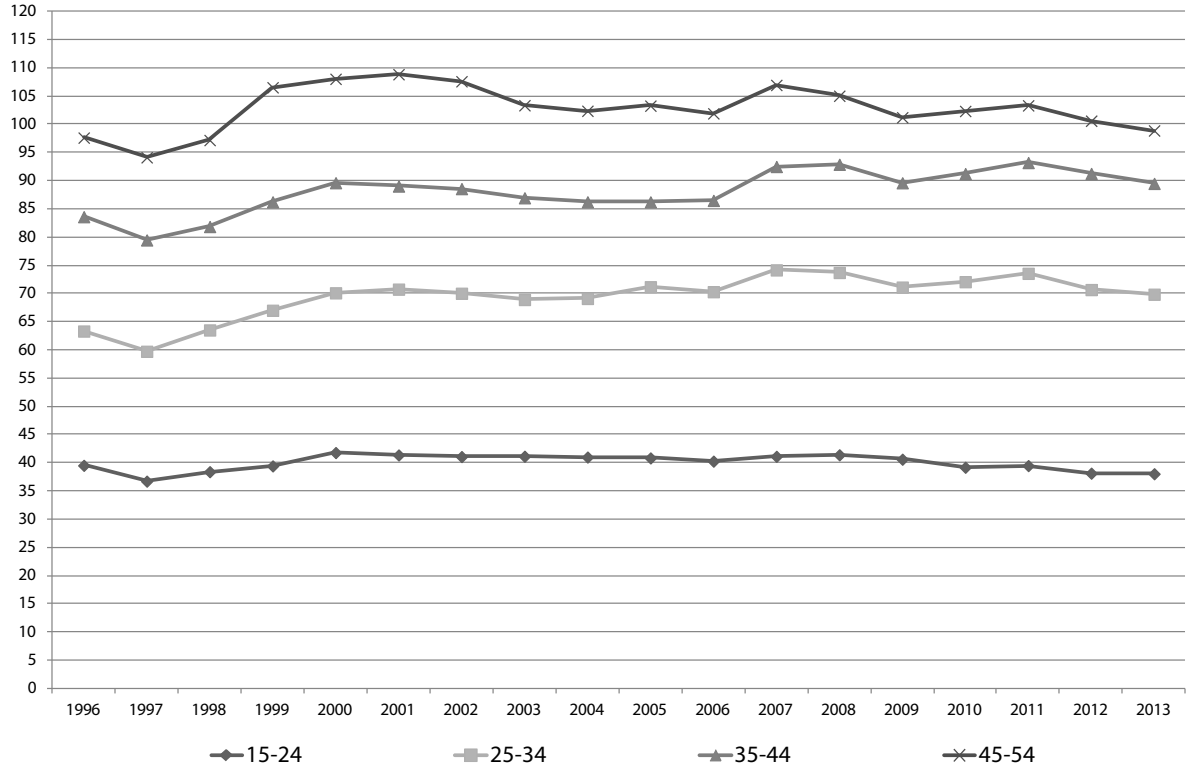
FIGURE 2.9: ANNUAL EARNINGS DIFFERENCES BY AGE. PRIVATE EMPLOYEES AGED 15-65. INDEX NUMBER, AGED 55-65=100



Source: elaborations on AD-SILC data

For what concerns geographical areas, gaps widened during the observation period, further disadvantaging Southern areas (Figure 2.10). Distinguishing workers by gender, the high earnings gender gaps observed in 1996 did not significantly reduce, in spite of the increase in the employment rates for women (Figure 2.10).

FIGURE 2.10: GENDER AND GEOGRAPHICAL GAPS IN ANNUAL EARNINGS. PRIVATE EMPLOYEES AGED 25-54. INDEX NUMBER, MALES AND NORTH=100



Source: elaborations on AD-SILC data

So far, we have looked at the average earnings differences attained by individuals with different characteristics (i.e. education, area of residence, gender, age). However, observing only average gaps implies missing the variability of wages within the group of people endowed by the same characteristic, whereas this variability can indeed be relevant. It is crucial to look carefully into the inequality within homogenous groups and compare it with the differences observed amongst the different groups.

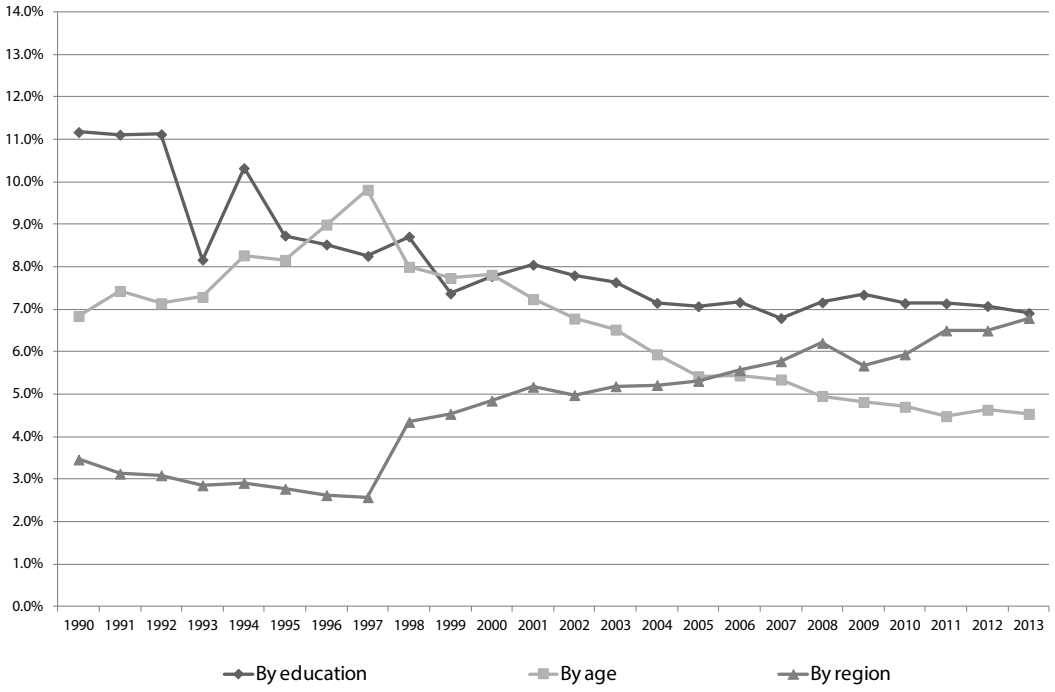
To this end, we have performed a decomposition of the inequality observed on the annual earnings of private employees, distinguishing workers by education, by age class and by region of residence, in order to compute between and within inequality as determinants of total earnings inequality. Given its decomposability properties, the Theil index is the measure of inequality we used in order to perform decomposition analyses.

In Figure 2.11, we show the trend of the share of total inequality that can be imputed to the mean differences among individuals belonging to the same subgroup (between inequality), while the complement to 100 measures the differences within each subgroup (within inequality). As clearly shown in Figure 2.11, the "within" component of inequality is enormously larger than the "between" component for all the types of subgroup considered.

For what concerns educational groups, as of 2013 only 7% of the annual earnings inequality was attributable to the between inequality and, inconsistently with aforementioned skill-bias hypothesis, the share of inequality related to mean skill premium reduced during the observation period. The largely predominant role played by the within component in explaining total inequality is also confirmed when we decompose the Theil index distinguishing individuals by age groups and geographical areas of residence (Figure 2.11), even though, for the latter, the role played by between inequality is shown to grow in the last part of the observation period. Therefore, in spite of the worsening of conditions in the labour market experienced by younger workers, the

weight of the average differences among individuals of different ages as determinant of the total inequality has decreased since 1996. On the contrary, in line with the widening of wage gaps among geographical areas the role played by mean differences in explaining total inequality increased from 1997 to 2013 (Figure 2.11).

FIGURE 2.11: SHARE OF ANNUAL EARNINGS INEQUALITY DUE TO EDUCATION, AGE AND REGION OF WORK. PRIVATE EMPLOYEES AGED 25-54. THEIL INDEX DECOMPOSITION BY SUBGROUPS, "BETWEEN" COMPONENT.



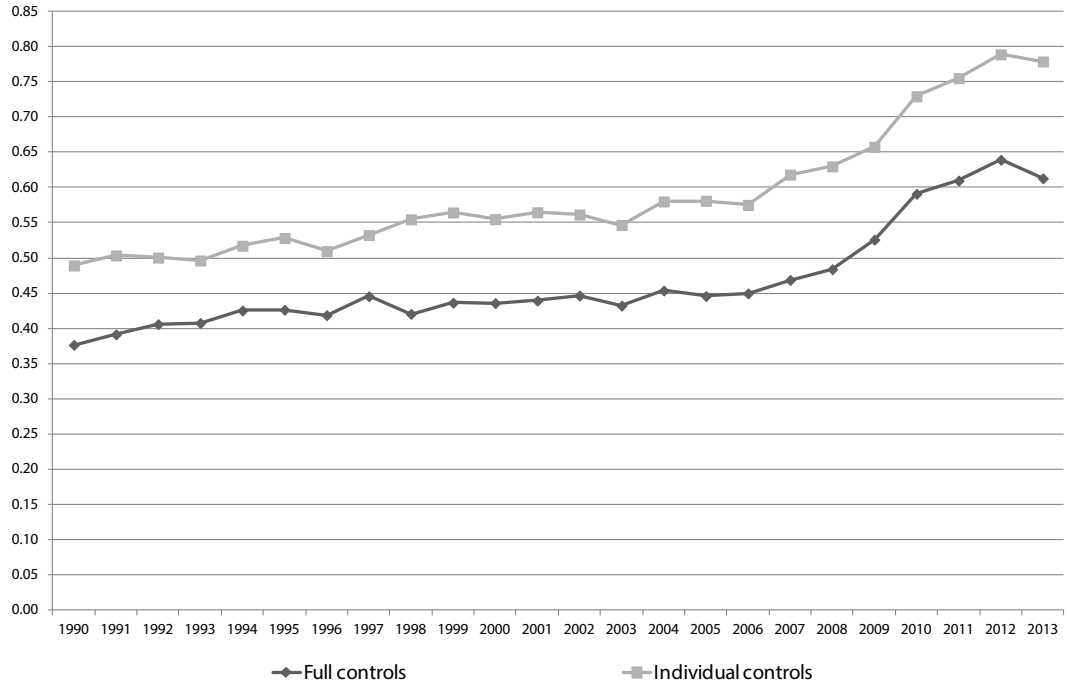
Source: elaborations on AD-SILC data

Finally, in order to compute how much inequality can be imputed to different individual characteristics and how much it is related to heterogeneity among individuals with a same observable characteristic, we have carried out some regressions of (log) annual earnings of private employees and we have computed the variance of the residuals as an index of residual inequality. Hence, using this indicator, we can assess how much of the individual earnings gaps is not explained by the observed characteristics that are usually included in the wage equations (Figure 2.12).

The estimates have been carried out with the use of two models with an increasing number of controls. In the first model, we have only employed the standard individual controls of the Mincerian wage equation – i.e. gender, age and seniority (both also squared) and educational attainments. In the second model, we have also employed the fixed effects of industrial sectors (i.e. dummy about 3 digits ATECO of the firm) and controls related to firm size and region of work.

As regards the first model, the wage equation shows that the share of variance explained by the traditional Mincerian covariates (age, gender, education, seniority) is quite limited. As regards annual earnings, R^2 is around 20% in the Mincerian model in 2013 and increases up to 45% in the "full model". What is perhaps more interesting to point out is that in both models the explanatory capacity of the covariates reduces during the observation period, thus suggesting an increase of the role played by individual unobserved heterogeneity in explaining earnings inequality. Indeed, the residual inequality shows an increasing trend along the whole observation period, especially when firms' characteristics are not included among the covariates (Figure 2.12).

FIGURE 2.12: TREND OF RESIDUAL INEQUALITY. OLS ESTIMATES ON ANNUAL EARNINGS OF PRIVATE EMPLOYEES



Source: elaborations on AD-SILC data

2.1.4 THE EFFECT OF THE RECENT ECONOMIC CRISIS ON EARNINGS INEQUALITY

Paragraph 2.1.2 shows that an increasing trend in earnings inequality has not emerged since the outbreak of the crisis. However, for a better understanding of earnings inequality trends during the recession and of the role played by labour income in individual living standards, our analysis also took into account those workers who were active in 2008 and then became unemployed in the following years.

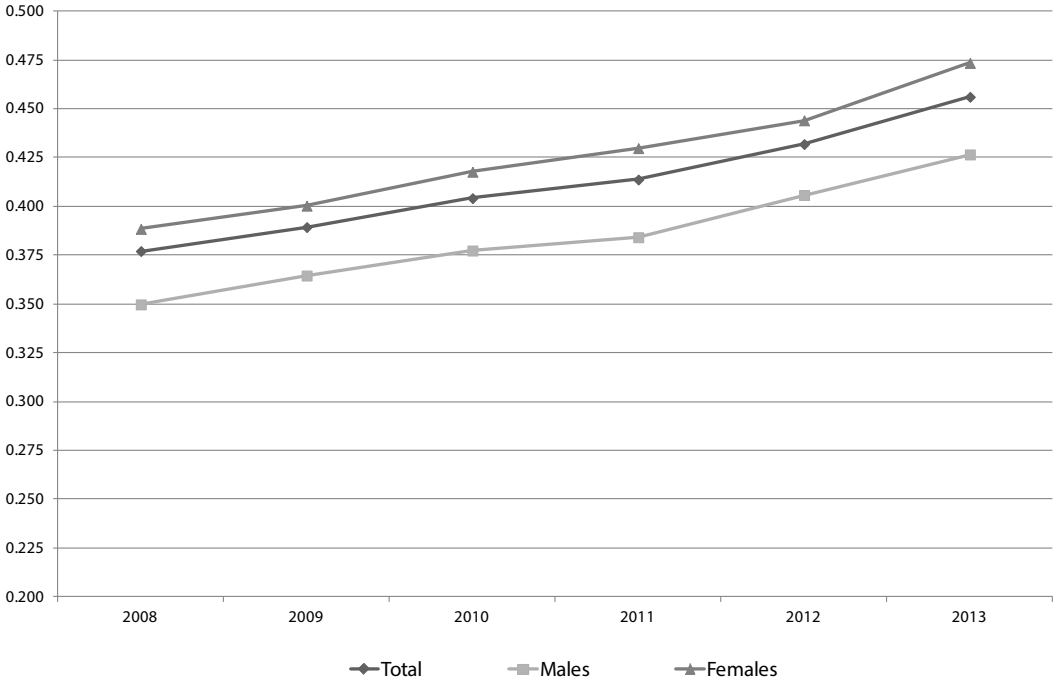
Exploiting the longitudinal nature of our dataset, we have carried out a simulation exercise on the impact of the recent economic crisis on earnings inequality, including in our analysis individuals who were employed in 2008, but then earned null incomes in the following years. Indeed, as already noticed, looking at the earnings distribution only among those with positive wages in a year – as is the usual practice – would prevent us from assessing the effect of unemployment spells that last over a year, thus underestimating a possible change in inequality due to the "composition effect". In order to consider such effect, we have focused on the subsample of those employed in 2008 who had not retired by 2013 and we have analysed the evolution of earnings distribution in this subsample in the years following 2008, including in the computation the "zero earners", i.e. those who are out of work for a whole year.

In order to observe the specific impact of the economic crisis, we have not included amounts received *Cassa Integrazione Guadagni* (CIG)[15]. We have considered the values of gross annual earnings inequality in the 2008-

15 Since 1947, the Italian welfare system has provided as "shock absorbers" a category of cash benefits to those workers who are suspended or who work only for a reduced amount of time due to temporary difficulties experienced by their firms. This institute, the Cassa integrazione guadagni (CIG) – "Redundancy Fund" –, is intended to relieve the firms them from the costs of unused workforce, while also supporting the workers that might lose part of their income. Workers entitled to redundancy payments receive 50% of their previous wages (80% before 1988), up to a maximum level established by the law. The Ordinary Redundancy Fund (Cassa Integrazione Ordinaria) applies for temporary events not attributable to the employer nor to the workers, such as a temporary market crisis. It can apply for a maximum of 12 months in 2 years, for a maximum period of 3 months in a row. The Extraordinary Redundancy Fund (Cassa Integrazione Straordinaria) applies to cases in which the production is halted, possibly for a long period of time and possibly due to the employer's decisions, after the authorization of the Ministry of Labour, because of industrial reorganizations, technological unemployment, prolonged crisis of the industry, bankruptcy, etc. The Extraordinary Redundancy Fund only applies to companies with more than 15 employees, and only to employees with more than 90 days of previous employment. The period of application of the Extraordinary Redundancy Fund varies according to its causes, but cannot exceed 36 months in a 5-year period.

2013 period for the subsample of individuals who had earned a positive labour income in 2008. Earnings inequality is then computed, including individuals that have become unemployed (i.e. earning null annual incomes) in the following years[16]. Following this approach, a large increase in labour income inequality in the 2008-2013 period emerges. Such increase is also steep when we part individuals by gender (Figure 2.13), by geographical area (Figure 2.14) - where a huge increase in inequality emerges in the South, due to the increase in unemployment rates in the area - and by educational attainment (Figure 2.15) - where the increase in inequality within tertiary graduates only emerged in 2013, while for the other educational groups a steep increase had already emerged in the previous years.

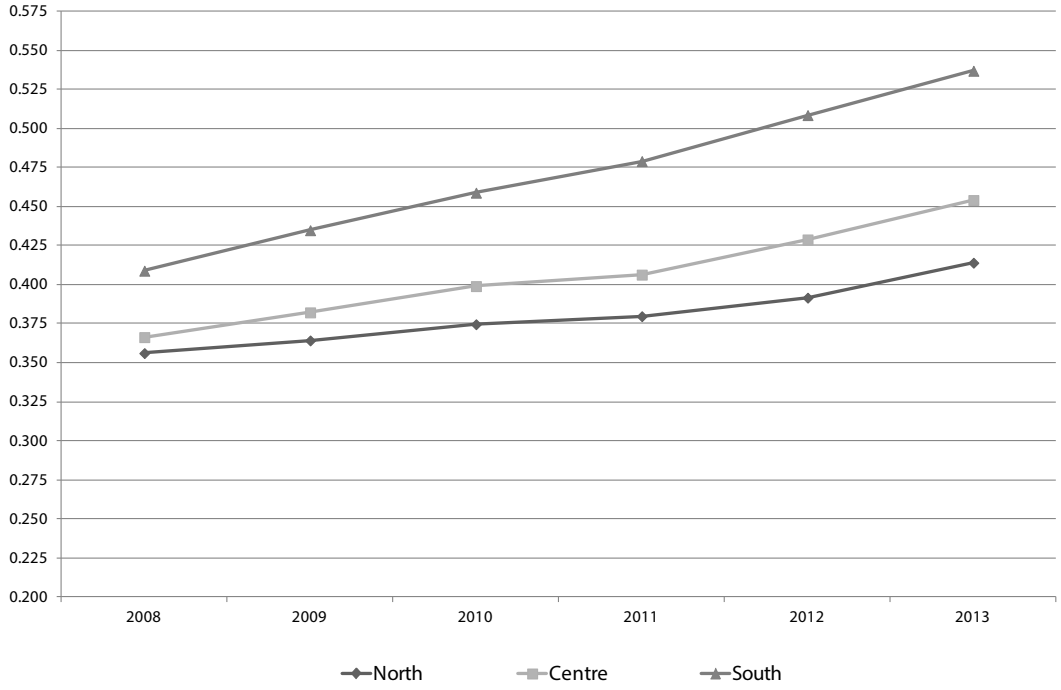
FIGURE 2.13: TREND OF THE GINI INDEX OF EARNINGS INEQUALITY DURING THE CRISIS BY GENDER



Source: elaborations on AD-SILC data

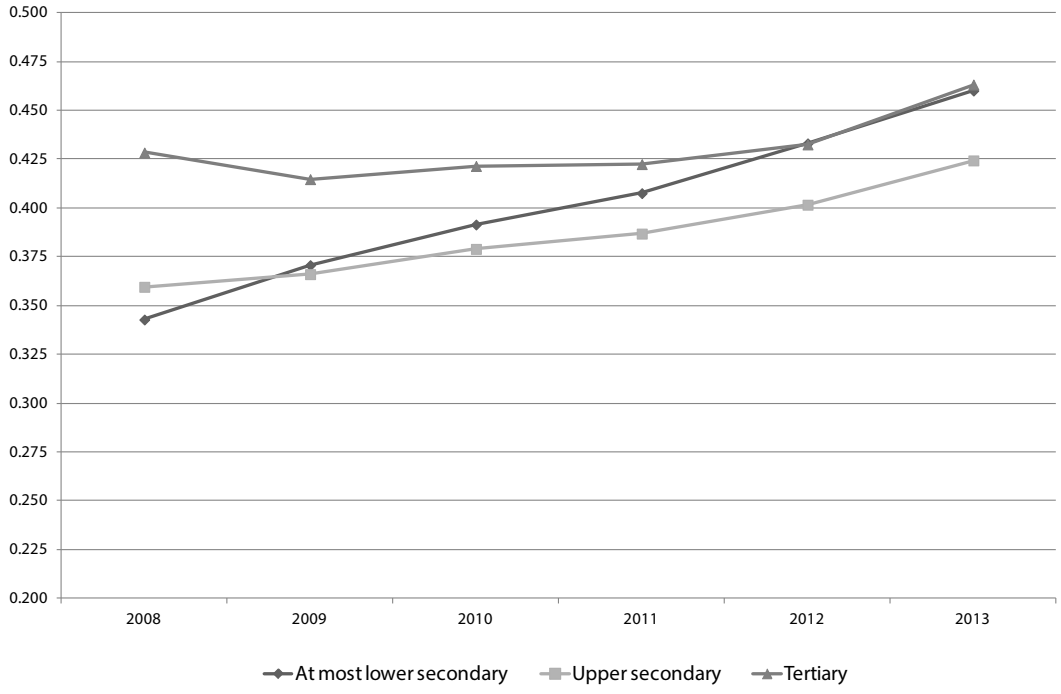
16 Individuals moving from private employment to public employment or self-employment have been dropped.

FIGURE 2.14: TREND OF THE GINI INDEX OF EARNINGS INEQUALITY DURING THE CRISIS BY GEOGRAPHICAL AREA OF RESIDENCE



Source: elaborations on AD-SILC data

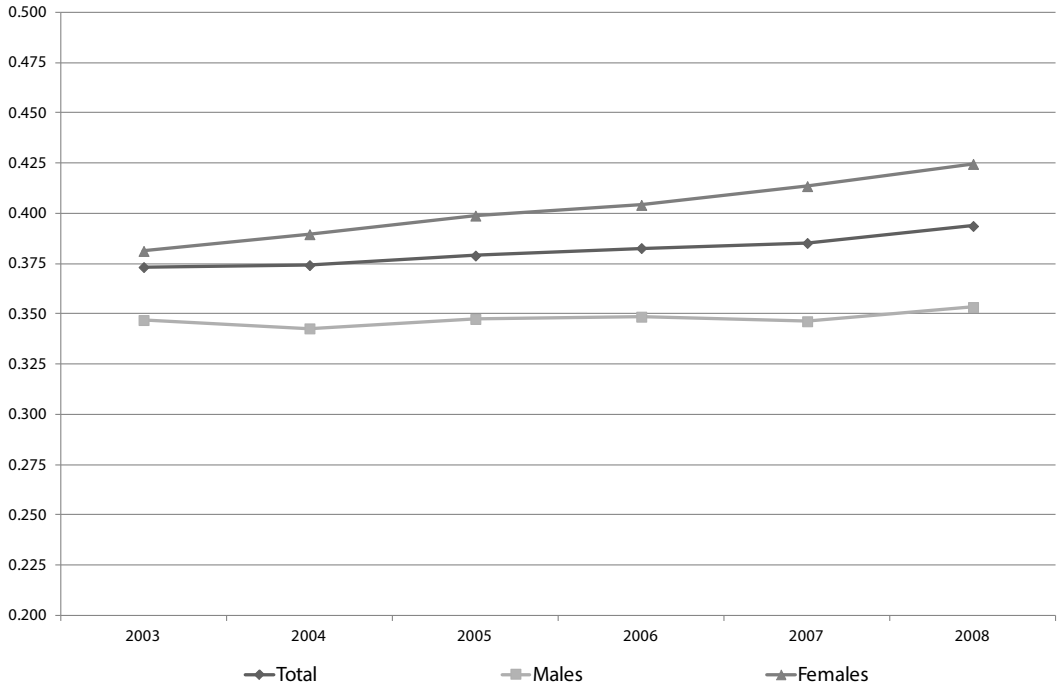
FIGURE 2.15: TREND OF THE GINI INDEX OF EARNINGS INEQUALITY DURING THE CRISIS BY EDUCATION ACHIEVEMENT



Source: elaborations on AD-SILC data

Finally, in order to validate our results, we have also carried out a counterfactual analysis following the same methodology. We have considered the trend in earnings inequality in the 2003-2008 period for those employed as private employees in 2003 who did not retired in the following years nor moved to other employment categories, including in the analysis also possible "zero earners" (Figure 2.16). The results show that, when the "zero earners" are included, the increase in inequality in the five-year period prior to the crisis looks much lower than the increase that has emerged since 2008.

FIGURE 2.16: TREND OF THE GINI INDEX OF EARNINGS INEQUALITY IN THE PERIOD 2003-2008



Source: elaborations on AD-SILC data

2.2 THE IMPORTANCE OF LOOKING AT WORKERS' TRANSITIONS

The analysis of workers' vulnerability in a multi-year period requires a deep longitudinal investigation of individuals' transitions across working conditions and a detailed exam of the relations between contractual arrangements and individual career prospects. For instance, low transition rates between fixed-term and permanent positions could imply entrapment in insecure jobs and poor career prospects for workers who do not succeed in obtaining a steady employment relationship soon.

Since the '90s, the Italian labour market has experienced a number of legislative interventions aimed at introducing several flexible contractual arrangements, and labour market segmentation between temporary and permanent workers has increased. In order to analyse the labour market segmentation and the vulnerability of different working conditions in the Italian labour market, it is crucial to investigate workers' transitions among different statuses. Labour market segmentation and the related problems of precariousness and insecurity are recorded when the most disadvantaged condition (being a worker with a temporary/atypical contract) is not a transitory phenomenon (i.e. in the stage of entry to or exit from the labour market), but becomes a permanent status. Likewise, vulnerability could also be observed when a large share of the supposedly "guaranteed" workers – i.e. those working under open-ended arrangements – experience a deterioration of their status.

The investigation worker mobility in the medium run in the Italian case is of the outmost importance also in order to inquire the possible future effects of the recently introduced labour market reform (the so-called Jobs Act) that has modified the contractual arrangement for those who will be hired with an open-ended contract from March 2015. The Jobs Act has eased the possibility for firms to dismiss open-ended private employees – providing a monetary compensation in case of dismissal motivated by economic reasons that increases with tenure.

The assessment of individual transitions among different working statuses requires the availability of a longitudinal micro dataset – i.e. the same individual has to be observed for many years – where detailed information about socio-economic characteristics of surveyed individuals are included. The AD-SILC dataset is very well suited for an in-depth study of short, medium and long term individual transitions among different working statuses, sorting by different individual characteristics (e.g. gender and educational attainment).

The observation of individual transitions among the various employment statuses in a decade is crucial to assess workers' vulnerability in Italy over aggregate indexes of precariousness (e.g., the share of atypical workers in a given year) and to find answers to a number of research questions, such as:

- Is Italy characterized by a "dual" labour market?
- Does a certain "liquidity" of the labour market emerge, before and after the crisis?
- Are temporary contracts a trap or a stepping stone?
- Do permanent contracts protect individuals from unemployment or downgrade risks?
- Are certain groups of individuals more exposed to risks than others?

In the following Paragraphs we will provide evidences that to try to answer these questions showing the individual transition matrixes among various working statuses in a 12-year period (i.e. in the 2000-2011 period; Paragraph 2.2.1), and then computing downgrade risks and upgrade chances for those working under permanent and temporary arrangements (Paragraph 2.2.2). Lastly, we show some evidences about the risks of dismissal during the present recession (Paragraph 2.2.3). Paragraph 2.2.4 concludes.

2.2.1 TRANSITION MATRIXES

As a first set of analyses, we follow the individuals that were working in 2000 up to 2011 and compute the transition matrixes from the working status in 2000 to the statuses held in the following years. We exclude from the analyses the older workers, thus we restrain our subsample to those born from 1950 on. Furthermore, we exclude the few individuals who retired or died during the observation period.

We define yearly individual working statuses as corresponding to the ones held at the end of a given year (i.e. 31st of December). We identify 7 possible working statuses: i) private employees with an open-ended arrangement; ii) private employees with a fixed-term arrangement; iii) public employees with an open-ended arrangement; iv) public employees with a fixed-term arrangement; v) atypical workers (among which we include those working under the so-called "parasubordinate" arrangements and enrolled to the *Gestione Separata*); vi) self-employed workers enrolled in INPS (artisans, merchants and self-employed farmers); vii) professionals (e.g. lawyers, architects, i.e. professional workers who are enrolled in pension funds managed by their professional association). In addition, we consider two further statuses as possible destinations: viii) unemployed (i.e. individuals working during a year, but not working at the end of the year); ix) inactive (individuals out of work for the whole year). Note also that periods spent receiving allowances for maternity or sickness or redundancy payments (*Cassa Integrazione*) are considered as employment, because the contractual arrangement is not terminated when these contingencies occur.

Before discussing the main results highlighted by the transition matrixes, it is interesting to present the distribution of the workforce by type of employment, gender and education attainment in 2000 and 2011. About 60% of the workers had a private employment arrangement in 2000 and, among them, 12.7% had a fixed-term contract (Figure 2.17). The share of public employees amounted to 17.1% (the share of temporary workers in public employment was 1.8%), while the shares of atypical workers (i.e. those enrolled to the *Gestione*

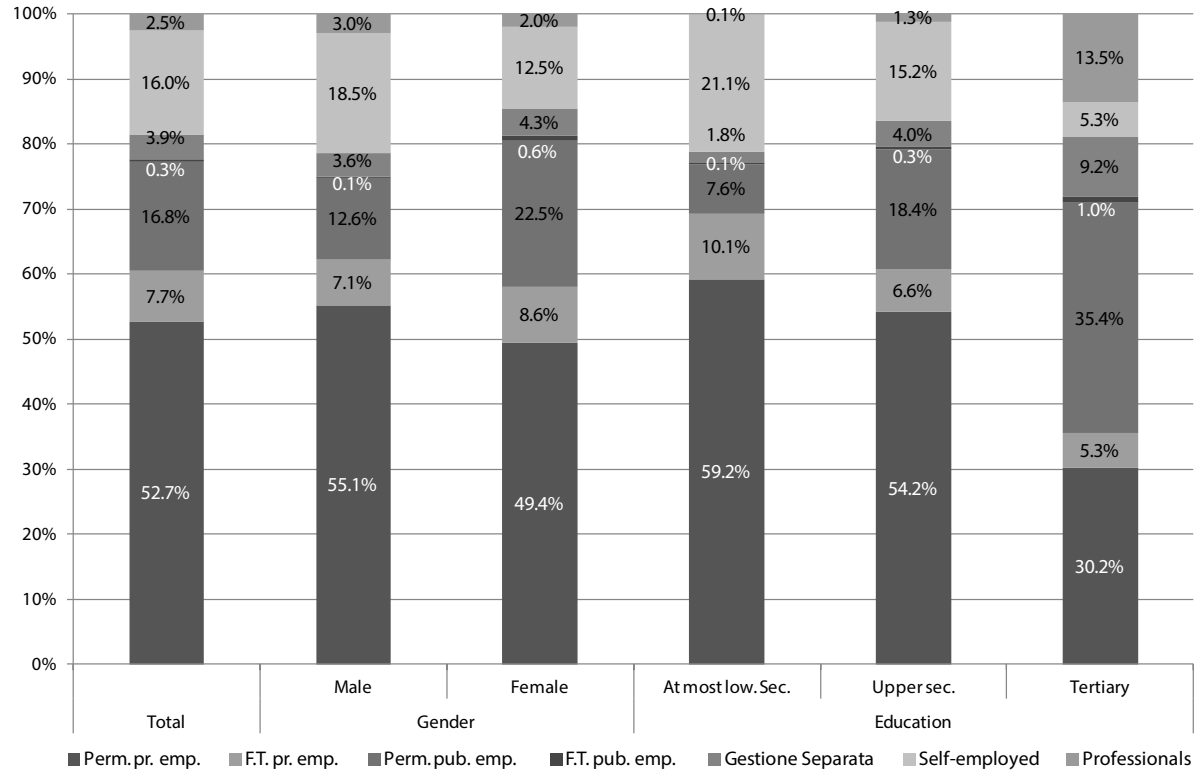
Separata), "pure" self-employed and professionals were, respectively, 3.9%, 16.0% and 2.5%.

Among female workers, public employment is relatively more common, but so are temporary contracts, including both fixed-term employment and atypical contracts (respectively, 9.2% and 4.3% among females, compared to 7.1% and 3.6% among males). The share of males working as self-employed or professionals is much higher than the share of females performing these types of jobs (respectively, 21.5% versus 14.5%).

Clear differences emerge when we distinguish individuals by education. In particular, tertiary graduates (that are still a minority in the Italian workforce) are more likely to work as public employees and, as expected, as professionals (the degree often being a prerequisite for performing professional activities). Conversely, the shares of those working as employees or self-employed are much higher among less educated workers. Interestingly, atypical arrangements are more common among tertiary graduates than among the low-skilled (9.2% of tertiary graduates had an atypical arrangement in 2000, while these shares were 1.8% and 4.0% among those who had achieved, respectively, at most a lower secondary degree and an upper secondary degree).

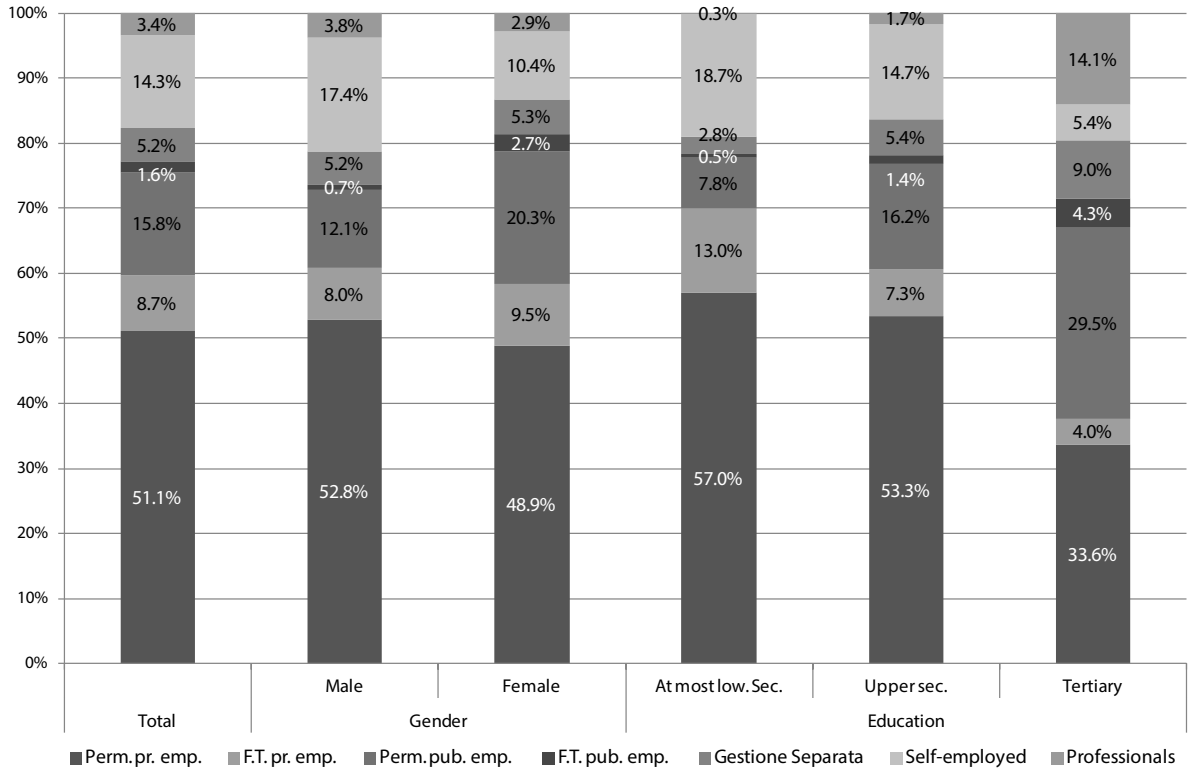
The picture does not dramatically change in 2011 (Figure 2.18). However, comparing the distribution of the workforce by employment status in 2000 and 2011 a large increase of the shares of fixed-term employees emerges, especially in the public sector.

FIGURE 2.17: DISTRIBUTION BY EMPLOYMENT STATUS OF THE WORKFORCE IN 2000, BY GENDER AND EDUCATION



Source: elaborations on AD-SILC data

FIGURE 2.18: DISTRIBUTION BY EMPLOYMENT STATUS OF THE WORKFORCE IN 2011, BY GENDER AND EDUCATION



Source: elaborations on AD-SILC data

The first research question we try to address concerns the rigidity of the Italian labour market. To this aim, we first observe workers' transitions among different statuses covering a time span up to 12 years. Tables 2.1-2.4 depict the destinations in 2001, 2002, 2005 and 2011 of those working in 2000 according to their type of employment in 2000 (row percentages are shown). The main findings that emerge from these transition matrixes are the following.

First, the Italian labour market does not seem as rigid as depicted by conventional wisdom. In particular, short- medium- and long-term persistence in open-ended contracts is always very far from 100% and frequent movements outside the active labour force are recorded. Overall, even if a certain degree of persistency in the same status can be observed (percentages along the principal diagonal are rather high, especially as concerns self-employed workers and professionals), our analysis reveals that a large share of workers change their status over time.

Table 2.1 shows that only 89.7% of permanent employees in 2000 still have a permanent contract the following year and this share drops to 86.3% after two years (Table 2.2), to 80.0% after five years (Table 2.3) and reaches 71.7% in 2011 (Table 2.4). Among workers with an open-ended contract at the end of 2000, 6.2% are unemployed or inactive one year later (Table 2.1) and this percentage increases substantially over time up to 14.3% in 2011 (Table 2.4). Furthermore, after 11 years, 4.5% of the people that had an open-ended contract in 2000 moved to a fixed-term employment contract and 1.7% moved to an atypical working arrangement (Table 2.4).

TABLE 2.1: WORKING CONDITIONS IN 2001 OF THOSE EMPLOYED IN 2000

					2001				
2000	*Perm. PR*	*F.T. PR*	*Perm. PB*	*F.T. PB*	*Atypical*	*Self-emp.*	*Profess.*	*Unemp.*	*Inact.*
Perm. private	89.7	2.4	0.3	0.1	0.5	0.7	0.1	5.5	0.7
Fixed term PR	29.6	53.6	0.7	0.2	1.0	1.0	0.1	9.7	4.1
Perm. public	0.5	0.4	93.4	3.4	0.2	0.1	0.1	1.3	0.7
Fixed term PB	1.2	1.8	16.7	62.5	1.2	1.2	1.2	13.1	1.2
Gest. Sep.	5.6	2.7	2.1	0.5	70.2	3.7	1.6	1.3	12.3
Self-emp.	1.5	0.3	0.0	0.0	1.4	93.9	0.0	1.5	1.4
Profess.	1.6	0.1	1.8	0.6	2.2	0.2	93.3	0.0	0.2

Note: Individuals who died or retired after 2001 are not considered

Source: elaborations on AD-SILC data

TABLE 2.2: WORKING CONDITIONS IN 2002 OF THOSE EMPLOYED IN 2000

					2002				
2000	*Perm. PR*	*F.T. PR*	*Perm. PB*	*F.T. PB*	*Atypical*	*Self-emp.*	*Profess.*	*Unemp.*	*Inact.*
Perm. private	86.3	3.1	0.5	0.2	1.2	1.6	0.1	4.4	2.7
Fixed term PR	39.7	39.7	1.2	0.3	1.8	1.9	0.1	8.7	6.5
Perm. public	0.7	0.3	93.1	3.7	0.2	0.1	0.2	0.7	1.1
Fixed term PB	1.2	2.4	20.2	59.5	1.2	1.2	0.0	6.6	7.7
Gest. Sep.	8.1	2.4	2.4	1.4	61.5	5.2	2.7	2.5	13.7
Self-emp.	2.6	0.9	0.1	0.0	2.3	89.2	0.0	1.7	3.1
Profess.	2.6	0.2	2.7	0.5	2.2	0.2	91.1	0.1	0.5

Note: Individuals who died or retired after 2001 are not considered

Source: elaborations on AD-SILC data

TABLE 2.3: WORKING CONDITIONS IN 2005 OF THOSE EMPLOYED IN 2000

					2005				
2000	*Perm. PR*	*F.T. PR*	*Perm. PB*	*F.T. PB*	*Atypical*	*Self-emp.*	*Profess.*	*Unemp.*	*Inact.*
Perm. private	80.0	3.9	0.8	0.5	1.6	3.5	0.2	4.9	4.7
Fixed term PR	45.2	30.7	1.3	0.9	2.1	3.6	0.3	6.5	9.4
Perm. public	1.3	0.4	92.5	3.9	0.2	0.1	0.2	0.5	1.0
Fixed term PB	3.6	1.8	37.1	42.5	2.4	0.0	1.2	4.2	7.2
Gest. Sep.	14.1	3.3	4.3	2.4	44.4	8.3	3.8	2.6	16.9
Self-emp.	6.2	2.0	0.1	0.2	3.5	79.6	0.1	1.8	6.6
Profess.	2.9	0.6	4.2	1.1	2.9	0.2	87.2	0.2	1.0

Note: Individuals who died or retired after 2001 are not considered

Source: elaborations on AD-SILC data

TABLE 2.4: WORKING CONDITIONS IN 2011 OF THOSE EMPLOYED IN 2000

					2011				
2000	*Perm. PR*	*F.T. PR*	*Perm. PB*	*F.T. PB*	*Atypical*	*Self-emp.*	*Profess.*	*Unemp.*	*Inact.*
Perm. private	71.7	4.5	1.7	0.5	1.7	5.3	0.4	5.9	8.4
Fixed term PR	45.5	23.1	2.8	1.0	1.4	5.7	0.4	6.5	13.7
Perm. public	1.5	0.2	93.8	1.3	0.3	0.1	0.4	1.2	1.2
Fixed term PB	7.6	1.3	60.1	20.3	1.3	0.6	0.6	4.4	3.8
Gest. Sep.	20.0	2.9	7.6	2.5	31.1	12.2	4.8	2.5	16.6
Self-emp.	10.1	2.8	0.4	0.2	4.1	66.3	0.2	3.0	13.0
Profess.	3.0	1.1	6.8	1.5	2.8	0.7	81.9	0.1	2.2

Note: Individuals who died or retired after 2001 are not considered

Source: elaborations on AD-SILC data

Following the career dynamics of atypical and temporary workers is crucial in order to understand whether the labour market liberalization process started in Italy in the mid '90s has eased the entry into the labour market of young workers or rather has impeded their move towards more stable forms of contracts.

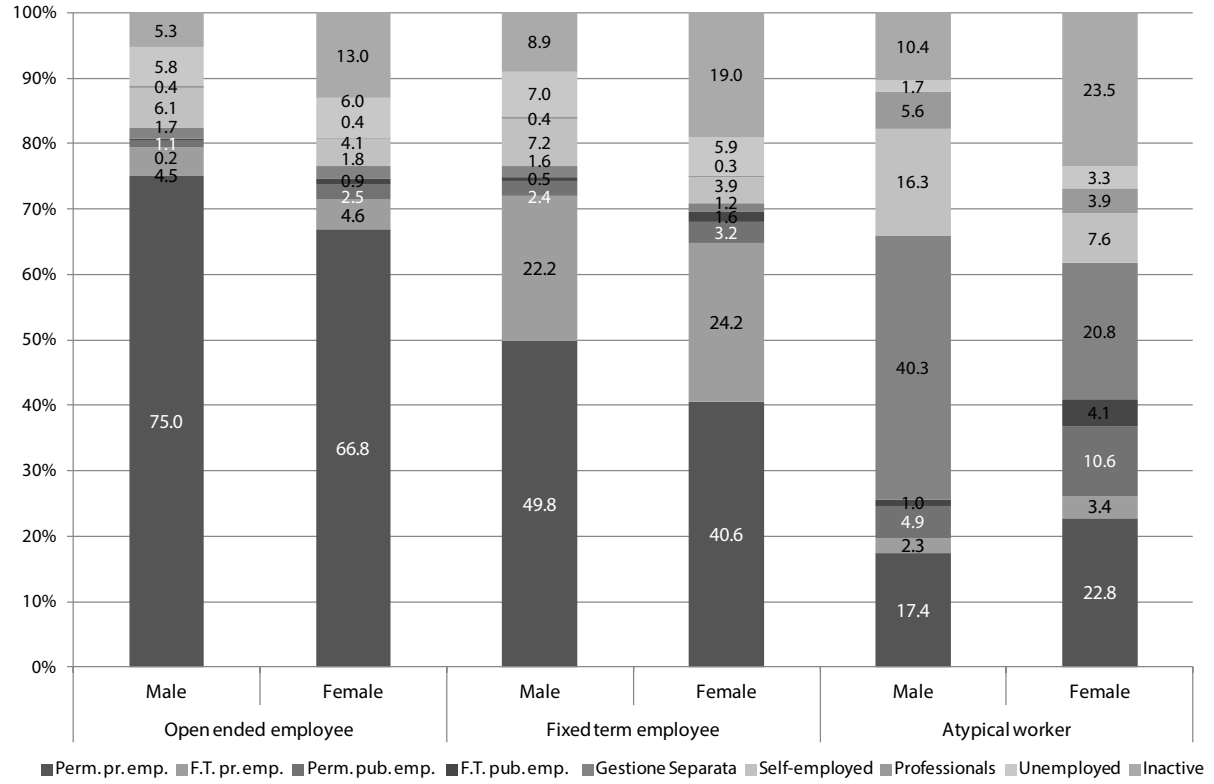
We find that a significant share of fixed-term employees and atypical workers tend to maintain their status, though this tendency decreases in time. For instance, 44.4% of the workers paying contributions to the *Gestione Separata* in 2000 are still in the same status after five years, while the five-year persistence rate in fixed term employment is 37.1% (Table 2.3). At the same time, of the employees with a temporary contract in 2000, 39.7% achieved a permanent arrangement after 2 years (Table 2.2), but this share does not largely increases in the following years (e.g., the share of temporary employees that has moved to a permanent arrangement by 2011 is 45.5%).

Furthermore, the shares of atypical workers that transition to dependent labour in the observed period is rather limited. Among those working as atypical workers in 2000, 24.1% had moved to public or private employment at the end of 2005 (Table 2.3) and this share increased up to 33.0% in 2011.

In the next three figures, we show the working statuses in 2011 of those working in 2000 as open-ended private employees, fixed-term private employees or atypical workers, distinguishing them by gender, education and geographical area of work in 2000 (respectively, Figures 2.19, 2.20 and 2.21).

As expected, females are characterized by worse career prospects in the labour market (Figure 2.19): indeed, compared to males, females are characterized by more frequent transitions to inactivity and a lower share of movements from fixed-term employment to open-ended employment. Conversely, among those performing atypical jobs in 2000, women are characterized by a higher share of movements towards public or private employment compared to men.

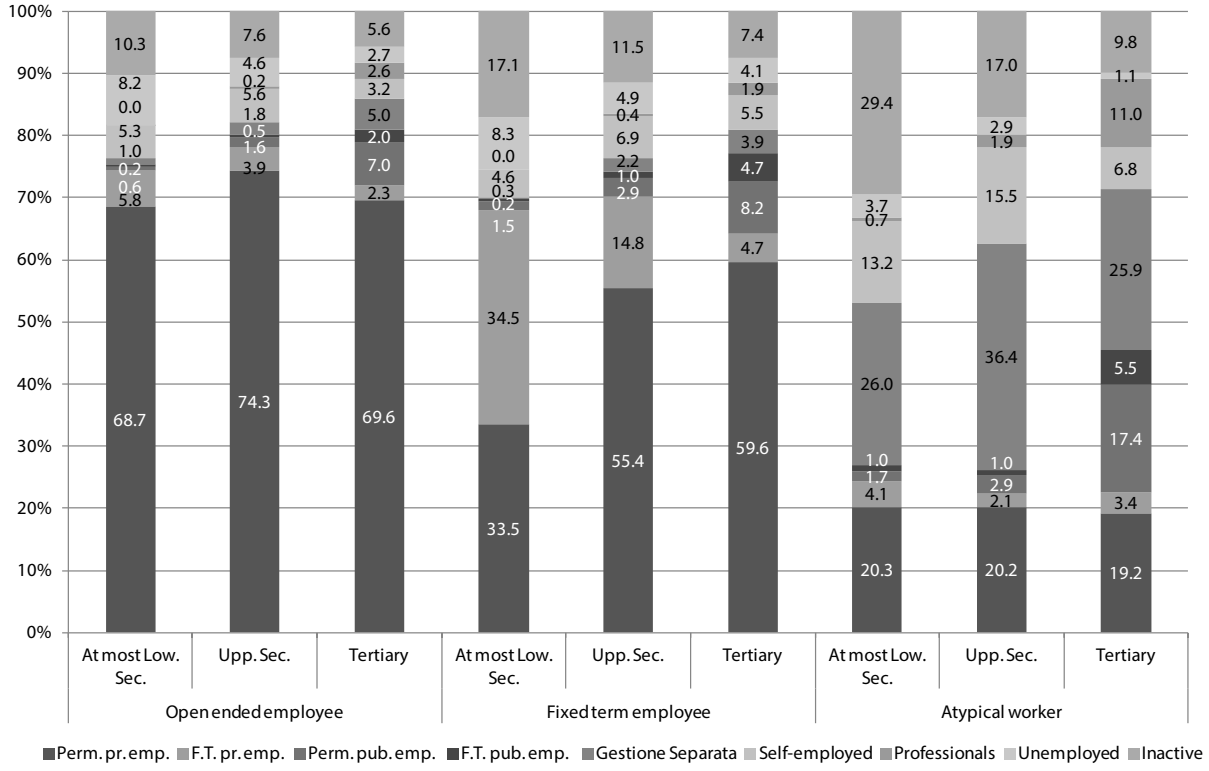
FIGURE 2.19: EMPLOYMENT STATUS IN 2011 OF THOSE WORKING AS PERMANENT OR FIXED-TERM EMPLOYEES OR AS ATYPICAL WORKERS IN 2000, BY GENDER



Source: elaborations on AD-SILC data

Distinguishing workers by educational attainment, interesting findings emerge (Figure 2.20). The advantage for tertiary graduates mostly refers to a lower risk of becoming inactive or unemployed, whereas the chances of improving one's working status by moving to a more stable contractual arrangement are not higher for graduates working with temporary contracts (fixed-term employees and atypical workers) than they are for lower-skilled workers. Likewise, the share of tertiary graduates working as open-ended employees both in 2000 and in 2011 (69.6%) is lower than that of those with an upper secondary degree (74.3%) and only slightly higher than that of those having attained at most a lower secondary degree (68.7%).

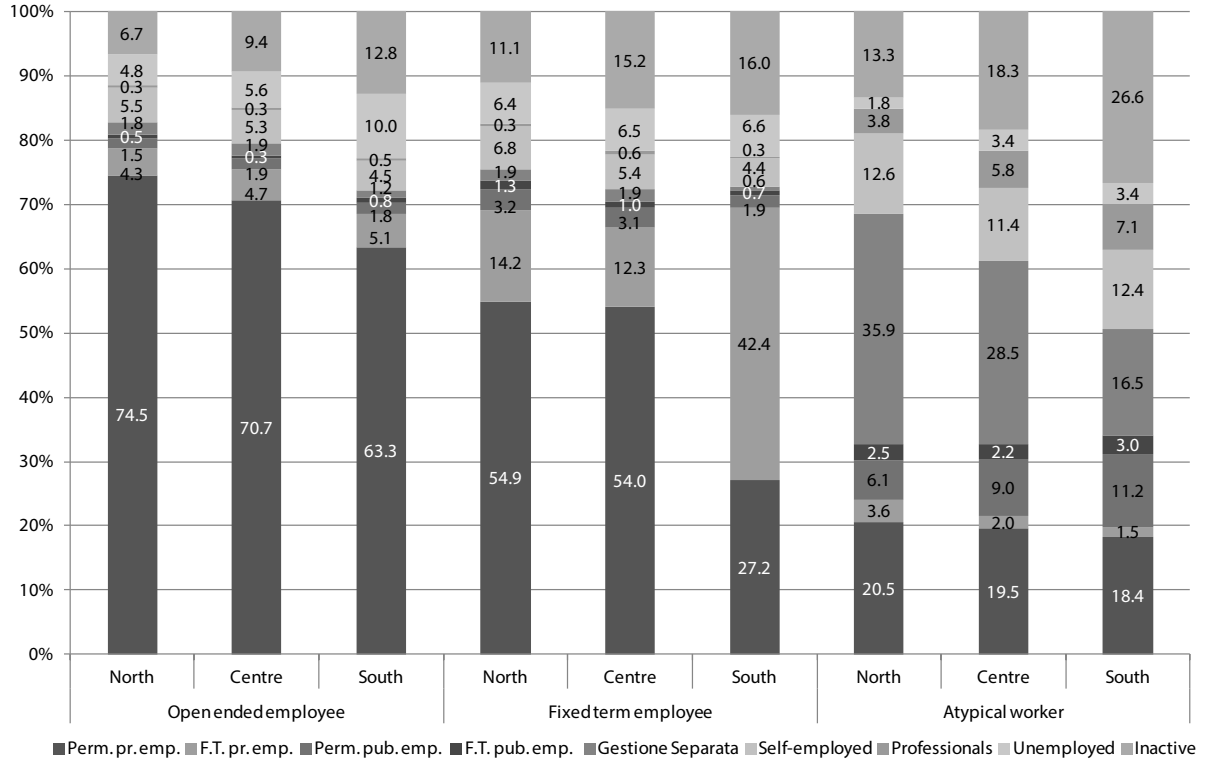
FIGURE 2.20: EMPLOYMENT STATUS IN 2011 OF THOSE WORKING AS PERMANENT OR FIXED-TERM EMPLOYEES OR AS ATYPICAL WORKERS IN 2000, BY EDUCATION



Source: elaborations on AD-SILC data

Finally, as expected, a clear geographical divide emerges (Figure 2.21). Compared to those working in the North and in the Centre of Italy, individuals working in the South are characterized by more frequent transitions towards inactivity and unemployment and by lower chances to move from a fixed-term to an open-ended arrangement.

FIGURE 2.21: EMPLOYMENT STATUS IN 2011 OF THOSE WORKING AS PERMANENT OR FIXED-TERM EMPLOYEES OR AS ATYPICAL WORKERS IN 2000, BY GEOGRAPHICAL AREA



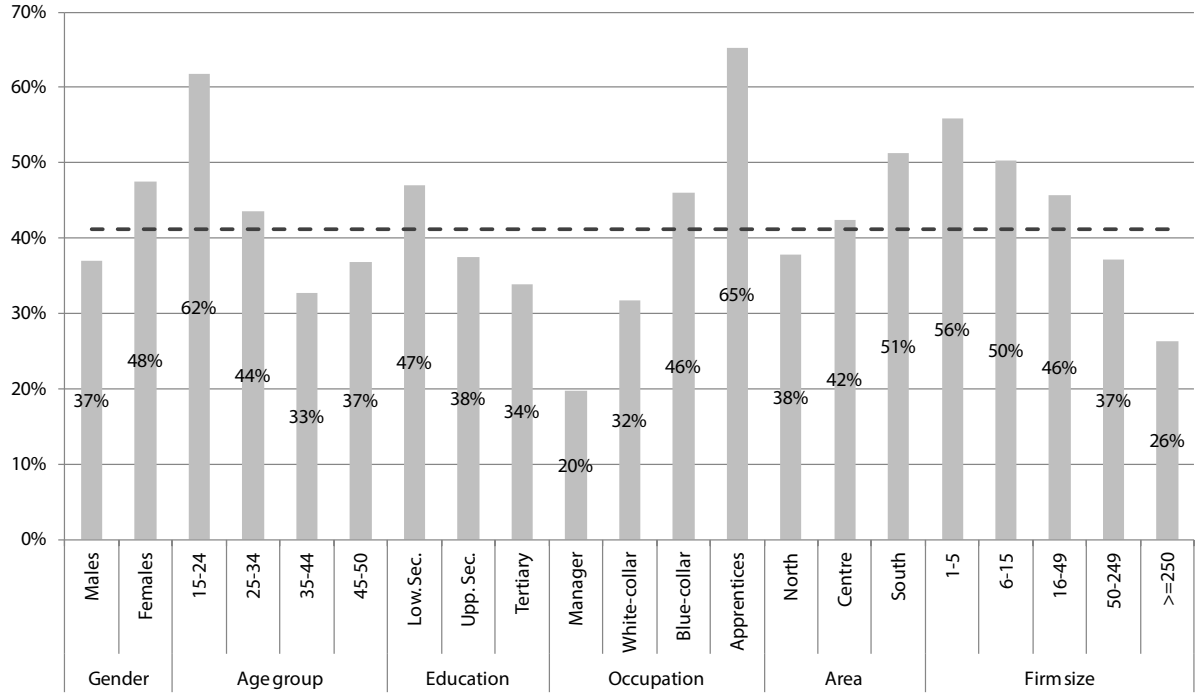
Source: elaborations on AD-SILC data

2.2.2 DOWNGRADE RISKS AND UPGRADE CHANCES

The matrixes presented so far show "point-to-point" transitions, i.e. they observe individual statuses in two moments in time, giving no information about any additional development occurred in between (for instance, a comparison of individual statuses in 2005 to those of 2000 gives no information about mobility in 2001, 2002, 2003 and 2004).

In order to thoroughly describe individual mobility among the various working statuses, it is interesting to observe how many permanent private employees lost their status (i.e. experienced a downgrade, moving to fixed term or atypical arrangements or to unemployment or inactivity) at least once in the 2000-2011 period (Figure 2.22). We have also computed the number of fixed-term private employees who moved at least once to an open-ended contract (either in the public or in the private sector) in the 2000-2011 period (Figure 2.23) and the number of atypical workers who moved to a dependent employment arrangement (either in the public or in the private sector, open-ended or fixed-term) at least once in the same period (Figure 2.24).

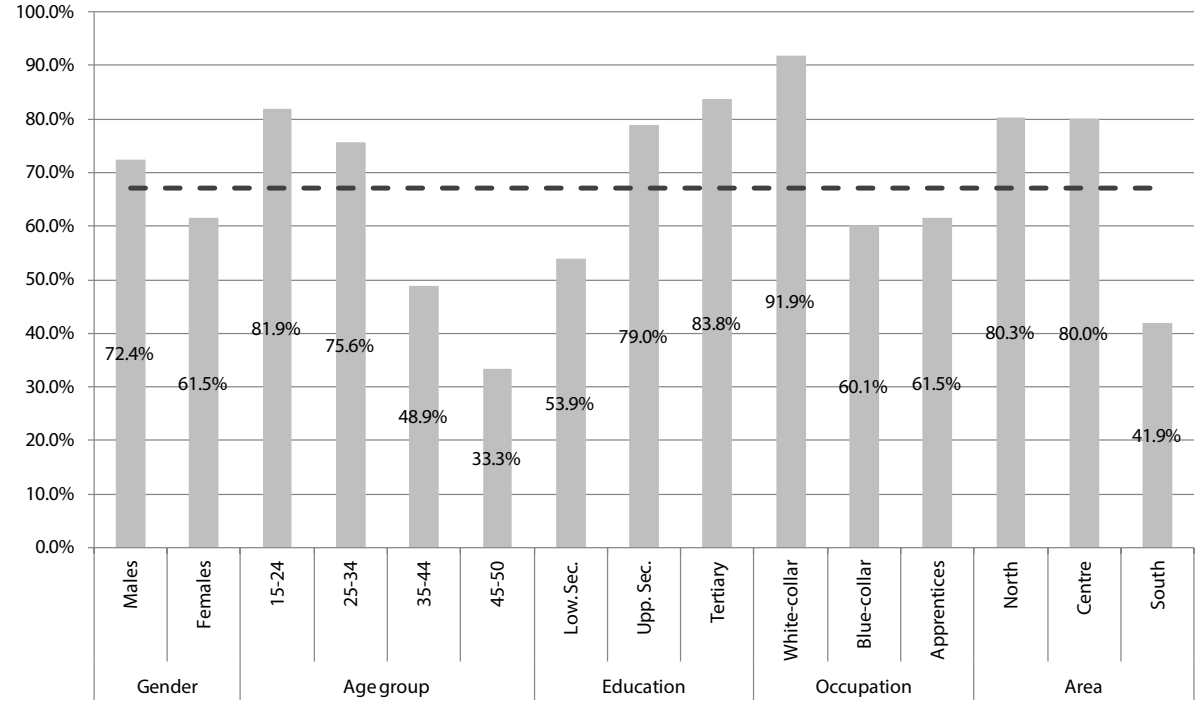
FIGURE 2.22: DOWNGRADE RISKS OF THOSE WORKING AS PERMANENT PRIVATE EMPLOYEES IN 2000 DURING THE 2001-2011 PERIOD [A]



[a] Mobility to fixed-term employment, atypical arrangements, unemployment or inactivity

Source: elaborations on AD-SILC data

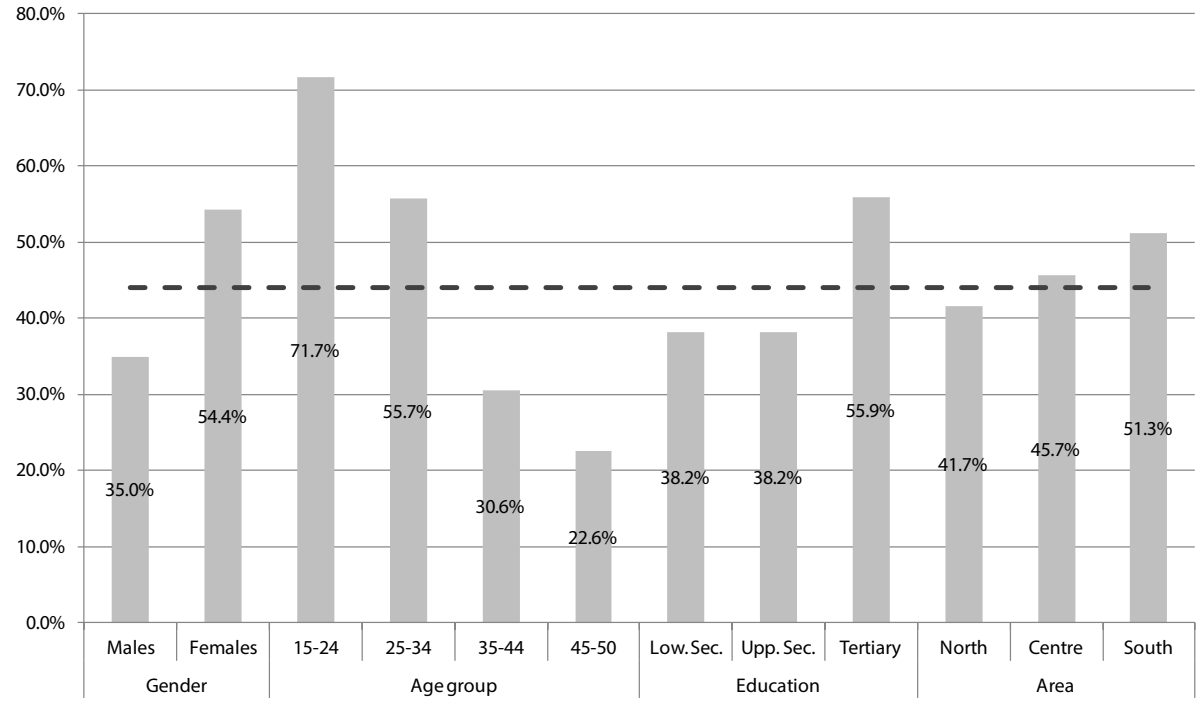
FIGURE 2.23: UPGRADE CHANCES OF THOSE WORKING AS FIXED-TERM PRIVATE EMPLOYEES IN 2000 DURING THE 2001-2011 PERIOD [A]



[a] Mobility to open-ended private or public employment

Source: elaborations on AD-SILC data

FIGURE 2.24: UPGRADE CHANCES OF THOSE WORKING AS ATYPICAL WORKERS IN 2000 DURING THE 2001-2011 PERIOD [A]



[a] Mobility to open-ended or fixed-term private or public employment

Source: elaborations on AD-SILC data

Confirming the picture of a rather mobile labour market that has emerged from the transition matrixes, 41% of the permanent private employees in the sample experienced at least one occupational downgrade during the 11-year period of analysis (Figure 2.22). Downgrade risks are higher for weaker groups of workers (e.g. low-skilled, females, apprentices and blue collars, those aged less than 35, those living in the South and working in small-sized enterprises), but insecurities emerge also among the most advantaged groups (e.g. tertiary graduates, those living in the North and working in large enterprises). In particular, no significant differences in workers' risks emerge among permanent employees hired in firms with around 15 employees, i.e. the threshold over which the reinstatement of employees at the job place in case of unfair dismissal was guaranteed before the introduction of the Jobs Act reform in March 2015.

Conversely, the share of temporary employees that moved at least once to permanent arrangements is rather high (on average 67.1%; Figure 2.23), even if the upgrade chances are much lower among the low skilled and those living in the South. The share of atypical workers who moved at least once to public or private employment in the 2000-2011 period is low, but not negligible (Figure 2.24). These data clearly show that "stabilization" towards open-ended contracts, also in large firms, does not cover individuals against risks to turn back to worse conditions. In conclusion, it has to be pointed out that data about individual working careers show that being hired under an open-ended arrangement or moving from a temporary to an open-ended arrangement do not seem sufficient to permanently reduce volatility in workers' statuses in the labour market.

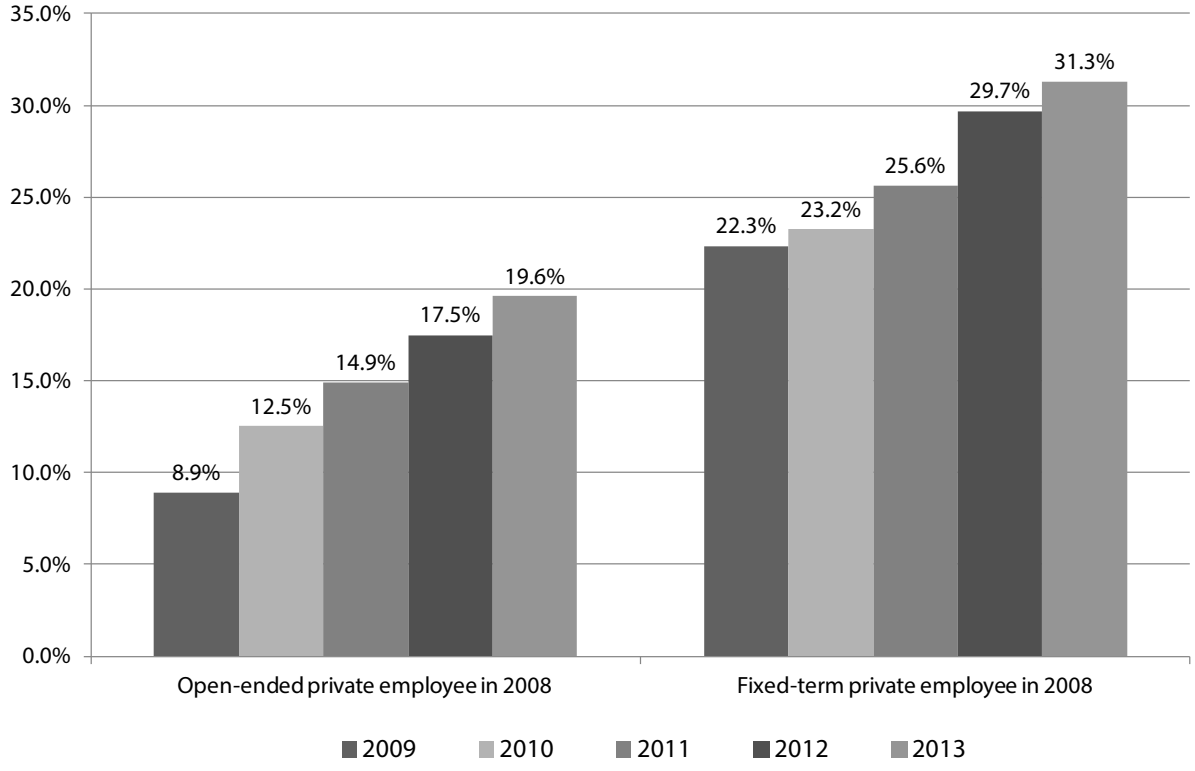
2.2.3 WORKERS' RISKS DURING THE CRISIS

The AD-SILC dataset, tracking all workers up to the end of 2013 – apart from public employees that are tracked up to 2011 – allows us to observe individual prospects in the labour market during the current economic crisis. Therefore, following the same definition of statuses applied in the previous Paragraphs, we shall observe the transitions in the 2009-2013 period of those individuals employed as open-ended or fixed-term private employees in 2008 (excluding those who retired or died during observation period).

In detail, following the definitions used in Paragraph 2.2, we focus on downgrade risks computing two indicators (Figure 2.25): i) the share of permanent private employees at the end of 2008 who in the subsequent five years have moved towards fixed-term or atypical arrangements or towards unemployment or inactivity; ii) the share of fixed-term private employees at the end of 2008 who in the subsequent five years have moved towards atypical arrangements or towards unemployment or inactivity.

As regards individuals working as permanent employees in the base year, the probability to worsen the working condition is 8.9% in 2009 and steadily increases in the 2009-2013 period. In other terms, in 2013, 19.6% of those employed under open-ended arrangements 5 years before had experienced a worsening of their working conditions. A clear worsening of the career prospects also emerges for those working as fixed-term private employees in 2008. In 2009, 22.3% of this subsample had moved to atypical contracts or to unemployment/inactivity and the share increased up to 31.3% in 2013.

FIGURE 2.25: DOWNGRADE RISKS OF THOSE WORKING AS PRIVATE EMPLOYEES IN 2008 IN THE 2009-2013 PERIOD [A]



[a] As concerns permanent employees in 2000: mobility to fixed-term employment, atypical arrangements, unemployment or inactivity. As concerns fixed-term employees in 2000: mobility to atypical arrangements, unemployment or inactivity.

Source: elaborations on AD-SILC data

2.2.4 MAIN FINDINGS ABOUT WORKERS' TRANSITIONS

Workers' vulnerability cannot be assessed by looking at the employment status in a given moment in time, but it is a condition that has to be empirically assessed studying the transitions experienced by workers during their career among the several working statuses (e.g. temporary jobs, permanent employment, unemployment, inactivity) in a dynamic perspective. Hence, the main research idea behind this chapter has been to analyse by means of the longitudinal dataset AD-SILC the interplay between contractual arrangements and individual prospects in a twelve-year period.

Data signal that, in the medium and long run, working trajectories are variegated and often not linear, i.e. they differ from the mere "fixed-term at the entry, then permanent" dynamic, even before the explosion of the current recession phase. Temporary workers are relatively more at risk and may be trapped in disadvantaged statuses (especially when working under atypical arrangements), but, more in general, the majority of workers, independently from their contractual status, record a non-negligible incidence of mobility.

Transitions regarding the stock of workers do not depict the Italian labour market as very rigid during the observation period. In particular, medium and long-term persistence in open-ended employment are very far from 100% and frequent movements outside the active labour force are observed. The frequency of people losing the status of permanent employee at least once in a five-year period is high (41%), and risks are higher for weaker workers (e.g. low skilled, females, people living in the South and working in small-sized firms). In this framework, the crisis greatly exacerbated workers' vulnerability, as can be assessed by looking at the share of employees who experienced a worsening of their contractual arrangements in the 2009-2013 period.

The empirical evidence presented in this chapter suggests that the Italian labour market is characterized by a certain level of "liquidity", rather than by a simple segmentation between insiders and outsiders, because a very large share of individuals continuously rise and fall among relatively advantaged and disadvantaged statuses.

2.3 ACCUMULATION OF PENSION CONTRIBUTIONS FOR THE FIRST COHORTS OF WORKERS BELONGING TO THE NDC SCHEME

As detailed in Chapter 1, the AD-SILC dataset allows an in-detail observation of the working histories of individuals who entered the labour market from 1996, i.e. of the cohorts of workers whose pension benefit computation will be entirely based on the NDC formula. Studying the working histories of these individuals up to 2013 helps assessing the potential adequacy risks of their future pension benefits, provided that their career patterns do not change in the upcoming decades.

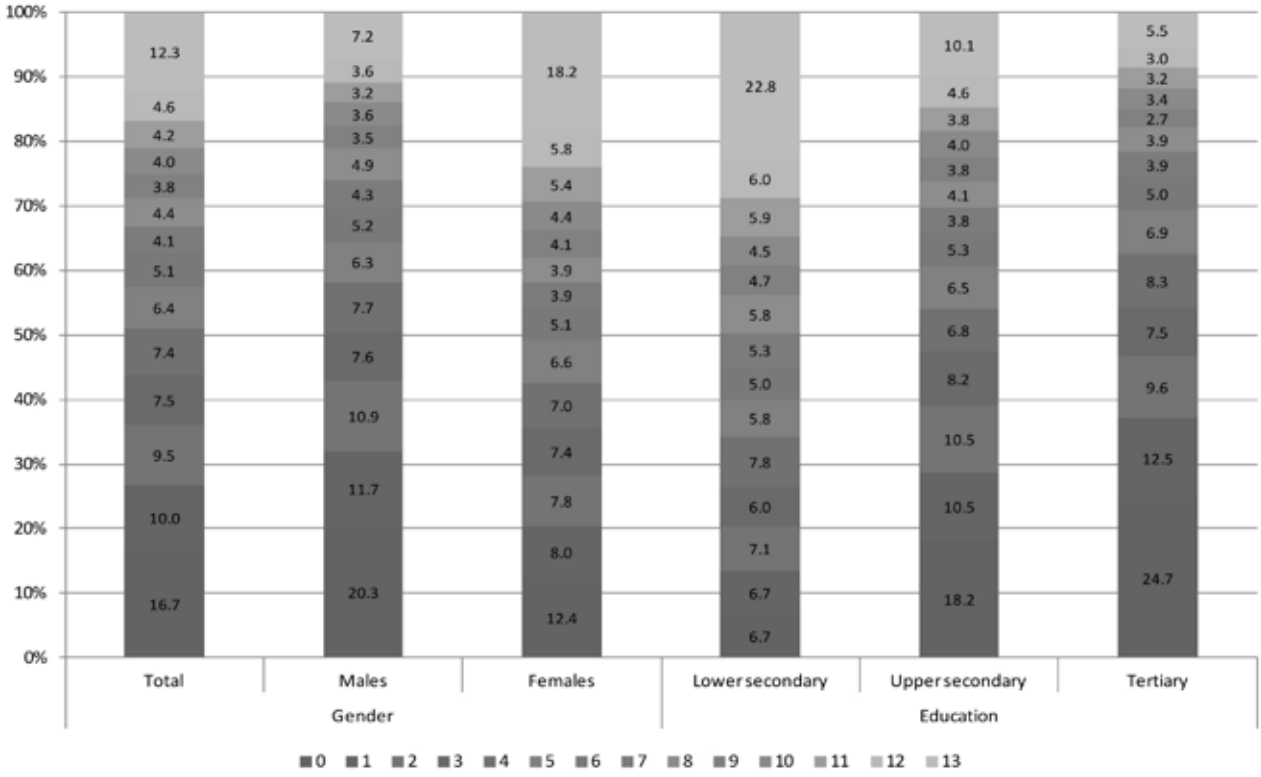
In this sense, it seems fruitful to separately analyse the impact of the three factors that may lead to low pensions, i.e. low wages, low contribution rates and high frequency of job interruptions. It is also crucial to understand how such factors have already affected the prospects of workers enrolled to the NDC scheme, by computing the amount of contributions they had already accrued by the end of 2013.

In more detail, we have considered in our analyses the sample of 5,911 individuals who entered the labour market in the three-year period 1996-1998, we have observed their career pattern and computed the pension contributions accrued in the first 13 years of their working career.

Concerning the risk to be low-paid workers, it is worth noticing that a large share of the cohorts of individuals enrolled in the Notional Defined Contribution scheme can be considered "working poor"[17] for many of the 13 years subsequent to their entry into the labour market. Only 26.7% of NDC workers had spent no more than one year earning less than the relative poverty threshold during the observation period, while around ¼ had spent at least 10 years as a working poor (Figure 2.26).

17 As already noted, in this chapter, following the economic literature, we call "working poor" those workers who earn less than 60% of the median earnings.

FIGURE 2.26: NUMBER OF YEARS SPENT AS WORKING POOR IN THE FIRST 13 YEARS OF CAREER

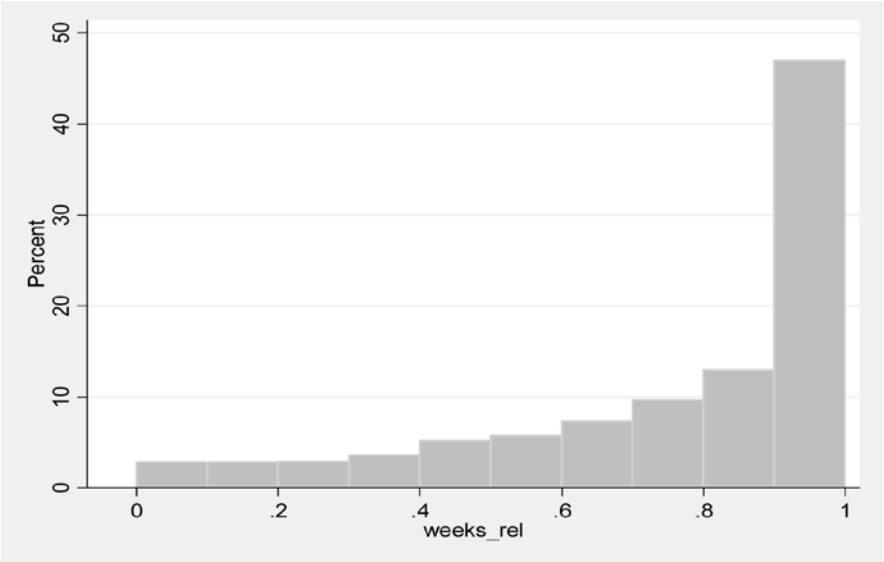


Source: elaborations on AD-SILC data

Coming to the second source of inadequacy risks of future pensions, i.e. the frequency of job interruptions without the provision of figurative contributions paid by the unemployment benefit system, it has to be stressed that wide gaps in terms of accrued weeks of contributions emerge, disadvantaging cohorts enrolled to the NDC.

As an indicator of the relevance of contribution gaps, we have computed the ratio of the actual seniority recorded in the AD-SILC dataset during the observation period and the weeks of seniority that could have been accrued had the individual continuously been employed (or had he received figurative contributions in case of unemployment).

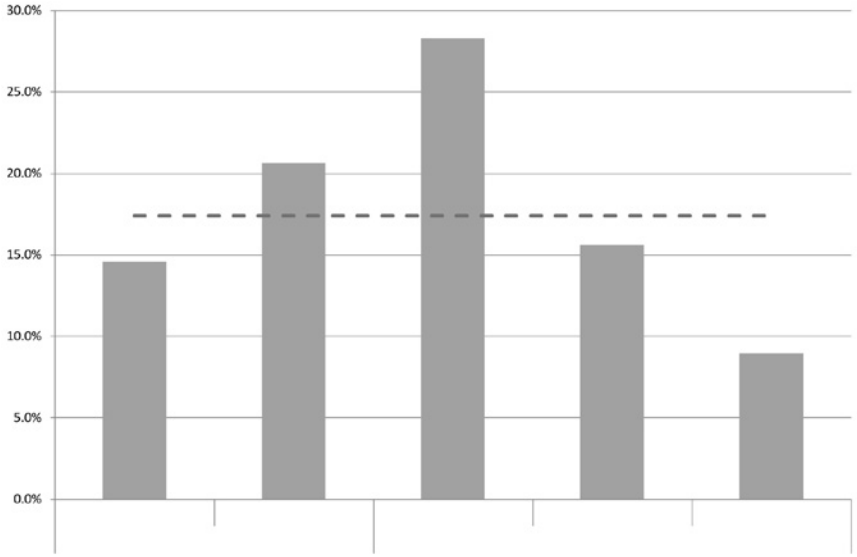
FIGURE 2.27: DISTRIBUTION OF THE RATIO OF ACTUAL CONTRIBUTION WEEKS ON POTENTIAL CONTRIBUTION WEEKS



Source: elaborations on AD-SILC data

Looking at the distribution of such ratio in Figure 2.27, only around 46% of the observed workers enrolled in the NDC scheme did not experience serious gaps in their seniority records in the first 13 years of their career, whereas around 18% of them accrued less than 50% of the potential contribution weeks (Figure 2.28).

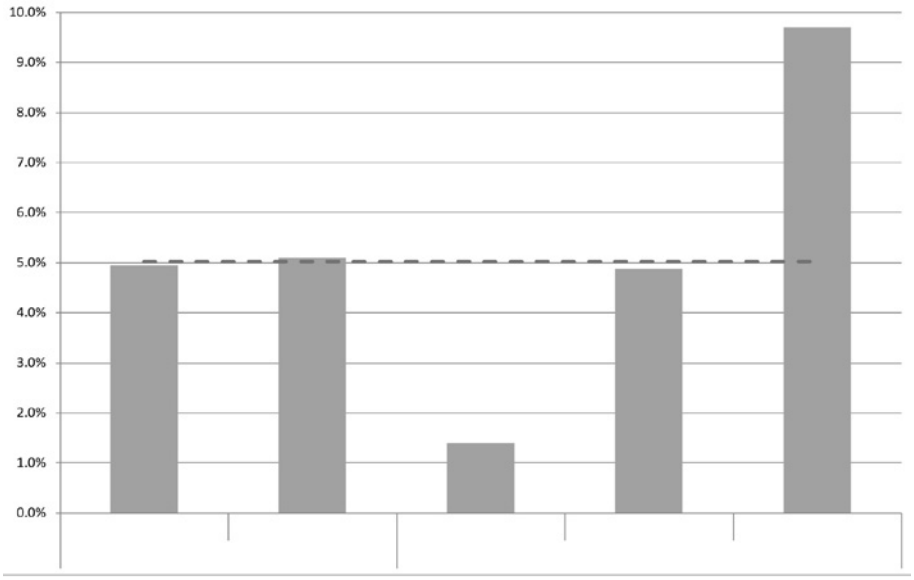
FIGURE 2.28: SHARE OF WORKERS HAVING PAID CONTRIBUTIONS FOR LESS THAN HALF THE POTENTIAL WEEKS



Source: elaborations on AD-SILC data

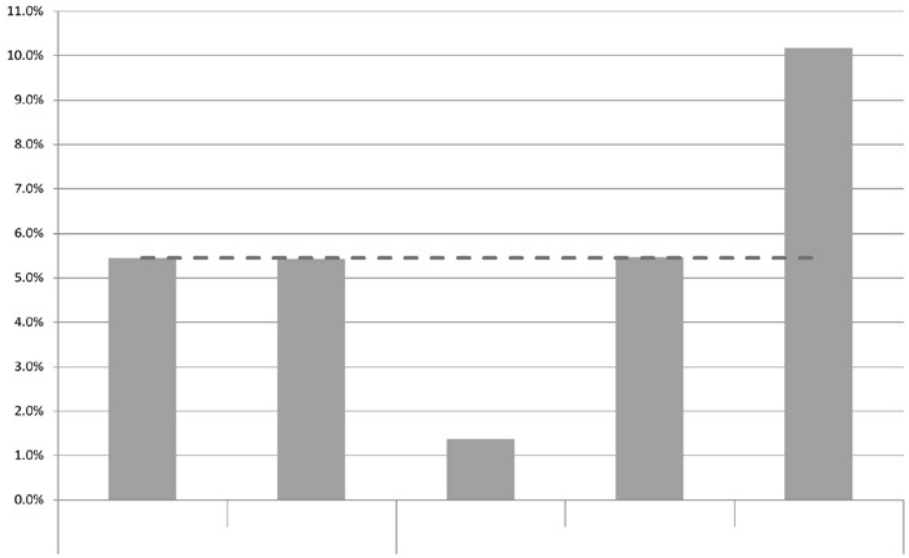
Concerning the third risk factor identified above – low contribution rates, typical of parasubordinate arrangements – it has to be pointed out that few individuals have spent the majority of their career as parasubordinate, so far (Figure 2.29). However, a few of the observed NDC workers, especially those with tertiary education (10.2%), spent at least 1/3 of their career working as a parasubordinate, thus paying lower contributions compared to their employed counterparts (Figure 2.30).

FIGURE 2.29: SHARE OF WEEKS SPENT IN THE GESTIONE SEPARATA



Source: elaborations on AD-SILC data

FIGURE 2.30: SHARE OF WORKERS HAVING PAID AT LEAST 1/3 OF THEIR WEEKLY CONTRIBUTIONS TO *GESTIONE SEPARATA*



Source: elaborations on AD-SILC data

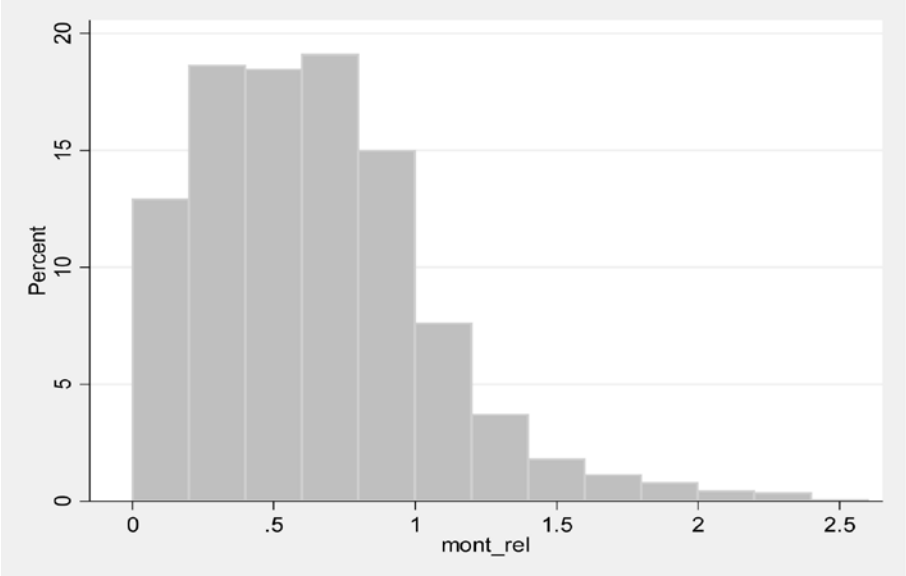
Summing up, three factors – often interacting – may lead to future pension inadequacy: low wages, low contribution rates and high frequency of job interruptions. All would engender a limited accrual of contributions and thus lead to low pension benefits, according to the NDC formula. In this framework, adequacy concerns are better assessed at the end of the working life. However, it is interesting to show how the new entrants observed in this Paragraph compare – in terms of the accrual of pension contributions – to a representative worker, always working as full-time employee, without job interruptions and earning each year the median income from private employment (around 25.000 Euros of annual gross earnings in 2015).

A first useful index is then the ratio between the accruals of actual workers and the accrual of this representative median worker. The distribution of this ratio computed for all cohorts entered since 1996 is highly asym-

metric to the left (Figure 2.31), highlighting that the large majority of workers belonging to the NDC scheme has so far accumulated less pension contributions than the hypothetical representative full-time private employee.

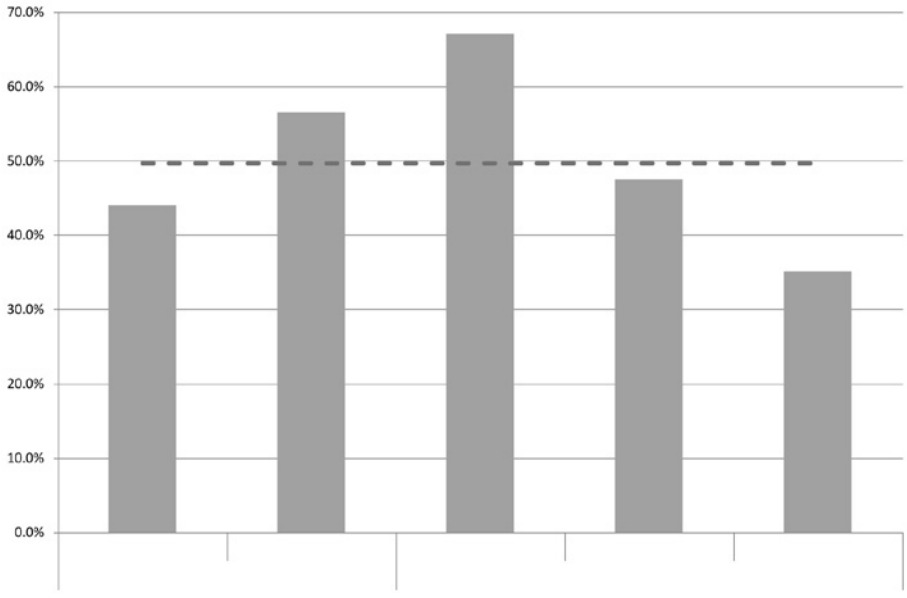
In particular, around 50% of the individuals who had entered the labour market in the 1996-1998 period had accrued less than the 60% of the amount accrued by representative employee at the end of the first 13 years of their careers (Figure 2.32). As expected, the incidence is higher for female and low-skilled workers, but the share of people accruing small contribution amounts is also high (over 1/3) among workers holding a tertiary education degree.

FIGURE 2.31: RELATIVE DISTRIBUTION OF CONTRIBUTIONS ACCUMULATION (WRT MEDIAN EMPLOYEE)



Source: elaborations on AD-SILC data

FIGURE 2.32: RELATIVE POOR OF CONTRIBUTIONS ACCUMULATION



Source: elaborations on AD-SILC data

3. SOCIAL DIFFERENCES IN LIFE EXPECTANCY IN ITALY: EVIDENCE FROM THE AD-SILC DATASET

In the last decades, the progresses of scientific research together with the increased coverage of the national health system, the general improvement of living standards and the spread of preventive measures have contributed to a fast increase in longevity in Italy. According to Eurostat data (Economic Policy Committee, 2015) life expectancy at birth has increased by around 12.5 years since the '60s and currently stands at 79.8 for males and 84.7 years for females, while life expectancy for 65-year-olds stands at 18.4 and 22.0 years.

The values of life expectancy are crucial in determining both retirement ages and the amount of pension benefits in the public Notional Defined Contribution (NDC) scheme. On the one hand, the 2009-2010 reforms established that all age requirements for retirement would be automatically updated in line with changes in life expectancy at 65, initially every three years and every two years starting from 2019. On the other hand, pension benefits in the NDC scheme are computed by multiplying the contributions accrued during the working life by the so-called conversion coefficients – that converts the accrued amount into an annuity – whose computation is based on life expectancy at the age of retirement and updated in line with age requirements[18].

Because NDC rules compute pension amounts according to average life expectancy, if specific social groups systematically outlive the average, the employment of homogeneous conversion coefficients would systematically favour them, causing a redistribution of pension savings from the shorter to the longer-lived. For instance, as females live longer than males on average, the NDC scheme redistributes from men to women, albeit this specific form of redistribution could be considered an ex-post compensation for women who are often disadvantaged in terms of career and wages in the labour market. However, this type of redistribution may be perceived as less acceptable if other socio-economic variables are considered, e.g. the richer have a systematic advantage over the poorer.

The relevant literature agrees on the correlation between longevity and individual socio-economic status, regardless of the variable used as a proxy of such status, e.g. income, occupation, education (see, among the others, Rosolia 2012, Leombruni et al. 2015, Marmot 2015 and the literature quoted therein). Therefore, if a "social differentiation" of longevity should emerge in Italy as well, the Italian scheme, which is based on average life expectancy, would lead to significant redistributive flows of lifetime pension savings from the less favoured to the more favoured individuals. In addition, as highlighted by The Economist (2012), the automatic increase in retirement ages when average longevity grows may not be regarded as neutral to individuals with heterogeneous characteristics, because the rich have a higher longevity and better chances to remain employed in safe and good jobs until retirement. Finally, if richer workers on average live longer than poorer workers, this would mean that, on average, higher pension benefits are paid out for a longer time than lower benefits, thus engendering sustainability concerns to the welfare system.

In conclusion, the issue of social differentiation of life expectancy is crucial in terms of both neutrality and sustainability and should be carefully considered in the economic policy debate. To this aim, this chapter aims at providing new empirical evidence for Italy as concerns the relationship between mortality and individual characteristics using the AD-SILC dataset, which is well suited to this scope. In more detail, the chapter is organized as follows: after a short review of the related literature (Paragraph 3.1), we present the data and the main descriptive evidence (Paragraph 3.2) and the methodology followed in the empirical analysis (Paragraph

18 Conversion coefficients are computed considering average life expectancy, regardless of gender or any other individual characteristics. Because the Italian pension system awards survivors benefits, the computation formula also has to take into account the probability that deceased pensioners leave a survivor behind, together with the average residual life expectancy of survivors.

3.3). Finally, we show the results of the micro-econometric estimates of the link between mortality and individual demographic and socio-economic characteristics (Paragraph 3.4).

3.1 RELATED LITERATURE

The evidence of large longevity gaps related to individual socio-economic conditions emerges in all countries where detailed analyses have been carried out. However, there is no agreement on the underlying causes that shape the correlation between individual economic status and longevity. A (not exhaustive) list of possible determinants of the advantages for well-off individuals should include: better medical treatments, more prevention, better life styles, lower stress, lower exposure to health risks.

Most of the empirical evidence refers to the US and the UK, due to the availability of proper micro-data linking information on mortality and health conditions to individual socio-economic characteristics (e.g. labour income, education, occupation). For what concerns Italy, as discussed below, the unavailability of long panel data representative of the Italian population has not allowed to carry out detailed estimates on these links so far. However, the empirical literature about Italy clearly confirms that individual longevity is associated with socio-economic characteristics.

As pointed out by Michael Marmot (2015), the leading scholar in this field, the social divide in health is a remarkably widespread phenomenon, and it is not limited to individuals in state of poverty. It involves the whole society, from the top to the bottom, with lower health conditions emerging at every step down the social hierarchy. Therefore, the social divide takes on the characteristics of a social gradient.

Indeed, many studies have identified social determinants as the "cause of causes" of the growing health inequalities within the most developed countries (e.g. Marmot et al. 2012, WHO-CSDH 2008, Marmot and Wilkinson 2006). These studies confirmed the existence of a social gradient – i.e. health and longevity improves when socio-economic conditions improve –, using different proxies of individual "socio-economic position", such as education, occupation or income, and some have even shown an increasing trend in this social divide (e.g. Dowd et al. 2011; Leinsalu et al. 2003; Mackenbach et al. 2003).

Quoting some recent empirical findings concerning the US, Munnell et al. (2008) show that life expectancy at 50 years of age amounts to 28.7 years for a white tertiary-graduated man, while it is 20.9 years for an upper-secondary-educated black man. Similar gaps emerge as concerns life expectancy in good health (that is crucial in order to assess the opportunity to postpone retirement age when longevity increases). When aged 50, a man belonging to the richest income quartile has a free-of-disability life expectancy of 23 years, while this value amounts to 14 years for men belonging to the poorest quartile.

Large gaps in longevity also emerge in the UK, in spite of the existence of the National Health System that, differently from the case of the US, should provide to all individuals similarly proper treatments, independently on their income. Therborn (2013) points out that longevity gaps among the various London neighbourhoods are similar to the gaps that characterize UK residents compared to Myanmar residents: people living in Chelsea-Kensington have a life expectancy at birth 17 years higher than those living in the London suburbs. Likewise, other studies show that life expectancy at 65 of those working as managers is 3.5 years higher than life expectancy of blue-collars, and these differences persist across generations (Office for National Statistics 2011): currently life expectancy at birth of managers' and blue-collars' offspring amounts to, respectively, 80.4 and 74.6 years.

Furthermore, the available evidence shows that the increase in longevity could be neither uniform nor random among individuals belonging to various socio-economic groups (Donkin et al. 2002). Indeed, the significant decrease in mortality in recent decades has not been equally distributed among the population and the health gap among different groups of individuals has increased in time (see, among the others, Dowd et al. 2011; Kunst et al. 2004; Mackenbach et al. 2003; Wilkinson and Marmot 2003).

For instance, detailed studies for the UK (Office for National Statistics 2011) show that the longevity gap at birth between managers' and blue-collars' offspring increased from 4.9 years in the '80s to 6.2 years at the beginning of the 21th century. Likewise, among employed females those working as managers have benefited of the highest increase in life expectancy (+3.7 years), while among blue-collar females the increase has been much lower (+1.9 years).

As concerns Italy, the evidence is still not exhaustive, due to limits in the available data. Some studies (e.g. Belloni et al. 2013; Leombruni et al. 2010; D´Errico et al. 2005), used the administrative archives collected by INPS (Italian Social Security Institute), which, however, do not record complete working histories and generally do not record crucial socio-economic variables as educational attainment or marital status. In order to overcome these shortcomings, a dataset merging INPS archives with death registers and census information has been developed, but this dataset only refers to the city of Turin or to the region of Piedmont, thus preventing scholars from extending the analyses to the entire Italian population.

Instead of relying on microdata, other scholars have developed analyses following a macro perspective, correlating average values in different local areas of death rates and socio-economic and demographic variables of the local population (e.g. Maccheroni 2009; Materia et al. 2005). However, the aggregate-level relationship between socio-economic status and the average level of mortality in specific areas gives little insight on the actual individual-level association between such variables.

However, despite the data shortcomings, all the existing studies confirm that in Italy longevity risks are clearly related to individual socio-economic characteristics as well (see the literature review of Rosolia 2012).

For instance, Costa (2009) and Maccheroni (2009) find a clear link between education and longevity and show that longevity gaps according to education have increased since the '80s. Cannari and D'Alessio (2004), using microdata of the Survey on Household Income and Wealth carried out every two years by the Bank of Italy, show that the probability to be still alive when the subsequent wave of the survey is carried out is higher for those with a better education and a higher income. Costa et al. (2010), using INPS administrative data, show that individuals who retire after a working life spent as low-paid employees have a significantly lower-than-average life expectancy, and life expectancy is even lower for those who have been employed in the transportation or in the mining industry.

Finally, Peracchi and Perotti (2009) employ ISFOL-PLUS data, that record self-reported subjective probabilities to survive at different ages – show that this probability (considered in the literature a good proxy of effective longevity) is significantly higher for those working through open-ended and high paid contractual arrangements.

3.2 DATA AND DESCRIPTIVE EVIDENCE

We estimate the link between longevity and socio-economic individual characteristics by using the dataset AD-SILC, built merging the information provided in the waves 2004-2012 IT-SILC (i.e. the Italian version of the European Union Statistics on Income and Living Conditions – EU-SILC) with the administrative social security records provided by INPS for those individuals interviewed in the 9 waves of IT-SILC (see Chapter 1 for a detailed description of the AD-SILC dataset). On the one hand, social security records collect detailed information about individual working lives since the entry in the labour market up to 2014. On the other hand, IT-SILC records dozens of individual characteristics in the year of the interview, e.g. educational attainment and marital status. Furthermore, for all individuals surveyed in IT-SILC in year t (e.g. in 2006), INPS archives record the date of death if they have died by 2014.

Therefore, AD-SILC is very well suited for studying social determinants of longevity, since it collects longitudinal microdata on individual working conditions and demographic and socio-economic characteristics and, most of all, it records individual survival at different moments in time. To our knowledge, in Italy there is no better dataset than AD-SILC for the pursuit of our research goals. Indeed, INPS archives are very detailed for what concerns working histories, but they do not record marital status nor educational attainments. Survey

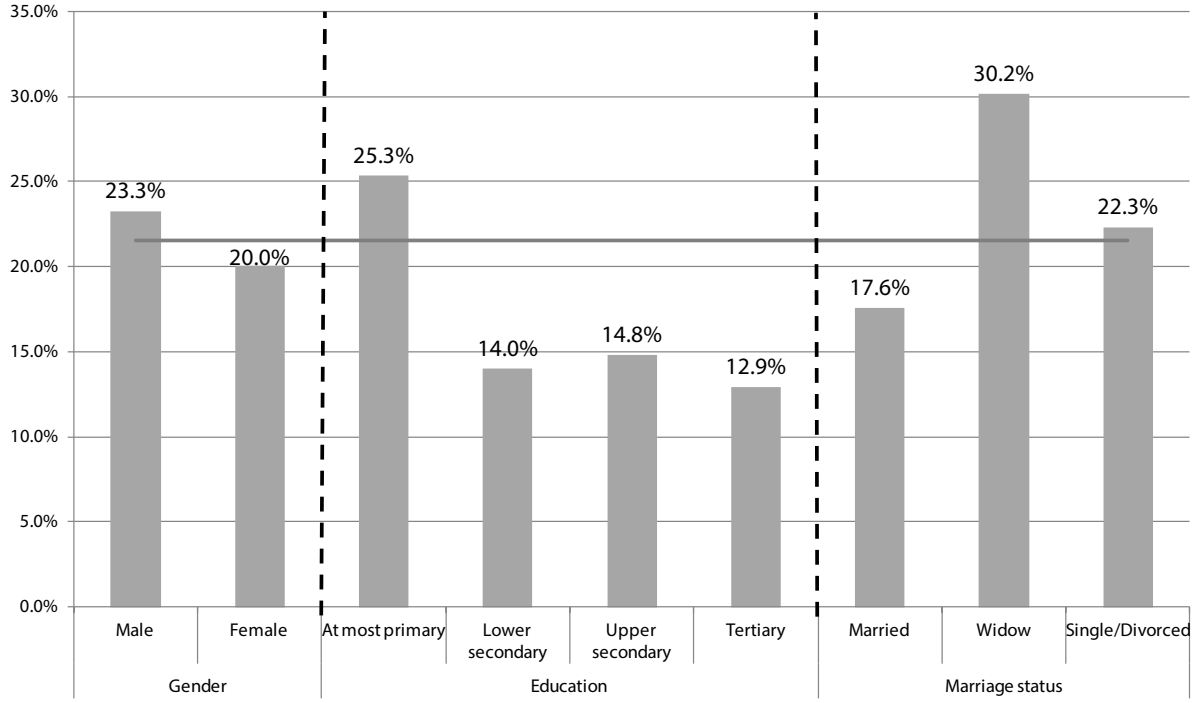
panel data (e.g. SHIW or IT-SILC) are characterized by a short-time span (4 years in IT-SILC) and may suffer from different drawbacks such as the huge attrition problems (i.e. non-causal disappearance from the panel) that do not advise the employment of these data for the study of mortality risks.

As explained in the next Paragraph, we aim at studying the association between survival and individual characteristics. In our estimates, we consider the following variables in their association to mortality risks: gender, education (primary, lower-secondary, upper-secondary or tertiary educated), geographical area of residence (North, Centre, South), marital status (married, widow, single or divorced), total effective experience in the labour market since the entry into activity (computed in weeks), type of employment relationship when active (employee, self-employed or no working activity) and, as a proxy of economic well-being, the logarithm of the equivalised disposable income[19]. Unfortunately, AD-SILC does not contain information on individual health condition and on dependency.

In our analysis, we have employed a subsample of AD-SILC composed by 361,162 observations concerning 44,385 individuals who were at least 60 years old when they got surveyed in IT-SILC. Among these 44,385 interviewed individuals, 9,562 had died by December 31st 2014.

Simple descriptive analyses on the share of individuals who died in the observation period in our sample clearly show that longevity is associated to different socio-economic characteristics and those characterized by better statuses have, on average, a lower mortality risk (see Figures 3.1-3.4, where the red line is the average value of the death rate).

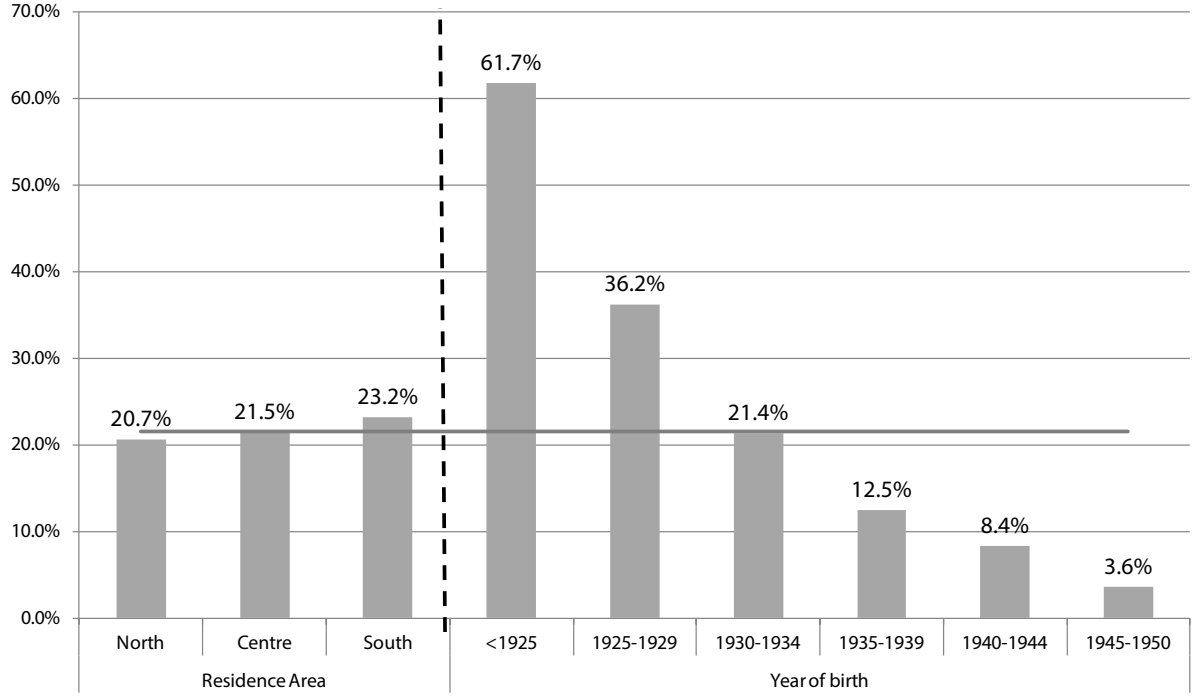
FIGURE 3.1: SAMPLE FREQUENCIES OF DEATH RATE BY GENDER, EDUCATION AND MARITAL STATUS



Source: elaborations on AD-SILC data

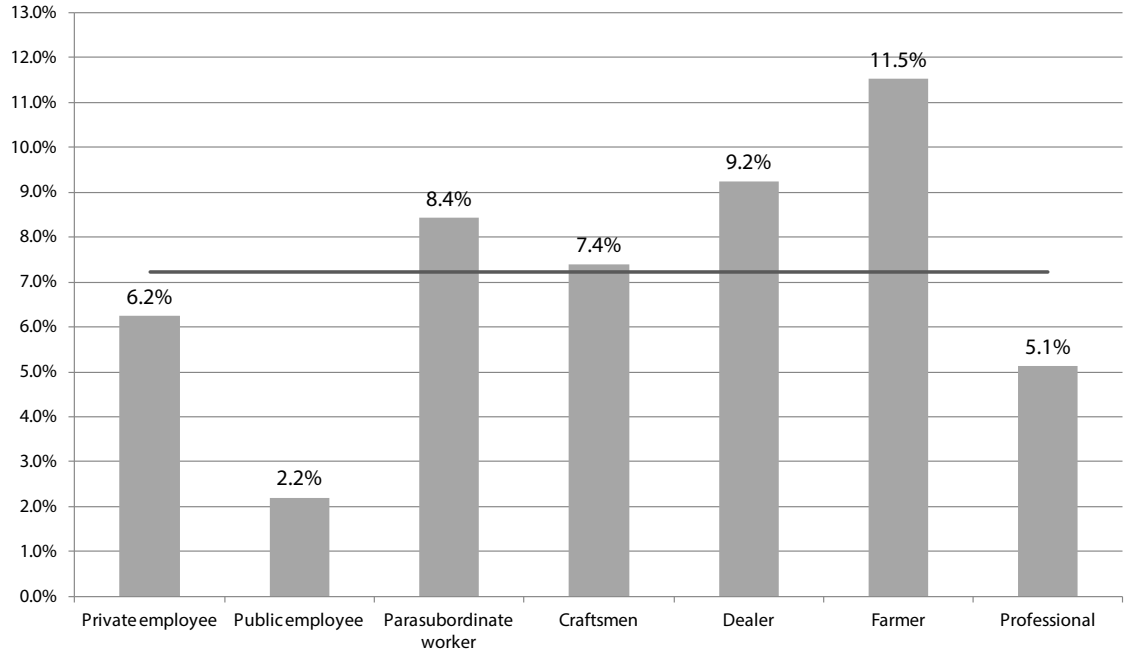
19 The equivalised disposable income is the total income of a household, after tax and other deductions, that is available for spending or saving, divided by the number of household members converted into equalised adults; household members are equalised (or made equivalent) by weighting each according to their age, using the so-called modified OECD equivalence scale. The following scale gives a weight to all members of the household: 1.0 to the first adult; 0.5 to the second and each subsequent person aged 14 and over; 0.3 to each child aged under 14 (Eurostat).

FIGURE 3.2: SAMPLE FREQUENCIES OF DEATH RATE BY MACRO-AREA OF RESIDENCE AND YEAR OF BIRTH



Source: elaborations on AD-SILC data

FIGURE 3.3: SAMPLE FREQUENCIES OF DEATH RATE FOR INDIVIDUALS STILL WORKING BY JOB TYPOLOGY

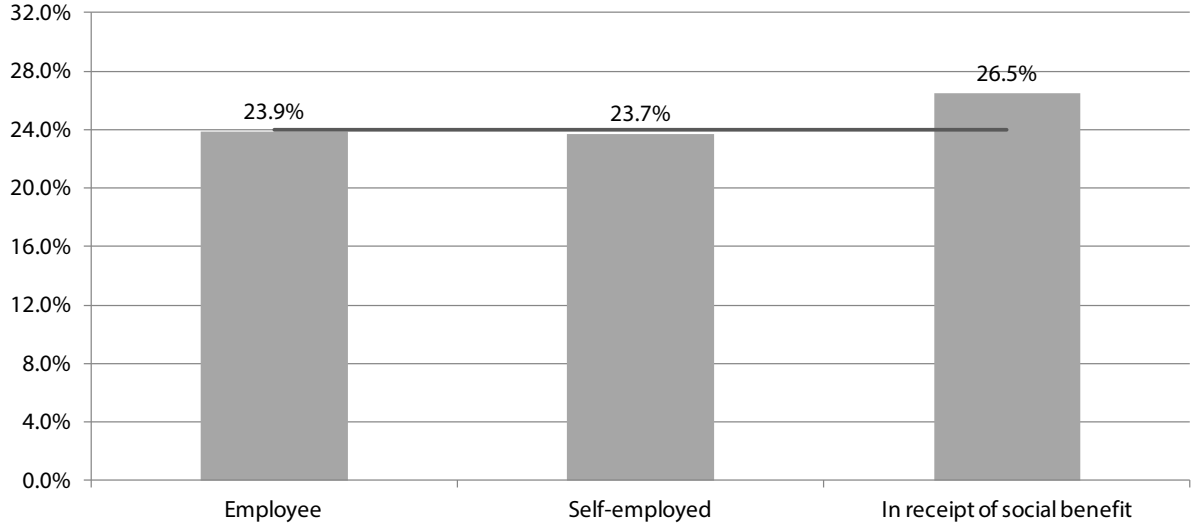


Source: elaborations on AD-SILC data

As expected, survival probabilities are higher for females than for males (Figure 3.1). Interestingly, the lower share of death rates emerges among tertiary graduates (12.9% of the interviewed die in the observation pe-

riod) while the highest concerns those with a primary degree (the share of deaths amounts to 25.3%; Figure 3.1). As obviously expected, survival rates steadily decline with age (Figure 3.2). Interestingly, among those who die while still in activity, the frequencies of death in our subsample is much lower than the Italian average for public employees and professionals, whereas it is much higher for farmers and dealers (Figure 3.3). Finally, as expected, the share of death is higher for those who receive a social pension that for those who previously worked as employees or self-employed workers (Figure 3.4).

FIGURE 3.4: SAMPLE FREQUENCIES OF DEATH RATE FOR RETIREES BY PREVIOUS EMPLOYMENT STATUS



Source: elaborations on AD-SILC data

3.3 METHODOLOGY

Survival analysis examines and models the time it takes for events to occur. Survival analysis focuses on the distribution of survival times. Although there are well known methods for estimating unconditional survival distributions, the most interesting survival models analyse the relationship between survival and one or more predictors, usually termed covariates in the literature (for details about survival analysis see, among the others, Cox 1972; Cox and Oakes 1984; Therneau and Grambsch 2000).

A nearly universal feature of survival data is censoring, the most common form of which is right censoring. Indeed, when the period of observation in a dataset ends, we do not know when the event might occur for those individuals who survived during the whole observation period.

The hypothesis of non-informative censoring is required to avoid obtaining estimates affected by biases. More in particular, conditionally on the values of explanatory variables, the probability for any individual to survive up to time t does not depend on censoring time. That is, the distribution of survival times of subjects who are censored at a particular time t is not different from that of subjects who are still under observation at this time.

Given the random variable T, computed to measure the time to death, the survival function is defined by $S(t)=Pr(T>t)$, and estimates the probability for each individual that the event death occurs beyond time t. Non-parametric methods are used for estimating the survival function, which do not require specific assumptions on the distribution of T. Having observed n individuals with survival times t_1 t_2,….,t_n , let n_j be the number of individuals who do not experience the event just before t_j and d_j the number who die at that time. Under the assumption that event time of the individuals in the sample occur independently, the estimator of the survival

function is given by:

$$\hat{S}(t) = \prod_{j=1}^{k}\left(\frac{n_j - d_j}{n_j}\right) = \prod_{j=1}^{k}\hat{p}_j(t) \text{ for } t_{(k)} \leq t \leq t_{(k+1)}\ k=1,\ldots,r\ r \leq n$$

Where r denotes the times of events recorded.

The standard error of the Kaplan Meier estimator is given by:

$$se\{\hat{S}(t)\} \approx \hat{S}(t)\left\{\sum_{j=1}^{k}\left(\frac{d_j}{n_j(n_j - d_j)}\right)\right\}^{\frac{1}{2}} \text{ for } t_{(k)} \leq t \leq t_{(k+1)}$$

The hazard function is estimated for evaluating the risk or hazard of the event (stabilization) at some time t, and is defined as the probability that an individual dies in t, conditionally on being alive up to that time. This conditional probability is expressed as a probability per unit:

$$h(t) = \lim_{\delta t \to 0} \frac{P(t \leq T \leq t+\delta t | T \geq t)}{\delta t}$$

so that h(t)δt is the probability that an individual will die in the interval (t,t+δt) conditionally on being alive at time t. In order to estimate the hazard function, it is useful to take the ratio of the number of events occurring at a given time, divided by the number of individuals at risk at that time. Thus, if there are d_j events occurring at the j^{th} event time $t_{(j)}$, j=1,…,r, and n_j at risk at time $t_{(j)}$, the hazard function in the interval from $t_{(j)}$ e $t_{(j+1)}$ is given by:

$$\hat{h}(t) = \frac{d_j}{d_j \tau_j} \text{ for } t_{(j)} \leq t \leq t_{(j+1)} \text{ and } \tau_j = t_{(j+1)} - t_{(j)}$$

and the standard error is given by:

$$se\{\hat{h}(t)\} = \hat{h}(t)\left\{\frac{(n_j - d_j)}{n_j d_j}\right\}^{\frac{1}{2}}$$

In order to assess the relationship between the survival time T and one or more explanatory variables (e.g. sex, wage, etc.), an approach based on statistical modeling is used. The basic modeling approach is given by a proportional hazard model (the Cox regression model) proposed by Cox (1972). This model is based on the assumption of proportionality of the hazard: if we have to compare the survival experience for two groups of individuals, let $h_A(t)$ and $h_B(t)$ be the hazards of stabilization for groups A and B, respectively. The proportional hazard model suggests the following simple formulation:

$$h_A(t) = \psi\, h_B(t)$$

where Ψ, a relative hazard or hazard ratio, is a constant and its value is the hazard of being at risk of dying at any time for an individual who belongs to group A relative to the other group. An implication of this assumption is that the corresponding true survivor functions for the two groups of individuals do not cross.

More in general if there are X_1 X_2….X_p explanatory variables that assume values represented by the vector $\mathbf{x}=(x_1,x_2,\ldots,x_p)'$, the first step in order to describe the Cox Model is taking as benchmark an individual for whom all the values in **x** are zero. This means that covariates do not influence the hazard of the event for an individual, that is $\beta_1 = \beta_2 = \ldots = \beta_p = 0$, so that:

$$h(t|x) = h_0(t)\ .$$

This function $h_0(t)$ is called the baseline hazard function. The hazard function for the i^{th} individual can be written as:

$$h_i(t) = h_0(t)\, \psi(x_i)$$

where $\psi(x_i)$ is a function of the values of the vector of explanatory variables for the i^{th} individual. The function $\psi(\,)$ can be interpreted as the hazard at time t for an individual whose vector of explanatory variables is x_i, relative to the hazard for an individual for whom x=0.

In matrix notation, if β is the vector of coefficients of the explanatory variables $x_1,\ldots x_p$, the quantity $\beta' x_i$ is the so called risk score (or prognostic index) for the i^{th} individual and the proportional hazard model, since $\psi(x_i)$ cannot be negative, it can be expressed by:

$$h_i(t) = h_0(t)\, \exp(\beta_1 x_{1i} + \beta_2 x_{2i} + \ldots. + \beta_p x_{pi})$$

thus:

$$\frac{h_i(t)}{h_0(t)} = \exp(\beta_1 x_{1i} + \beta_2 x_{2i} + \ldots. + \beta_p x_{pi})$$

hence, we may write :

$$\frac{h_i(t)}{h_0(t)} = f(\beta, x)$$

In this latter formulation, it is useful to underline that in the Cox Model the hazard of the event for two groups of individuals does not depend on time, but it is constant over the period.

The hazard of the event can be also expressed by:

$$\log \frac{h_i(t)}{h_0(t)} = \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots. + \beta_p x_{pi}$$

Therefore, the proportional hazard model may be regarded as a linear model of the logarithm of the hazard ratio. In the linear component of the proportional hazard model, there is no constant term and no particular form of probability distribution is assumed for the survival time. In the specification of the model, no assumption is made about the actual form of the baseline hazard function.

An implicit assumption of hazard models is that if two individuals have identical values of the covariates, they also have identical hazard functions. If there are no covariates in the model, then the entire sample is presumed to have a single hazard function: this is an unrealistic assumption. Individuals and their environments differ in so many respects that no set of measured covariates can possibly capture all the variation among them.

In order to deal with the issue of individual heterogeneity it is convenient to add random effects to survival models as continuous variables, in order to take into account excess of risk or frailty for distinct categories. The idea is that individuals have different frailties and those who are frailer will experience the event earlier than the others. Frailty is useful in modeling correlations in multivariate survival analysis. Frailties are treated as unobserved covariates.

In our analysis we then use the shared frailty model, so that all the observations share a common frailty. In others approaches frailties can be nested (when individuals within a family may share a common frailty, while families within communities share another common frailty); in others cases frailties can be correlated. The standard model can be now modified with the introduction of the frailty term $\acute{\omega}_{(i)}$, so that:

$$h_i(t) = h_0(t)\, \acute{\omega}_{(i)}\, \exp(\beta_1 x_{1i} + \beta_2 x_{2i} + \ldots. + \beta_p x_{pi})$$

where the frailty $\acute{\omega}_{(i)}$ has a gamma distribution with mean 1 and variance θ.

3.4 ESTIMATION RESULTS

The results of our empirical estimates are shown in Tables 3.1 and 3.2. In these Tables, various estimated models are shown, where models differ by the set of covariates that are included. We show the estimated coefficients, where a positive sign suggests that the covariate is a predictor of an earlier death, while a negative sign suggests that the covariate is associated to a higher probability to survive.

In Table 3.1, we start considering only the gender as a covariate (model M1). Then we add the geographical area of residence (M2), the marital status (M3) and the educational attainment (M4). Afterwards, in Table 3.2 we add to M4 the effective experience in the labour market when active (computed in weeks; model M5). Then we include the information on the type of past or current employment relationship (employee is the reference category; self-employed and "in receipt of a social pension" – i.e. a proxy of individuals with at most very short working careers – are the covariates; model M6). Finally, in the most complete model, we also add the equivalised disposable income recorded in IT-SILC as a further proxy of individual economic well-being.

As expected, in all models mortality risks are higher for males than for females. Interestingly, living in the South is associated with higher mortality even in models where several proxies of individual living standards are included among the covariates. Married individuals and widows are characterized by lower risks when compared to singles and divorced. Furthermore, being a tertiary graduate is associated to a lower mortality risk in all the estimated models (see models M4-M7).

Those who worked as self-employed have higher survival rates than those who worked as employees, while those who receive social pensions (i.e. those characterized by short or null working careers) are characterized by significantly higher mortality risks compared to those who previously worked, either as self-employed or as employees. *Ceteris paribus*, longer working careers reduce survival rates.

Finally, even when controlling for several proxies of individual socio-economic status (e.g. area of residence, occupation, education), higher equivalised disposable incomes are associated with lower mortality risks.

In conclusion, our results are consistent with the findings shown for other countries in pointing out that longevity does variate according to socio-economic individual statuses. As clearly shown in our estimates, all covariates exert a significant effect on survival rates. Consequently, it is very likely that every factor characterizing those living in better economic conditions (e.g. income, education, occupation) exerts a positive effect on longevity, thus engendering a large and significant cumulative effect on longevity.

TABLE 3.1: ESTIMATES OF DEATH PROBABILITIES BY INDIVIDUAL DEMOGRAPHIC CHARACTERISTICS. COX REGRESSION MODEL WITH GAMMA FRAILTY.[1]

	M1	*M2*	*M3*	*M4*
Male	0.778***	0.782***	0.583***	0.582***
	[0.025]	[0.026]	[0.030]	[0.031]
	0.000	*0.000*	*0.000*	*0.000*
North		0.052***	0.047	0.033
		[0.031]	[0.033]	[0.033]
		0.092	*0.150*	*0.320*
South		0.201***	0.213***	0.192***
		[0.035]	[0.036]	[0.037]
		0.000	*0.000*	*0.000*
Married			-0.190***	-0.186***
			[0.046]	[0.046]
			0.000	*0.000*
Widow			-0.797***	-0.781***
			[0.048]	[0.049]
			0.000	*0.000*
Upper secondary				0.317***
				[0.082]
				0.000
Lower secondary				0.260***
				[0.082]
				0.002
Primary				0.282***
				[0.074]
				0.000
Number of observations	44,352	44,352	44,352	44,352

[1] Reference category is Center for geographical area; single or divorced for marital status; tertiary graduates for education. Standard errors in brackets, p values in italics.

* p<0.10; ** p<0.05; *** p<0.01. Source: elaborations on AD-SILC data

TABLE 3.2: ESTIMATES OF DEATH PROBABILITIES BY INDIVIDUAL DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS. COX REGRESSION MODEL WITH GAMMA FRAILTY.

	M5	M6	M7
Male	0.369***	0.392***	0.415***
	[0.029]	[0.033]	[0.033]
	0.000	*0.000*	*0.000*
North	0.017	0.019	0.016
	[0.016]	[0.033]	[0.032]
	0.590	*0.560*	*0.640*
South	0.242***	0.258***	0.243***
	[0.035]	[0.038]	[0.037]
	0.000	*0.000*	*0.000*
Married	-0.167***	-0.194***	-0.188***
	[0.042]	[0.046]	[0.046]
	0.000	*0.000*	*0.000*
Widow	-0.678***	-0.707***	-0.675***
	[0.047]	[0.049]	[0.050]
	0.000	*0.000*	*0.000*
Upper secondary	0.227***	0.213***	0.161*
	[0.078]	[0.083]	[0.084]
	0.004	*0.010*	*0.054*
Lower secondary	0.174**	0.150*	0.077
	[0.079]	[0.082]	[0.083]
	0.027	*0.068*	*0.350*
Primary	0.218***	0.199***	0.112
	[0.071]	[0.075]	[0.077]
	0.002	*0.008*	*0.140*
Experience	0.000***	0.001***	0.001***
	[0.022]	[0.000]	[0.025]
	0.000	*0.000*	*0.000*
Self-employed		-0.169***	-0.198***
		[0.033]	[0.034]
		0.000	0.000
In receipt of social benefit		0.653***	0.613***
		[0.058]	[0.058]
		0.000	0.000
Log Income			-0.113***
			[0.024]
			0.000
Number of observations	44,352	44,352	44,352

[1] Reference category is Center for geographical area; single or divorced for marital status; tertiary graduates for education; employees for type of working activity. Standard errors in brackets, p values in italics.

* p<0.10; ** p<0.05; *** p<0.01. Source: elaborations on AD-SILC data

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4. THE ITALIAN PENSION SYSTEM: RECENT REFORMS AND PRESENT CHALLENGES

Pension reform has been a national priority and has dominated the public debate in Italy since the beginning of the '90s. The main goals have been ensuring financial sustainability for the social security system in the short and long term, reducing the asymmetries and minimizing the deadweight costs engendered by the traditional Defined Benefit computation formula, introducing and developing private pension schemes.

Since 1992, an outstandingly long series of reforms (1992, 1993, 1995, 1997, 2004, 2005, 2007, 2010, 2011) has radically transformed the Italian pension system, modifying several fundamental parameters of the public system –computation formulas, indexation rules, eligibility requirements for old-age and early retirement – and trying to foster the development of private occupational and personal pension plans.

As a result of the reform process, the pay-as-you-go (PAYG) financed public scheme has switched from a Defined Benefit formula (DB, in Italy known as *retributivo*) to a Notional Defined Contribution one (NDC, in Italy known as *contributivo*); age and contributions requirements significantly rose and further increases are expected in the future, due to the automatic link to changes in life expectancy; the system's architecture adopted a multi-pillar configuration, even though the public pillar is still largely predominant.

Concerning the two main objectives to be pursued by pension systems in EU countries, sustainability and adequacy[20], it has to be pointed out that the reforms of the last two decades, mostly because of the gradual phasing in of the NDC scheme, are expected to ensure financial sustainability in the medium and long run, in spite of the intense ageing process that is characterizing the Italian population[21]. On the other hand, in spite of the still high replacement ratios, providing adequately high benefits may prove challenging particularly to individuals characterized by unsuccessful working histories and/or who spend many years as atypical workers.

In this report we first review the pension reform process of the last twenty years: Paragraph 4.1 focuses on the characteristics of the system before the reform process started and on the '90s' reforms, Paragraph 4.2 focuses on the reforms introduced in the period 2000-2010 and Paragraph 4.3 on the measures introduced by the Monti Government in December 2011 and on the most recent adjustments. In Paragraph 4.4 we present the architecture of the private pillar, highlighting its main drawbacks. Afterwards, we move focus to the public NDC pillar, clarifying its characteristics and highlighting the main challenges that will have to be addressed in the future in terms of adequacy issues (Paragraph 4.5).

20 See European Commission (2010, 2012).

21 The old-age dependency ratio is supposed to raise dramatically from 32.66% in 2013 to 53.06% in 2060 (Eurostat).

4.1 THE REFORMS OF THE '90S

Following the numerous expansionary reforms of the 1950s-60s (Jessoula, 2009; Cinelli, 2012), at the beginning of the '90s the Italian pension system presented a single public pillar structure, pay-as-you-go financed and informed to Defined Benefit computation rules, that covered nearly all workers[22]. A means-tested pension supplement (*trattamento minimo*) was provided to retirees with very low contributory pensions. A means-tested social assistance allowance (*pensione sociale*, since 1996 known as *assegno sociale*), financed via general taxation, was also provided to poor elderly who did not fulfil seniority requirements for contributory pensions[23].

In Italy, two typologies of retirement have historically existed:

- 'Old-age pensions': the welfare system intervenes to provide workers with adequate means for their subsistence needs when they cannot provide for themselves because of old-age[24]; the access to old-age retirement has traditionally been subject mainly to age requirements.
- 'Seniority pensions': the welfare system rewards workers with high seniority, generally regardless of age[25].

The most generous aspect of pension rules at the beginning of the '90s concerned the retirement age. According to L. 153/1969, the 'Brodolini reform', old age pensions were awarded at 60 for males and 55 for females (with at least 15 years of seniority) and, independently on age, workers with at least 35 years of contributions were entitled a seniority pension[26].

The traditional Defined Benefit computation formula for the first pension reads:

$$(1)\ P=r*S*E(w)$$

where *r* is the conversion rate – showing the return for each year of contribution[27] –, *S* is the seniority[28] and *E(w)* – the so-called *retribuzione pensionabile* – is a 'conventional salary' calculated as an average of final earnings[29]. Being linked to final wages, the *retributivo* system granted replacement rates up to 80% when *S*=40.

In addition to that, up until 1992, existing benefits were indexed to the growth rate of nominal wages.

The generosity of public pensions broadly crowded out supplementary private schemes, virtually unknown until the mid-1990s[30]. The single pillar pension system effectively guaranteed income maintenance to the workforce, as well as (limited) poverty protection to those not entitled to a contributory pension. This scenario, however, was doomed to disappear. Joint pressures from the EU convergence parameters set in Maastricht – forcing national authorities to consolidate public finances – as well as the 1992 crisis had a tremendous impact on the Italian pension system, which at the time presented three main drawbacks (Fornero and Castellino, 2001; Franco and Marè 2002), the first being a critical financial situation, mostly in the long run due to

22 Professionals (e.g. lawyers, architects) did (and still do) not participate to the public scheme, but they are obliged to enroll to a private fund managed by their category (see L. 537/1993, D.lgs. 509/1994, l. 335/1995, D.lgs 103/1996, L. 111/2011).

23 *Trattamento minimo* (2015): 502.38 Euros; *Assegno sociale* (2015): 448.51 Euros.

24 See art. 38 of the Italian Constitution.

25 First introduced with L. 903/1965, then suppressed and reintroduced by L. 153/1969, one of the main scopes of seniority retirement was to allow middle-aged workers to leave the job market earlier and 'make room for the young', in a period of economic and demographic boom. Referring to such line of thinking, some authors have used the expression 'lump of labor fallacy'.

26 Much lower requirements were set in specific sectors: public employees could access seniority retirement having paid contributions for just 20 years, 15 if they were women with children.

27 Said 'annual rate' is generally set at 2%, but is higher in some sectors, e.g. public employment. L. 67/1988 introduced a set of 4 rates (later augmented to 5 by the 'Amato reform') set to operate *pro quota* progressively on the 'conventional salary' *E(w)* (the higher the value of *E(w)*, the lower the value of *r* applied *pro quota*).

28 In the Defined Benefit formula applied in Italy, seniority cannot exceed 40 years, hence reducing incentives to postpone retirement (e.g. DB pensions awarded to individuals with 45 years of seniority are computed considering 40 years).

29 According to pre-1992 rules, the calculation was based on the last 5 annuities of pensionable earnings for private employees and on the final monthly wage for public employees.

30 Before the 1993 reform of private pensions (d.lgs. 124/1993), only pension funds sponsored by banks and insurance companies in favor of their employees, the so called 'pre-existing funds', were operating.

the fast ageing of the population. Moreover, the pension system design contained a strong incentive to early retirement: the Defined Benefit formula did not take into account retirement age, engendering an implicit tax on the procrastination of retirement once minimum requirements had been reached (Gruber and Wise 1999, 2004). In addition, wide (and often regressive) inequities were present, due both to the differences in computation rules and eligibility requirements across occupational categories and to the fact that the Defined Benefit formula grants higher implicit internal rates of return (on contributions) to workers who enjoy a steep wage profile at the end of their careers and to those with lower seniority, thus advantaging the ones who least need it and the ones who least 'deserve' it – since they have contributed less to the maintenance of the PAYG system (Gronchi 1995, 2003). This 'reverse solidarity' (Cinelli, 2012) can be attenuated, but not eliminated, by extending the number of annuities on which *E(w)* within formula (1) is calculated and by employing a set of progressive annual rates for *r* – the higher the value of *E(w)*, the lower the value of *r* applied (Gronchi and Nisticò, 2006).

As a consequence of the interaction of low retirement ages, high replacement rates and a fast ageing of the population, the pre-1992 pension rules would have engendered huge increases of the pension spending in the upcoming decades. Hence, the main target of the reforms introduced in 1992 ('Amato reform') and 1995 ('Dini reform') was to restrain the rise in pension spending, by both tightening pension eligibility requirements and lowering the average amount of pensions.

The 1992 'Amato reform' (d.lgs. 503/1992) adopted a number of relevant parametric retrenchments to the first pillar, maintaining the Defined Benefit frame. The main measures introduced were:

- A gradual increase of the age requirements for old age pensions from 60 and 55 to 65 and 60, for males and females respectively, and of the seniority requirements from 15 to 20[31].
- The extension of the number of annuities included in the calculation of *E(W)* in formula (1) to the whole working life rather than to the final years. This extension was phased in very gradually, though, because the change in computation rules only concerned the *quota* of benefit relating to contributions accrued after 1992 (i.e. only individuals who had entered the labour market from 1993 on would have received a benefit entirely based on the whole working history)[32].
- A harmonization of rules applied to different categories of workers, in particular between private and public sector workers.
- The parameter for the indexation of pension benefits changed from nominal wages growth to inflation growth[33].

Major changes were later introduced by the 'Dini reform' (l. 335/95), namely:

- The introduction of the NDC rules in benefit calculation.
- The increase of seniority requirements (gradually raised from 35 to 40 years) and the introduction of an age requirement (gradually raised from 53 to 57 years) for early retirement.
- The continuation of the harmonization process in terms of pension rules among different categories of workers.
- The extension of compulsory coverage to "parasubordinate" workers, i.e. economically dependent workers[34].

31 For individuals having already accrued 15 years of contributions in 1992, requirements did not change.

32 Also, the formula did not substantially change for individuals having already accrued 15 years of seniority in 1992: for this category of workers, the period for the computation of *E(W)* was only extended from the last 5 annuities (last month for public employees) to the last 10 annuities.

33 Also, starting with L. 730/1983, later modified by L. 449/1997 and L. 388/2000, a partial indexation has been set for the portion of benefit exceeding certain brackets. L. 388/2000, which will resume its effectiveness in 2017, once the present 'transitional period' is over, reduces indexation by 10% for the portion of benefit between 3 and 5 times the so-called 'minimum benefit' (*trattamento minimo*) and by 25% for the portion exceeding it over 5 times.

34 Individuals formally acting as self-employed but usually working as substitutes for employees.

- The incentive to access private pension plans.

First and foremost, the 'Dini reform' replaced the traditional Defined Benefit scheme (*retributivo*) with the new Notional Defined Contribution scheme (*contributivo*). The public pension system remains pay-as-you-go financed, but in the new NDC environment benefits are computed on the basis of actually paid contributions and according to life expectancy at retirement, following neutral actuarial rules. The system is conceived as a virtual bank, where individuals have 'personal accounts' in which contributions are 'deposited', while in work, and from which pension benefits are 'withdrawn', while in retirement (Gronchi and Nisticò, 2008).

In a NDC environment, pensions are computed as:

$$(2)\ P=cc(\delta,m)*M(w,\pi)$$

Where *M*, the accumulation of contributions, is positively correlated to wages (*w*) and to the annual rate of return virtually accrued on contributions (π) – in Italy equaled to the average nominal GDP growth of the previous five years –, while *cc*, the conversion coefficient, is positively correlated to the parameter δ[35] – in Italy set to 1.5% – and negatively correlated to life expectancy at retirement (*m*). The 'Dini reform' established that conversion coefficients would be updated every 10 years, L. 247/2007 set a triennial update, and finally the most recent 'Fornero reform' established that from 2019 coefficients will be updated every two years.

When properly applied, the NDC formula insures neutrality: all pensioners earn the same return on contributions paid to the system, explicitly set to π by the policy-maker, regardless of the length or success of their careers[36]; the NDC formula also guarantees sustainability in the long run, as long as π in formula (2) is set equal to the wage bill growth rate (the choice to set it equal to the trend growth rate of GDP is admissible as long as the percentage incidence of wages on GDP stays constant)[37].

Consistently with the actuarial logic of the scheme, the 'Dini reform' allowed for flexibility in pensionable age in the age bracket 57-65 (for both men and women). While the seniority requirement was lowered to 5 years, a new 'amount requirement' was set, as retirement was allowed before 65 only if the benefit equaled at least 1.2 times the amount of the *assegno sociale*.

The means-tested pension supplement (*integrazione al minimo*) is no longer provided in the new NDC scheme; poor elderly, independently of their previous contribution record, are only entitled to the means-tested social allowance for people over 65 (*assegno sociale*)[38].

The 1995 'Dini reform' designed a very slow phasing in of the new NDC scheme. Individuals who in 1995 had been working for 18 years or longer[39] continued to be included in the Defined Benefit scheme. Those with lower seniorities would calculate their benefits employing the DB rules for the *quota* relating to contribution years up to 1995 and the NDC rules from 1996 forth (the so-called *pro rata* scheme). Only individuals who have started accumulating contributions from 1996 will receive a benefit entirely calculated according to the new formula (2). Some have expressed criticism concerning the gradualness of the transition (Patriarca, 2014), especially in relation to the way the same process has been dealt with in Sweden (Gronchi, 2003).

35 'δ' works as an 'anticipated return' awarded to 'virtual accounts'.

36 Of course, neutrality can only be guaranteed on average: individuals exceeding (not reaching) life expectancy at retirement will earn higher (lower) returns than π. Nevertheless, uniformity would still be assured *ex ante* if all workers electing to retire at a given age had the same life expectancy. The consequences of heterogeneous mortality could be sterilized by diversifying the conversion coefficients by homogeneous social groups, but diversification may prove technically unfeasible and socially unacceptable (Gronchi and Nisticò, 2008).

37 For further problematization of the assumptions underlying the desirable properties of neutrality and sustainability in a NDC scheme, see Samuelson (1958), Aaron (1966), Gronchi and Nisticò (2008) and Gronchi and Gismondi (2008).

38 One third of the NDC pension is not computed in the means test for the *assegno sociale*. Hence, people with no other sources of income receive part of the means-tested social assistance benefit if their pension does not exceed 1.5 times the *assegno sociale*.

39 The same category protected by the 'Amato reform'.

4.2 THE REFORMS INTRODUCED IN THE 2000-2010 DECADE

At the beginning of the 2000s, pension reform remained on top of the political agenda, as policy makers aimed at elevating retirement age and reduce pension spending during the long transitional period towards the phasing in of the NDC scheme. As discussed in Paragraph 4.4, some measures promoting the participation to supplementary private schemes were also introduced.

The 2004 'Maroni reform' raised the age requirement for seniority retirement, setting an increase from 57 to 60 years of age, starting from 2008, with an abrupt 3-years rise (the so called 'big step', *scalone*). Contextually, the flexibility in pensionable age for workers enrolled in the NDC scheme was removed, as they went subject to the same requirements for old-age and seniority retirement as workers enrolled in the DB and *pro rata* schemes.

The following Government, issuing the so-called 'Protocol on Welfare' (L. 247/2007), annulled the 'big step' introduced in 2004, setting new criteria for seniority pensions based on the so-called 'quotas', composed of the sum of age and seniority requirements (Table 4.1). The possibility to retire regardless of age, having accrued 40 years of contributions, was confirmed.

The flexibility in pensionable age for workers enrolled in the NDC scheme, suppressed by the 2004 reform, was not restored.

TABLE 4.1: ELIGIBILITY REQUIREMENTS FOR SENIORITY PENSIONS SET BY L. 247/2007

	Employees	Self-employed
From 1/1/2008	Age: 58. Seniority: 35	Age: 59. Seniority: 35
From 1/7/2009	Age: 59. Seniority: 35. Quota: 95 (i.e. 59+36 or 60+35)	Age: 60. Seniority: 35. Quota: 96 (i.e. 60+36 or 61+35)
From 1/1/2011	Age: 60. Seniority: 35. Quota: 96 (i.e. 60+36 or 61+35)	Age: 61. Seniority: 35. Quota: 97 (i.e. 61+36 or 62+35)
From 1/1/2013	Age: 61. Seniority: 35. Quota: 97 (i.e. 61+36 or 62+35)	Age: 62. Seniority: 35. Quota: 98 (i.e. 62+36 or 63+35)

Further increases in retirement age were introduced later in the decade. Following a judgement of the European Court of Justice, in the 2010 Budget Law Italy took the first step towards the equalization of the (rigid) age requirement for old-age retirement for both men and women, raising it to 65 for female employees in the public sector, starting from January 2012[40]. The same Budget Law introduced the so-called 'mobile window', fixing a time window of 1 year between the achievement of the eligibility requirements for old-age and seniority pensions and the actual possibility to retire, thus *de facto* increasing the age requirement by one year.

Moreover, L. 122/2010 has linked pensionable age to increases in life expectancy: starting from 2013, statutory age requirements to access old-age pensions, seniority pensions and social assistance benefits are set to be automatically adjusted once every three years, in line with the variation in life expectancy at age 65 as measured by ISTAT with reference to the previous three-year period.

40 In the summer of 2011 two different decrees were passed concerning pensionable age for all female workers: d.l. 98/2011, conv. in l. 111/2011, and d.l. 138/2011, conv. in l. 148/2011. Both were abrogated by d.l. 201/2011, conv. in l. 214/2011 (see section 3).

4.3 THE 'FORNERO REFORM' AND THE MOST RECENT ADJUSTMENTS

In order to regain credibility on the sustainability of public finances, which were severely hit by the impact of the financial crisis, after a month from its designation, the Monti Government introduced a new comprehensive pension reform (D.L. 201/2011, conv. in L. 214/2011), with the main aim of obtaining an immediate saving on pension expenditure through a significant increase in the effective retirement age.

On the one hand, the reform has established a quick raise of pensionable ages, with a gradual increase for women in the private sector to meet the age requirement of all other workers by 2018 at 66[41].

On the other hand, stricter limits to early retirement have been introduced: the 'quota system' has been abrogated, and since 2012 early retirement is only possible to those who have accrued 41 years and 1 month of seniority, for women, and 42 years and 1 month, for men (both requirements have been increased by 1 additional month in 2013 and again in 2014). Art. 20 co. 10, d.l. 201/2011, conv. in L. 214/2011, also set a penalization on the portion of benefit computed according to the DB formula for workers retiring before their 62nd birthday, amounting to 1 point percentage for each year if they retire at 61 or 60, and of 2 points percentage for each year if they retire earlier.

For example, retiring at 58, one would compute his/her benefit as:

$$P=(100\%\text{-}1\%\text{-}1\%\text{-}2\%\text{-}2\%) * DB\ quota+NDC\ quota$$

A number of later measures (art. 6 co. 2-*quarter*, d.l. 216/2011, conv. in L. 14/2012; art. 4-*bis*, D.L. 101/2013, conv. in L. 125/2013; art. 1 co. 493, L. 147/2014) had exempted workers from said penalizations under growingly loose conditions, until art. 1 co. 113, L. 190/2014 postponed their entry into force until 2018 for all workers. As another short-term measure, the 'Fornero reform' set a halt to indexation for benefits worth over 3 times the *trattamento minimo* (see above) – approximately 1450 Euros a month – for 2012 and 2013.

Regarding measures that impact the medium-long term, in order to speed up the transition to the Notional Defined Contribution scheme, it has been established that, starting from 2012, benefit computation for all workers will employ the NDC rules, at least *pro rata*.

Therefore, depending on calculation rules, present participants to the pension system can be divided into two categories:

- 'NDC' or 'pure NDC' (*contributivo puro*), for workers with no seniority prior to 1996, for whom benefits are entirely calculated according to the NDC rules.
- 'Mixed' (*misto*):
    - workers with less than 18 years of seniority in 1995, for whom benefits are calculated according to the NDC rules *pro rata* for all years of seniority following 1995.
    - workers with at least 18 years of seniority in 1995, for whom benefits are calculated according to the NDC rules *pro rata* for all years of seniority following 2011.

Individuals enrolled in the NDC scheme will be characterized by much tighter rules than those originally introduced by L. 335/1995: the 'Fornero reform' has indeed reinstated some degree of flexibility in pensionable age, but at much higher ages and with stricter seniority and 'amount' requirements than before. Table 4.2 sums up the requirements introduced by the most recent reform; four modalities are observable.

41 The mechanism of the "windows" has been abrogated by the 2011 reform.

TABLE 4.2: ELIGIBILITY REQUIREMENTS SET BY D.L. 201/2011, CONV. IN L. 214/2011

Criteria	Regime	Requirements		2012	2015
Old Age 1	NDC	age		63 years	63 years, 3 months
		seniority		20 years	20 years
		amount		2.8 * *assegno sociale*	2.8 * *assegno sociale*
Old Age 2	NDC, mixed	age	female public employees, males	66 years	66 years, 3 months
			female private employees	62 years	63 years, 9 months
			self-employed females	63 years, 6 months	64 years, 9 months
		seniority[1]		20 years	20 years
	NDC	amount		1.5 * *assegno sociale*	1.5 * *assegno sociale*
Old Age 3	NDC, mixed	age		70 years	70 years, 3 months
		seniority	NDC	5 years	5 years
			mixed	20 years	20 years
Seniority	NDC, mixed	seniority	males	42 years, 1 month	42 years, 6 month
			females	41 years, 1 month	41 years, 6 month

[1] 15 years suffice for workers with at least 15 years of seniority as of Dec 31st 1992.

As previously mentioned, the age requirement for all female workers will align to that of their male counterparts by 2018[42]. In line with previous measures (L. 122/2010), the reform also confirmed that all age requirements and seniority requirements for the last criteria enlisted in Table 4.2 (labelled 'Seniority') will be periodically updated according to variations in life expectancy. The updating process has been aligned with the review of conversion coefficients (every 3 years until 2019 and every 2 years afterwards). The first update, which increased said requirements by 3 months, took place in 2013 and its implications are visible in Table 4.2. Starting from 2016, those requirements have been further increased by 4 months[43].

Short of sufficient income sources, any individual will be entitled to the *assegno sociale* at 65 years and 3 months, in 2015. The age requirement for the social assistance benefit is also updated according to L. 122/2010, and art. 24 co. 8 of the 'Fornero reform' established that it would be increased by one year in 2018, by so aligning it to the age requirement of the Old Age 2 criteria.

Basing calculations on the European Population Projections (base year 2013), around 2040 individuals will retire according to the following conditions:

- Old Age 1: 66 years of age if he/she has at least 20 years of seniority and a pension benefit amounting to at least 2.8 times the *assegno sociale*.
- Old Age 2: 69 years of age if he/she has at least 20 years of seniority and a pension benefit amounting to at least 1.5 times the *assegno sociale*.
- Old Age 3: 73 years of age if he/she has at least 5 years of seniority, regardless of the amount of the benefit accrued.
- Seniority: 44 years of seniority if female, 45 if male, regardless of any other condition.

42 Starting from 2018, the only difference will concern the seniority requirement for the Seniority criteria.

43 See: INPS, Circ. 63/2015. Available at www.inps.it.

Short of sufficient income sources, any individual will be entitled to the *assegno sociale* at 69 (age requirement for Old Age 2).

D. L. 101/2013, conv. in L. 125/2013, introduced an important differentiation in terms of access to retirement for public employees, clarifying doubts originated by art. 24 co. 4, d.l. 201/2011, conv. in L. 214/2011. When they reach the 'age legal limit' (*limite d'età ordinamentale*) of their category (for most public employees, such limit is set at 65), public employees can only keep working until they reach the minimum (age, seniority, amount) requirements for retirement (old-age or seniority), but not further. Unlike age requirements for retirement, 'age legal limits' are not updated according to the variations in life expectancy.

The intent of the norm is obviously to manage the present surplus in public employment, though at the expense of the uniformity of retirement conditions for all workers, that are generally incentivized to keep their job beyond the attainment of minimum requirements for retirement, since the NDC rules will grant higher benefits.

4.4 THE ARCHITECTURE OF THE PRIVATE PILLAR

As previously mentioned, since the early '90s Italian policy makers have favoured the development of funded supplementary pillars (second and third pillar) in order to integrate benefits paid out by the public pension system (first pillar).

Supplementary pillars operate on a voluntary basis, they are fully funded and provide benefits computed according to Defined Contributions (DC) rules[44]. Following the 1993 reform (d.lgs 124/1993) and subsequent revisions, the supplementary pillars are organized into three different types of pension institutions: closed (collective occupational) funds (CPFs), open funds (OPFs), and personal pension plans (*Piani Pensionistici Individuali*, PIPs).

CPFs, not-for-profit institutions, are set up within the frame of collective bargaining between employers and trade unions. They can be created at several levels: companies or groups of companies, industrial or economic sectors, geographical areas; associations of self-employed workers can also set up a closed fund. The regulatory framework does not allow CPFs to manage assets, thus they have to make agreements with financial institutions.

OPFs are promoted and managed by banks, insurance and investment companies. They can offer both personal and occupational (i.e. based on a collective enrolment) plans: the difference between occupational and personal schemes (i.e. second and third pillar) does not depend on the type of pension fund (closed or open), but on affiliation modalities (collective or individual).

Since 2000, personal pension plans can be offered also through life insurance contracts (PIPs), under the condition that benefits have to be paid according to the same rules applying to pension funds; the same tax regulation of pension funds are applied. The 2005 reform (d.lgs. 252/2005) has introduced a number of new rules for PIPs, mainly concerning the administrative costs they can impose on buyers.

Aimed at fostering the development of supplementary pillars through the devolution of the TFR[45], the 2005

44 Only pre-existent funds (established *ante* d.lgs. 124/1993) may provide benefits calculated according to Defined Benefit formulas.

45 The TFR (*Trattamento di Fine Rapporto* or, in the public sector, *Indennità di Buonuscita*) is a sort of mandatory severance payment for public and private employees, financed by a deferred portion of wages: every year, 6.91% of gross wage is retained by firms and a fixed return (1.5% plus 3/4 of the inflation rate) is granted on the amount accrued, which is then paid as a lump sum when the job relationship ends (because of termination, resignation or retirement). Employees with at least 8 years of seniority in the same firm may receive 70% of the accrued TFR in order to sustain certain extraordinary expenses (e.g. medical expenses). Due to the different phases in which it can be 'withdrawn', the average length of TFR accumulation does not exceed 10 years. Given its features, TFR cannot be considered as a mere mandatory occupational plan because it is addressed to solve liquidity constraints in specific phases of life, rather than to correct individual myopia and ensure the payment of an annuity during old age (Cozzolino et al. 2006).

Being the rate of return guaranteed by firms on TFR – 1.5% plus 3/4 of the inflation rate – usually much lower than the interest rate on debt (especially for small and medium size enterprises, that are often credit constrained) TFR has traditionally been considered by firms as a very cheap

reform (in force since 2007), introduced the 'silent consent' formula for the transfer of the latter to supplementary funds: if a worker does not explicitly disagree, his/her TFR flows (not the stock already accrued by firms) are transferred from firms to pension funds. The previous logic is thus inverted (before 2007, the default choice was assumed in favour of the firm). Since 2003, based on the 'implicit consent' procedure, about 231,000 workers have devolved their TFR funds to private pension schemes, among which 8% were newly hired private sector employees (COVIP, 2014)".The reform has stated that the TFR can be transferred to any kind of fund (CPFs, OPFs or PIPs). However, if workers do not explicitly declare to which fund it should be paid to, the TFR is automatically transferred to the closed fund of their occupational category[46]. In case such fund is not specified by any collective agreement, the TFR is devolved to a residual fund administered by INPS (FONDINPS).

L. 190/2014 has recently introduced an additional option for the period March 2015 – June 2018: private employees with a firm-specific seniority of at least 6 months have the possibility to ask the employer to receive the quota of TFR relating to each month together with their salary. Even workers that have chosen to devolve their TFR to pension funds in the past can ask to now receive it as part of their monthly wage. Once the request is made, workers will not be able to modify their choice earlier than June 2018.

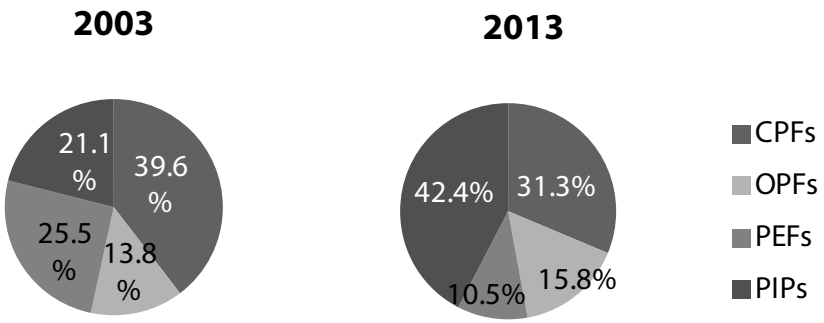
The TFR received as part of the salary is subject to the usual taxation on income ('*IRPEF*' rates), while the stock of TFR kept within the firm, once dispensed (at the end of the employment relation), is taxed according to more favorable rules. The sums perceived as benefits from pension funds are subject to an even more favorable set of rates.

Following the mentioned reforms, the architecture of the Italian pension system as a whole presents a public NDC pillar and a complex system of private pension schemes, though the latter are still underdeveloped in terms of actual coverage and take up rates[47]. It has to be noted that parasubordinate workers are not entitled to pay contributions as TFR, and no specific closed fund based on a collective agreement is provided for them. Hence, compared to employees, their chance to participate to supplementary pensions is strongly weakened.

According to the most recent data, the take-up rate in private supplementary schemes is still limited: in 2013, about 2,935,000 individuals were members of closed and open pension funds and the enrolment growth rate in both types of funds has been almost null since 2007: the number of workers enrolled in CPFs has actually decreased by 4.5% in the 2008-2013 period.

Personal plans based on life insurance contracts (PIPs) seem more appealing: in 2013, about 2,640,000 individuals had subscribed a plan, with a growth rate of 92% in the 2008-2013 period (COVIP, 2014).

FIGURE 4.1: ENROLMENT IN PRIVATE PENSION PLANS BY TYPOLOGY (2003, 2013)[48]



Source: COVIP (2003, 2013) – own elaborations

financing source.

46 Confirming the system's favor for CPFs, additional employers' and employees' contribution set in collective agreements can only be paid to collective funds.

47 For a detailed appraisal of the Italian private pillar development see Pizzuti and Raitano (2009) and Jessoula (2011).

48 PEFs: pre-existent funds (see above).

In 2013, the total number of individuals enrolled in supplementary schemes, including pre-existent funds, amounted to about 6.2 millions, 27.6% of all workers.

TABLE 4.3: INDIVIDUALS ENROLLED IN PRIVATE PENSION PLANS BY TYPOLOGY OF WORK (END OF 2013)

Type of worker	Enrolled	In work	Participation rate
Private employees	4,335,970	13,543,000	32.0%
Public employees	160,263	3,335,000	4.8%
Self-employed	1,687,530	5,542,000	30.4%
Total	6,183,763	22,420,000	27.6%

Source: COVIP (2014)

The enrolment rate targeted by policy makers (40% among private employees) is still far from being reached[49].

Although their future replacement rates have been reduced by the introduction of the NDC rules, the enrolment rate is still low among young generations, probably due to binding liquidity constraints and high discount rates on future pension benefits. The average age of pension funds' members is rather high (45.2) in comparison to that of the working population (42.1), and only 15% of workers under 35 are enrolled.

The tax regime for all private schemes (CPFs, OPFs and PIPs) is sort of a hybrid: contributions are exempted until a threshold of 5,165 Euros each year; investment returns are taxed by a 20% proportional rate[50]; benefits are taxed by a proportional rate between 9% and 15%, depending on the duration of the membership in the fund[51], exempting the share for which taxes on investment returns have already been paid.

These fiscal rules have raised controversies, especially on the grounds of fairness: a deep incoherence emerges between a public scheme that taxes benefits progressively and a private one that taxes them proportionally. In effect, such fiscal rules operate regressively, because the proportional rate applies to a system whose enrolment probability increases with income.

The literature in favour of the development of private funded schemes[52] argues that in the long run market returns are usually higher than the GDP growth rate, that is, approximately, the return rate that a pay-as-you-go system can guarantee in steady state (see above). However, international empirical evidence on the long term relation between GDP growth rates and bond returns does not confirm the superiority of private sources, whereas the comparison between GDP growth rates and equity returns highlights the much wider volatility of the latter (Jorion and Goetzmann, 2000; Burtless, 2000).

In order to assess performances, it is crucial to compare the interest rates virtually accrued on Notional accounts in the public NDC scheme with the returns earned by pension funds and with those granted by firms on TFR (see Table 4.4).

49 Several reasons may explain why the enrolment rate has been much lower than expected: i) TFR and pension funds are not perfect substitutes in terms of returns, risks and liquidity (Cozzolino et al. 2006); ii) financial markets' performances have been rather poor in recent years; iii) the choice in favour of pension funds is irreversible, whereas in every moment the worker can choose to devolve TFR to funds, thus making it rational to postpone the choice between the two alternative investments, especially in times of crisis; iv) the peculiarity of the Italian economy, based on a large share of small and medium size firms with low unionization rates (Jessoula, 2009 and 2011).

50 Said rate was until recently set at 11%, but was modified by l. 190/2014, which also elevated the tax rate on TFR returns from 11% to 17%.

51 The tax rate is reduced yearly by 0.3% for every enrolment year after the 15th, till a minimum rate of 9% is reached. Prior to 2007, benefits were taxed by the progressive tax rates on personal income (*IRPEF*).

52 See Feldstein (1997).

TABLE 4.4: NET RATES OF RETURN: 1ST PILLAR, CPFS, OPFS AND TFR (2000-2013)[53]

Year	1st pillar	CPFs	OPFs	TFR
2000	5.2%	3.5%	2.9%	3.5%
2001	4.8%	-0.5%	-5.6%	2.9%
2002	4.4%	-3.4%	-13.1%	3.1%
2003	4.2%	5.0%	5.7%	2.8%
2004	3.9%	4.6%	4.3%	2.5%
2005	4.1%	7.5%	11.5%	2.6%
2006	3.5%	3.8%	2.4%	2.4%
2007	3.4%	2.1%	-4.0%	3.1%
2008	3.5%	-6.3%	-14.0%	2.7%
2009	3.3%	8.5%	11.3%	2.0%
2010	1.8%	3.0%	4.2%	2.6%
2011	1.6%	0.1%	-2.4%	3.5%
2012	1.1%	8.2%	9.1%	2.9%
2013	0.2%	5.4%	8.1%	1.7%
Standard deviation	1.5%	4.3%	8.2%	0.5%
Cumulative return	55.4%	48.8%	17.1%	45.9%

Source: COVIP (2014), INPS – own elaborations

After years of weak performances (ever since 2007, with the exception of 2009), pension funds showed signs of recovering in 2012 and 2013. As expected, returns on TFR are much steadier, though lower (and decreasing in the past few years due to low inflation).

In the overall span 2000-2013, the 1st pillar (where returns in period *t* correspond to the average growth rate of nominal GDP from *t-5* to *t-1*) has offered steadier and cumulatively higher returns than those provided by private plans. Also, starting from 2015, returns coming from pension funds are subject to a considerable increase in tax rates (from 11% to 20%). Applying such increase on the 2000-2013 series, cumulative returns would be reduced from 48.8% to 42.6% for CPFs and from 17.1% to 15.6% for open funds.

TABLE 4.5: NET RATES OF RETURN: 1ST PILLAR, CPFS, OPFS, PIPS AND TFR (2008-2013)

Year	1st pillar	CPFs	OPFs	PIPs[1]	TFR
2008	3.5%	-6.3%	-14.0%	3.5%	2.7%
2009	3.3%	8.5%	11.3%	3.5%	2.0%
2010	1.8%	3.0%	4.2%	3.8%	2.6%
2011	1.6%	0.1%	-2.4%	3.5%	3.5%
2012	1.1%	8.2%	9.1%	3.8%	2.9%
2013	0.2%	5.4%	8.1%	3.6%	1.7%
Standard deviation	1.3%	5.6%	9.5%	0.1%	0.6%
Cumulative return	12.0%	19.5%	14.8%	23.8%	16.4%

1Data refer to 'first branch' PIPs (life insurances not indexed nor linked to investment funds).

Source: COVIP (2014), INPS – own elaborations

53 The introduction of private schemes is relatively recent in Italy, therefore a long time series (30 years or more) – normally needed to assess performances of financial markets – is not available.

Adding life insurances to the analysis and isolating results for the 2008-2013 period[54] (Table 4.5) the underperformance of the 1st pillar – due to the impact of the economic crisis on GDP growth rates – is evident. In latest years, PIPs have experienced the highest and steadiest returns of the bunch.

It has to be stressed that, apart from financial markets' performances, returns on pension funds' investments depend on the level of administrative costs (Murthi et al., 1999; Whitehouse, 2000) and related literature finds that occupational plans usually have much lower costs than personal ones; these stylized facts are confirmed observing administrative costs of Italian pension funds (Table 4.6). In line with their not-for-profit nature, the returns to scale deriving from the greater size of assets managed and the lower marketing costs[55], the administrative costs of CPFs are significantly lower than those imposed by OPFs and PIPs (the most expensive plans), even if a wide dispersion of funds' performances emerges. For all kinds of funds, the ISC decreases when the membership to the fund lengthens.

TABLE 4.6: SYNTHETIC INDICATOR OF COST (ISC) OF PENSION FUNDS BY LENGTH OF MEMBERSHIP TO THE FUND

	2 years	5 years	10 years	35 years
CPFs	0.9	0.5	0.4	0.2
OPFs	2.1	1.4	1.2	1.1
PIPs[1]	3.5	2.3	1.8	1.5

[1] The statistics refer to 'new PIPs', conforming to regulations set by d.lgs. 252/2005.

Source: COVIP (2014)

4.5 THE MAIN CHALLENGES FOR THE ITALIAN PUBLIC PENSION SYSTEM

Concerning the two main objectives of sustainability and adequacy to be pursued by pension systems, the current pension debate in Italy mostly focuses on the former. Suggestions to reduce pension spending come from two different perspectives: i) the need to improve public finances in the short term, reducing one of the major items of public expenditure, usually considered too high in international comparison; ii) the concern that the fast ageing process in Italy will make public pensions financially unsustainable in the long run.

In international comparisons, the Italian pension expenditure generally stands high: in 2012 (latest comparable data available) the gross public pension expenditure amounted to 16.1% of GDP, the highest value in Europe, as opposed to a 12.5% EU-28 average (Eurostat). However, such comparisons are often misleading due to several reasons (Pizzuti, 2011). First, pension expenditure in Italy includes social assistance benefits, considered as different items of spending in other countries. Second, the 'anomaly' greatly reduces when the spending is considered net of taxes: in Italy pension benefits are burdened with the normal tax rates on income, whereas in other countries (e.g. France and Germany), lower tax rates are levied on pensions. Third, data do not compute the cost for public finances coming from the tax expenditures engendered by the fiscal incentives benefited by people enrolled in private schemes; these costs are currently low in Italy and much higher elsewhere, particularly in Nordic and Anglo-Saxon countries (Adema and Ladaique, 2009). Finally, Eurostat considers the TFR as part of the Italian pension spending, even though, as previously noted, the TFR is not a mere pension tool, but a 'deferred wage' provided to workers each time the job relationship ends or when they have to sustain certain expenses.

54 Only comparable data available.

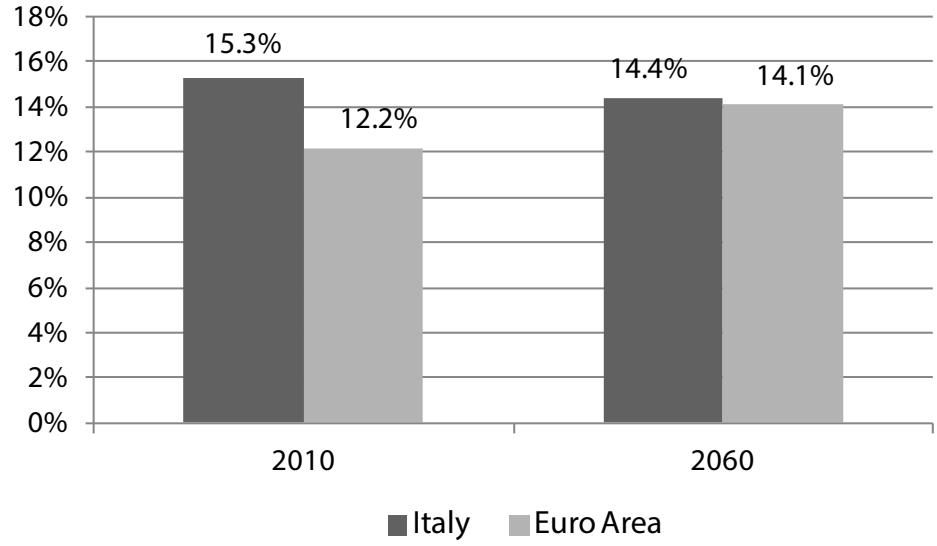
55 Where the enrolment into a fund is constrained by ties to a specific firm or category, competition is almost non-existent and this significantly reduces marketing expenses.

Taking into consideration the ratio between social protection expenditure[56] and GDP, Italy is only seventh in Europe, and in the very last placings in the sections 'Sickness/healthcare', 'Disability', 'Family/children', 'Unemployment', 'Housing', 'Social exclusion not elsewhere classified'. Only for old age and survivors' benefits does Italy register a relatively high level of spending, the highest in Europe: 61.3% of all social protection expenditure is destined to this branch, against a 45.7% average in EU-27 (Eurostat, 2011).

Due to the specific characteristics of NDC schemes, once the new system is fully phased in (around 2035) the share of GDP transferred to new pensioners will be sustainable 'by definition' and will start decreasing thereafter as an effect of the disappearance of the baby boom cohorts. This computation method is based, as noted, on a strict actuarial link between the contributions paid during the entire career and the benefits received when elderly. Pensions are computed by multiplying the accumulation of contributions (on which a rate of return tied to the growth rate of GDP is guaranteed every year) for the so-called conversion coefficients, which convert such amount into an annuity according to life expectancy at retirement. The periodic update of conversion coefficients makes sure that when life expectancy increases the annuity is proportionally reduced, thus offsetting the impact of an ageing population on aggregate spending[57].

In the long term the sustainability of public spending on pensions should not constitute a major challenge, as also confirmed by the long run projections on age-related expenditures carried out by the Ageing Working Group (Economic Policy Committee, 2015), which show that Italy is one of the few countries that will experience a decrease in the ratio between pension spending and GDP in the 2010-2060 period, aligning to the predicted average value for the Euro Area (Figure 4.2).

FIGURE 4.2: PENSION EXPENDITURE ON GDP, 2010-2060



Source: Eurostat

In order to understand the effective criticalities related to the phasing in of the new NDC scheme, let us first point out that in such schemes pension benefits depend on determinants both at macro (GDP growth rate,

56 The generic term 'social protection' includes benefits for: 'Old age and survivors', 'Sickness/healthcare', 'Disability', 'Family/children', 'Unemployment', 'Housing', 'Social exclusion not elsewhere classified'. Source: Eurostat.

57 Gronchi (2003) has expressed criticism over the characteristics of the updating process for conversion coefficients in Italy, as opposed to the method implemented in Sweden: by reassigning conversion coefficients to all cohorts of workers – and not just to the one about to enter pensionable age – different life expectancies are 'applied' to workers born in the same year. Not only does it hardly seem fair, such procedure also engenders an incentive to retire right before the new coefficients come out, which contradicts the system's basic intent to keep people in work until the age requirements for Old Age 3 (see Table 4.2) are met (see art. 24 co. 4 d.l. 201/2011, conv. in L. 214/2011).

variations in life expectancy) and micro level (length and success of the working career). The risk of adverse events happening on both levels are borne by individuals. Apart from the provision of a means-tested social assistance benefit for the poorest elderly (the *assegno sociale*), when the NDC rules fully phase in, pension benefits will depend on contributions paid during the working life. In other terms, the NDC scheme acts as a 'mirror' of labour market outcomes, therefore the capacity of the Italian labour market to guarantee long and profitable careers becomes a crucial issue in order to assess the challenges in terms of adequacy originating from the new architecture of the public pension system.

A simulation of pension prospects for individuals entering the labour market in 1996 at 24 years of age[58] may be carried out considering 3 typologies of worker: blue-collar, white-collar and manager. The blue-collar's wage in 2015 is equaled to 3 times the *assegno sociale* in the same year, and the wage growth is equaled to the GDP growth rate minus 0.5%. The white-collar's wage in 2015 is equaled to 4 times the *assegno sociale*, and the wage growth is equaled to the GDP growth rate. The manager's wage in 2015 is equaled to 7 times the *assegno sociale*, and the wage growth is equaled to the GDP growth rate plus 0.5%. GDP growth rates are the historical ones up to 2014, then assumed constant at 1.5%[59]. Inflation rates are similarly the historical ones up to 2014, then assumed constant at 2%. Pensionable ages and conversion coefficients are calculated according to AWG mortality projections[60]. Following art. 24 co. 7 of the 'Fornero reform', the future dynamic of the *assegno sociale* is linked to the rate of return on contributions (average GDP growth rate in the previous 5 years).

TABLE 4.7: EXPECTED PENSION BENEFITS FOR REPRESENTATIVE EMPLOYEES. CONTINUOUS CAREERS.

a. **Benefit on *assegno sociale* ratios**

		Worker		
		Blue collar	*White collar*	*Manager*
Age	66	2.27	**3.04**	**5.36**
	67	2.40	**3.23**	**5.71**
	68	2.55	**3.43**	**6.08**
	69	**2.71**	**3.65**	**6.50**

b. **Replacement rates**

		Worker		
		Blue-collar	*White-collar*	*Manager*
Age	66	75.8%	68.4%	62.1%
	67	80.6%	72.7%	65.7%
	68	86.0%	77.3%	69.7%
	69	91.8%	82.3%	74.1%

Table 4.7-a shows that, despite a very long career (42 to 44 years of seniority), the blue-collar worker cannot retire according to Old Age 1 criteria (see Table 4.2), because of the relatively low wages earned, about 18,000 Euros in 2015 (gross), that don't allow for the 'amount requirement' to be met.

58 Employment rate for the age-group 20-29 went from 53.4% in 2008 to 41% in 2013; it is not unconceivable that – especially highly skilled – individuals will start accumulating contributions later than at 24.

59 In accordance with the average growth rate forecasted by the Italian Stage General Accounting Department. See: MEF, 2014.

60 Parameters regarding survivors' pensions are assumed equal to those of 2008 (Istat, 2012).

All workers can however retire according to Old Age 2 criteria at 69 years of age (45 years of seniority): they all earn benefits richer than 1.5 times the *assegno sociale*.

Table 4.7-b shows that the workers who experience a slower wage growth during their careers earn higher replacement rates: rates of return accrued on contributions are all neutrally equaled to GDP growth rates, so that for the blue-collar (manager) contribution accumulation 'grows' more (less) than his/her salary throughout the working life; this is evident once benefits are computed.

In general, the main issues on pension adequacy concern individuals who are unable to spend a long career as employee, due to the lower contribution rates characterizing self-employed and parasubordinate workers (currently at 30% and set to reach 33% by 2018, but at 10% in the mid-'90s and below 20% up to 2007), due to the weak coverage of unemployment benefits (which pay figurative contributions) for individuals with intermittent careers and due to low wages, often paid to atypical workers (including part-time employees) and to new entrants in the working population.

Due to such adverse events (and the positive correlation amongst them), even individuals who have been active for a long span but with discontinued career may receive modest benefits in retirement[61].

TABLE 4.8: EXPECTED PENSION BENEFITS FOR REPRESENTATIVE VULNERABLE WORKERS

a. **Blue-collar employee; discontinuous career[62].**

		B/*AS*[1]	RR[2]
Age	66	1.70	67.6%
	67	1.80	72.1%
	68	1.87	77.5%
	69	**1.99**	83.0%

b. **White-collar parasubordinate worker; continuous career.**

		B/*AS*[1]	RR[2]
Age	66	2.44	54.9%
	67	2.60	58.6%
	68	2.78	62.7%
	69	**2.98**	67.1%

c. **White-collar part-time employee; discontinuous career[63].**

		B/*AS*[1]	RR[2]
Age	66	1.19	62.5%
	67	1.27	66.5%
	68	1.32	71.5%
	69	1.41	76.3%

[1] Benefit on *assegno sociale* ratios

[2] Replacement rates

61 On this topic, see Raitano (2011), who assesses possible measures for increasing pension prospects of individuals characterized by unsuccessful working histories.

62 The periods of unemployment are evenly distributed throughout active life (1 year of unemployment every 4-year period).

63 The periods of unemployment are evenly distributed throughout active life (1 year of unemployment every 4-year period). The part-time wage is computed as 60% the salary of the white-collar full-time worker.

It is important to highlight how the position of the white-collar worker varies as a consequence of different contractual typologies: a white-collar parasubordinate worker (Table 4.8-b) will not be able to access early retirement according to the Old Age 1 criteria, because he/she does not meet the amount criteria[64].

In the last case (Table 4.8-c), the white-collar part-time employee may not meet the amount requirements for Old Age 2 criteria, and is therefore forced to keep working beyond 69 years of age. The amount criteria will only be disregarded when he/she meets the age requirement for Old Age 3, which, according to the Europop 2013 mortality projections, should be set at 73[65].

Obviously, the risk of modest pensions is not merely caused by the NDC scheme, rather by the coexistence of strict actuarial rules, low growth rates and the inefficiencies and horizontal inequalities of the labour market.

Some authors (Patriarca 2011) see the recently legislated automatic increase of retirement age, together with the (limited) flexibility in the access to retirement reintroduced by the 'Fornero reform', as a viable option to improve future pensioners' prospects, since in the NDC scheme longer careers imply both a greater accumulation of contributions and a higher annuity due to the lower life expectancy at retirement.

However, one would have to assume that the Italian productive system will be able to ensure an adequate labour demand for older workers. This would require a rather profound transformation of the Italian productive structure: indeed, the employment rate of older workers (traditionally computed for the age group 55-64) has grown by over 12% from 2008 to 2014, and the average effective retirement age registered by the OECD in Italy in 2012 (latest data available) was 61.1 for men and 60.5 for women.

Also, limiting retirement only to individuals who have earned a benefit equal to at least 2.8 times the *assegno sociale* at 63 years and 3 months (in 2015), and equal to at least 1.5 times the amount of the *assegno sociale* at 66 years and 3 months (in 2015)[66], the present scheme forces individuals characterized by the least successful careers to further postpone retirement.

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64 It is however conceivable that the amount of wage that is not paid as contributions between 1996 and 2018 (contribution rates for parasubordinate workers have been lower than those applied to employees) has been otherwise saved (e.g. invested in private pension schemes). Because the 'amount requirement' only takes into account the potential amount of the public pension benefit, the white-collar parasubordinate worker is forced to stay active for a longer period of time than its employed by his counterparts, even if he/she may be able to provide for his/her needs in old age just as well.

65 However, once 69, if the worker meets the income criteria set by the means test, he/she is entitled to the *assegno sociale*.

66 See above Table 4.2. The justifications of such limitations on flexibility in terms of sustainability are only valid in the short term. In the long term, NDC rules guarantee the equilibrium between revenues and expenditures within the system, regardless of individual retirement choices.

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5. THE NEW VERSION OF T-DYMM

According to the definition given by O'Donoghue (2001), Microsimulation Models (henceforth MSMs) are those which "uses simulation techniques and which take micro level units as the basic units of analysis when investigating the effects of social and economic policies.[67]".

In the recent years and in particular since the '80s, thanks to the expansion and accessibility of computing power, the use of these simulation techniques as a tool for economic analysis and support for decision-making processes has been spreading wider. On the other hand the increasing availability of larger and detailed micro datasets has made MSMs an ever-increasing powerful tool for the evaluation of income distribution and social policies[68].

The focus of this chapter is on the characteristics and functions of the updated version of the *Treasury Dynamic Microsimulation Model* (henceforth, TDYMM 2.0).

The model T-DYMM 2.0 contains a few differences compared to the previous release, in particular:

i) An enhanced simulation platform LIAM2, that updated the one employed previously LIAM;

ii) Some changes on the structure of the main modules that compose the model (demographic, labour market and pension module);

iii) The extension of the model with an extra sub-module that allows to analyse the dynamics of private pension schemes.

The chapter contains four sections. Section 5.1 provides a quick review on the literature on MSMs. Section 5.2 summarises the recent history of T-DYMM focussing on its birth and on its initial structure. Section 5.3 gives an overview of the updated in the demographic and pension modules of TDYMM 2.0, describing also the contents of the external tax module.

5.1 MICROSIMULATION MODELS: A SHORT REVIEW

Microsimulation traces its origin from the idea of Guy Orcutt of mimicking natural experiments in economics (Orcutt, 1957); this idea was further followed by the development of the first behavioural dynamic MSMs (i.e. DYNASIM).

However, the development of microsimulation was boosted only recently in accordance with increasing computing power and the availability of micro-data. The approach has also gained a high interest among policy makers for studying distributional issues in the aftermath of the recent economic downturn (OECD, 2011).

The strength of MSMs in the analysis of public policies depends firstly on the capacity of allowing for the heterogeneity of individuals and/or households in terms of behaviour, accounting for several dimensions representing demographic and socio-economic characteristics and, therefore, considering the assessment of how heterogeneous individuals (potentially every individual into the population) are affected by policy changes, as opposite to the representative agent approaches. To this end, the main aim of microsimulation is modelling the whole distribution of key variables (Klevmarken, 2005). Moreover, its appeal depends on the possibility

67 O'Donoghue (2001), p. 2.

68 See Atkinson and Sutherland (1998), Harding (1996), O'Donougue (2001), Zaidi and Rake (2002) for a detailed description of the evolution of microsimulation in economic analysis and for a complete taxonomy of MSMs.

of using real policy parameters, without the need to simplify the institutional framework or to use average tax/benefit rates. An additional feature concerns the possibility to evaluate financial cost/benefit of a reform, through the aggregation (once the sample has been expanded with appropriate weights) of individual level output. Finally, MSMs have the ability to fully describe redistribution mechanisms accounting also for equity/efficiency trade-offs. For these reasons microsimulation has become a widely accepted instrument to shape and support government policy making[69].

A number of authors have proposed a useful taxonomy to illustrate the main features of existing microsimulation models (Klevmarken, 1997; O'Donoghue, 2001; Zaidi and Rake, 2002; Bourguignon and Spadaro, 2006). Following the widely agreed classification MSMs broadly are divided in static and dynamic models, according to whether or not they incorporate a time element in the analysis.

Concerning *static models*, they do not consider the time dimension, but simulate the "morning after" impact of counterfactual conditions (policies) on a population of individual units. They usually consist of two main elements: a reference cross-section database and a model for estimating the effect of counterfactual policies on each individual. This type of models provide useful information only for the short run and is used, for instance, to determine the distributive effect and/or the budgetary cost impact of alternative tax/benefit policies (Sefton,Van de Ven, 2004). The most famous European static model is EUROMOD[70], which has been developed by an international research group for the EU27 countries (Sutherland and Figari, 2013). Sutherland and Figari's definition gives a good description of what means static in the sense of EUROMOD: "[it] is a static model in the sense that the arithmetic simulation of taxes and benefits abstracts from potential behavioural reactions of individuals and the socio-demographic characteristics of the population are assumed to be fixed over time."[71] The most important advantage of this model consists in the possibility of cross-country analysis .

An attempt to introduce the time dimension is carried out in *dynamic models with static ageing*. Although time is present in this kind of models, the updating of the demographic structure is obtained by simply re-weighting the reference dataset using exogenous aggregate projection data for a future time period. Hence, the structure of the sample itself is not modified. After the re-weighting procedure, each micro-unit is considered in the sample as many times as the number of units in the universe population given by the new weights, while the relations among the variables of each microunit remain unchanged. These models therefore do not allow for the simulation of Bismarckian changes, and according to Dekkers (Dekkers, 2015) these models ignore the impact of past one-shot events. As long as characteristics of the population do not change rapidly, a static ageing procedure can be appropriate for short and medium-run forecasts (Merz, 1994). The most important static ageing model is the Belgian STATION. (Dekkers, 1999).

On the opposite, in the evaluation of social policies which has to be carried out on a long term horizon such as, for instance, pension system and population ageing, *dynamic microsimulation models with dynamic ageing* "provide one of the most useful available modeling tools for projecting the likely future distributional consequences of possible policy changes" (Harding, 2007).

Dynamic microsimulation models (DMSMs) contain inter-temporal decisions (i.e. events) such as ageing, marriage, fertility, education, occupational status, consumption and saving, retirement decision and so on. They mimic individual life-cycle trajectories consistently with recorded socio-demographic phenomena.

The typology of Dynamic MSMs with dynamic ageing can be further refined according to the dataset that is considered as a starting point. A first class, called *longitudinal* or *dynamic cohort models*, is based on a single cohort (but the simulation can be repeated for all others cohorts) and produces complete life histories simulating each individual for all years independently from each other. An example of this class is PENSIM (Holmer et al., 2005), a pension policy simulation model that has been developed in the U.S. to analyse lifetime coverage and adequacy of employer-sponsored pension plans. Dynamic cohort MSMs imply in practice the absence of micro-interactions: this kind of structure usually allows a more developed theoretical foundation; therefore they appear to be well suited for modelling life-cycle decisions, being in general used for academic applications (Dekkers, 2005).

69 For a comprehensive overview of microsimulation models and applications, see the website of the International Microsimulation Association, www.microsimulation.org

70 See www.euromod.ac.uk.

71 Sutherland and Figari, 2013, p. 4

A second class – *dynamic population* or *cross-sectional MSMs* – presents a dynamic cross-sectional sample of the whole population, allowing for interactions between individuals and characteristics as well as for the implementation of both cross-sectional (at different point of time) and inter-temporal/life cycle analyses (on individuals living in different periods).

The principal uses of the dynamic MSMs are (O'Donoghue, 2001):

1. Projections;
2. Evaluations of public policy;
3. Designing policy reform;
4. Studies of inter-temporal processes of behaviour;
5. Investigating Inequality and Redistribution.

Some of the most known models are shown in Table 5.1. T-DYMM can be considered as another element of this class of dynamic MSMs.

TABLE 5.1: A SHORT DESCRIPTION OF THE MAIN DYNAMIC MICROSIMULATION MODELS

Model	*Country*	*Base dataset*	*Uses*
CAPP_DYN	Italy	Survey of Households' Income and Wealth (SHIW)	Analyses the long term redistributive effects of social policies
DESTINIE I & II	France	Financial Assets Survey	Public pensions models and intergenerational transfers
FAMSIM	Austria	Family and Fertility Survey	Models the demographic behaviour of young women
GAMEO	France	French Labour Force Survey (FLFS)	Analyses and assesses the consequences of various higher education policies
IFS Model	UK	English Longitudinal Study of Ageing (ELSA)	Studies pensioner poverty under a variety of alternative tax and benefit policies
IFSIM	Sweden	Swedish Household Panel Survey (HUS)	Studies intergenerational transfers and the interdependence between demography and the economy
LIAM 1	Ireland	LII survey	Evaluates potential reforms to the Irish pensions system in terms of changes to life-cycle incomes
PENSIM	UK	Retirement Survey	Models the treatment of pensioners by the social security system across the income distribution

Source: elaborations on O'Donoghue (2013)

Dynamic population models have been more attractive to policymakers than longitudinal ones; in fact, recent dynamic MSMs, which influence social policy processes, belong to this class, usually starting with a cross-section of the population (census o survey data) or with longitudinal – administrative or survey – data (Harding, 2007). Dynamics are achieved essentially by "updating attributes of each micro-unit for each time interval" (Caldwell, 1990), where the ageing process can be probabilistic or behavioural. In practice, however, most dynamic MSMs use both dynamic ageing and static ageing procedures, and the latter use alignment procedures (Zaidi, Rake, 2002).

Traditionally, DMSMs are not equilibrium models as they solely account for the supply side of the labour market. The partial equilibrium approach can be advocated as long as in the long run the supply side (of the labour market) is what mainly matters (Flood et al., 2005). However, in general, a dichotomy still exists between Computing General Equilibrium Models (CGE) based on a representative agent approach and MSMs, mostly working in a partial equilibrium framework. In a sense, MSMs exchange the loss in fully accounting for average effects with the gain in explicitly allowing for agents heterogeneity. Nevertheless, as highlighted by Klevmarken (1997), in presence of high non-linearity of economic relations, of heterogeneity in sub-groups behaviours as well as censoring and truncation introduced by tax and benefit programs, the average impact of a policy could not be appropriately assessed by modelling average behaviour, while it could be better evaluated in a micro-simulation framework by modelling the conditional distribution.

As for the macroeconomic framework, it is accounted for through the role of alignment procedures which exogenously draw the dynamic path of macro-demographic (population growth, fertility, mortality) and macroeconomic variables (GDP growth, unemployment, interest rates), importing a macro dimension into the microeconomic framework. Although such dynamics are usually derived as an output from general equilibrium models, they do not allow macro feedbacks. Aligning the micro values with an exogenous input requires some modification of model estimates that change aggregate outputs, but generally does not change the distributions, therefore preserving the microeconomic content. So far, a general agreement in empirical literature appears to have been achieved about the need for alignment of the micro outputs to future macroeconomic and demographic aggregates, although "there is still debate on the level of disaggregation at which this should occur and about how extensive any such alignment should be." (Harding, 2007).

Another fundamental component of any dynamic microsimulation model is its baseline dataset. This is usually composed of a main source, based on individual records taken from survey or administrative data, augmented with information imported from additional sources, using imputation or matching techniques. The rationale behind the use of multiple sources of data is often to fill information gaps in the primary data source or simply to integrate external information.

Some studies have underlined the main advantages and disadvantages of the microsimulation approach. In this paragraph, we summarize some aspects of this literature. Among the major advantages of DMSMs is the use of micro units, which allows at analyzing complex interactions between different population groups even to small detail. As specified by O'Donoghue (2001), MSMs are very flexible allowing easily to change the underlying assumptions of the single micro processes, whereas dynamic MSMs have also the virtue to examine inter-temporal issues and make long-term projections. Another important advantage is the possibility to analyse the micro consequences of macro phenomena. This means that the microsimulation approach, likewise the macroeconomic one, allows to study macro phenomena, yet without leading to biases at micro level.

Others authors instead have outline many disadvantages of the microsimulation approach. Dynamic MSMs require the simulation of several micro-processes that regarding demographic, educational, labour market, welfare programs, etc.. In addition, given that, a jointly modelling of single the micro-processes is rather complex, interactions among modules may suffer from several shortcomings, which, in turn, risk to lower the reliability of the simulated population dynamics (Burtless, 1996). Other drawbacks are related to the limited size, time span or quality of the microdata employed in the models, which can lead to biased estimates and weak projection power. Furthermore, erroneous model specification can compromise the entire simulation process. Finally, dynamic microsimulation models generally require substantial amount of resources in terms of computational tools, large scale data, time, and last but not least financial and human resources.

5.2 RECENT HISTORY OF T-DYMM: THE FIRST RELEASE OF THE MODEL

The first version of the dynamic microsimulation model (DMSM) T-DYMM (henceforth, T-DYMM 1.0)[72] has significantly benefitted from the experience of MIDAS-IT model (Dekkers, 1999), a DMSM previously developed by ISAE (the Italian Institute for Studies and Economic Analyses)[73].

T-DYMM 1.0 used the Italian population as its base, it simulated the evolution of a cross-sectional sample representative of the population, with both individuals and households as units of analysis.

Following O'Donoghue's (2001) taxonomy, T-DYMM 1.0 can be described as it follows :

i. It is a model with dynamic ageing;

ii. It is a discrete-time model: transitions in the labour market and all updating processes are carried out year-by-year;

iii. The ageing process is probabilistic: simulation and transitional dynamics are achieved through probabilistic methodologies. In particular, discrete transitions (in the labour market or in others sections) are obtained by means of a Monte Carlo technique;

iv. It is a closed model: it simulates life-cycle evolution of the main demographic and economic population features within the sample, with new individuals that enter the population each year due to birth and others who exit due to death. Up to now, migration flows are not simulated.

T-DYMM 1.0 inherited from MIDAS-IT the general structure, such as: the focus on pensions adequacy, the demographic module and the simulation platform LIAM[74]. Differently from MIDAS-IT, T-DYMM 1.0 contained in the fiscal module the main elements of EconLav[75], a static micro-simulation model of the Italian tax-benefit system developed by ISFOL[76], with the support of the Ministry of Economy and Finance and the Ministry of Labour, for the analysis of the effects of tax and benefit system reforms (Figure 5.1).

Basing its econometric estimates on a longitudinal dataset of the previous version of AD-SILC (see Chapter 1), T-DYMM 1.0 simulated individual transitions over the life cycle – such as births and deaths, marriages, educational and labour market decisions, retirement – and related outcomes such as earnings and pension benefits. By modelling with a high detail the relevant pension and tax rules, the model started from 2006 and simulated, in a life-cycle perspective, the future evolution of the main demographic and economic events, in order to carry out medium to long-run distributional analyses. This analyses were both intra and intergenerational.

In such a framework, a particular attention was paid to public pensions' adequacy following the radical pension reform process that begun in the '90s and that continued in Italy over the following 20 years. Designed to accompany sustainability analyses, the model aimed at providing efficiency evaluations of different pension schemes, taking into account a given demographic and labour market structure.

72 See MEF-FGB (2012).

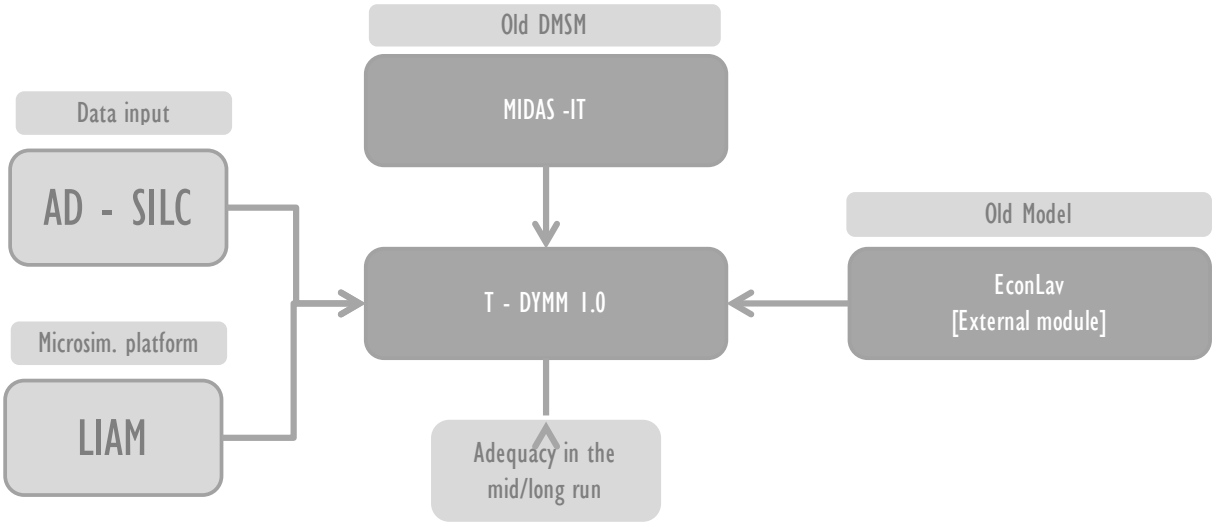
73 The model was developed in the context of AIM, a European-funded sixth framework project (see Dekkers et al., 2009).

74 See O'Donoghue et al. (2009).

75 See Coromaldi and Guerrera (2009).

76 The Italian research institute for vocational education and training employment and social policies. See: http://www.isfol.it/

FIGURE 5.1: THE MODEL AND ITS COMPONENTS



The stylised structure of the model T-DYMM 1.0 consisted of three main modules linked to each other by recursive feedbacks (i.e. in the same period the causal relationship is unidirectional), then integrated with a fourth one (so far external) regarding the taxation system.

In detail, T-DYMM 1.0 included:

1. A **Demographic module**, inherited by MIDAS (Dekkers et al., 2009) which estimated intergenerational persistence, birth processes, educational achievements and the "marriage market".
2. A **Labour market module**, that probabilistically simulated individual labour market dynamics, namely employment transitions (in and out of the labour market and among employment categories, sectors and contractual arrangements).
3. A **Pension module**, for the definition of eligibility requirements and retirement decisions and for the computation of pension benefits.
4. A **Fiscal module**, running separately at the end of the simulation process, that produced with a high degree of detail on the Italian tax-benefit system. net labour and pension incomed.

T-DYMM 1.0 used alignment procedures (i.e. calibrations) – in particular in the demographic module – in order to link several aggregate estimates (couples formation, fertility and mortality rates, employment rates, disability rates) to official projections. The main source of alignment were the Ageing Working Group (AWG) baseline demographic and macroeconomic projections for the period 2006-2060.

5.3 THE NEW RELEASE OF THE MODEL: FROM T-DYMM 1.0 TO T-DYMM 2.0

The model T-DYMM 2.0 is based on econometric estimates carried out on the new and updated longitudinal dataset (AD-SILC presented in Chapter 1) and its aim is to simulate individuals' transitions over life cycle (births, deaths, marriages, educational and labour market decisions, retirement) and analyse their condition at retirement.

The focus of this section is on presenting the most important features of T-DYMM 2.0, highlighting the main differences between its new and old versions. Four main points will be described in more details:

i) the new platform of the simulation, with a new programming code (LIAM2);

ii) the new structure of the model and the characteristics of the single sub-modules;

iii) T-DYMM 2.0's complete departure from MIDAS – IT exogenous estimates;

iv) the new sub-module on private pension schemes (henceforth, PPS).

5.3.1 THE NEW SIMULATION PLATFORM

The model T-DYMM 2.0 operates on the new simulation platform LIAM2, that represents a natural evolution of the previously employed LIAM and provides considerable improvements in terms of speed and data capacity.

LIAM2 is a generic microsimulation modelling toolbox, which allows to develop almost any microsimulation model as long as it uses cross-sectional ageing. Being it an open-source tool[77], and with the increased cooperation through meetings and code sharing, LIAM2 greatly reduces the development costs (in terms of both time and money) of microsimulation models. It should enable the use of very large datasets, such as AD-SILC, or even the expansion of the survey data to the whole population in order to fulfil representativeness requirements. Due to its new programming code, LIAM2[78] – in the version 0.11 – is much more flexible and increases the simulation scopes. The platform's interface is very friendly and allows for an easy and flexible use for microsimulation team.

Most of all, LIAM2 is much faster than its predecessor, reducing time costs for each simulation by about ten times.

5.3.2 THE NEW STRUCTURE OF THE MODEL AND THE NEW CHARACTERISTICS OF THE MODULES

T-DYMM 2.0 (Figure 5.2) has maintained the general structure and features of the previous version (T-DYMM 1.0). It consists of three main modules linked to each other by recursive feedback, plus a fourth external module (Tax module).

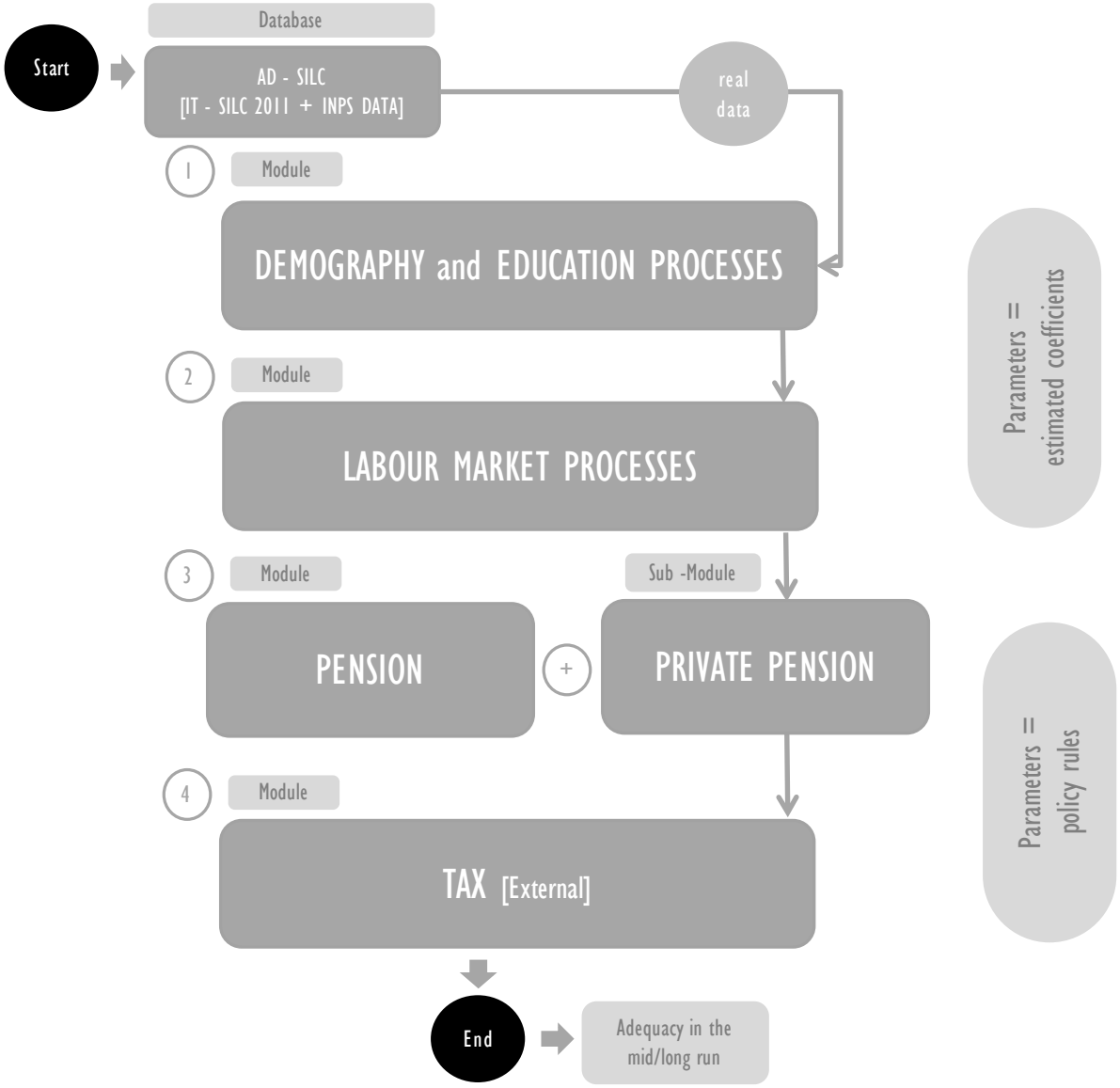
In particular, T-DYMM 2.0 is composed of:

1. a **Demographic module**;
2. a **Labour market module**;
3. a **Pension module** (with a sub-module on private pension schemes);
4. a **Tax module** (external).

77 It is licensed under the GNU General Public License (GPL) version 3.

78 For more details, see http://liam2.plan.be/

FIGURE 5.2: THE T-DYMM 2.0'S STRUCTURES



Similarly its old version, T-DYMM 2.0 is a dynamic ageing model, where individual statuses are updated annually – a typical characteristic of discrete time models – by means of probabilistic transitions. Lastly, it is a closed model, meaning that migration flows are not considered.

In the model, all the monetary values (gross income, pensions and other welfare benefits) are expressed in real terms. Generally, though, welfare rules establish that monetary parameters and cash benefits – e.g. "*Assegno sociale*", "*Integrazione al minimo*", etc. – are indexed to inflation. T-DYMM 2.0 does not account for inflation, and assumes that these monetary values are instead indexed to GDP real growth, as projected by AWG[79].

In its current version, the main purpose of T-DYMM 2.0 is to analyse the *adequacy* of the Italian pension system in the medium-long run. Yet, it is worth highlighting that the model is very flexible and can support other secondary objectives, e.g., simulating pension reforms or analysing the impact of labour market reforms and eventually assessing the sustainability of the pension system.

79 This procedure allows accounting for a necessary periodical update of such parameters by the policy maker. A mere indexation to inflation, in a context of economic growth, would greatly penalize the amount of social benefits over the long run.

5.3.3 DEMOGRAPHIC MODULE

T-DYMM 2.0's demographic module estimates intergenerational persistence, birth processes, educational achievements and the "marriage market". Differently from T-DYMM 1.0's module, endogenous parameters which are needed to run the model are no longer drawn from MIDAS-IT. Indeed, in T-DYMM 2.0 all the underlying econometric regressions have been based exclusively on the new version of AD-SILC[80] database, ensuring more reliable and suitable estimations. The module simulates four types of processes (Table 5.2):

TABLE 5.2: DEMOGRAPHIC MODULE

	Process	Description	Alignment
1	Alive	Individuals are assigned to either life or death	AWG 2015
2	Birth	Which and how many women give birth	AWG 2015
3	Education	Three levels: Compulsory, upper-secondary and university level. Achievement dependent on parental education	Istat
4	Marriage market	Coupling process (marriage or cohabitation). Divorce/separation process	Internal

These processes can be aggregated in three kinds of demographic events (or choices):

1. events that mainly modify the population structure by sub-group composition, such as mortality and fertility rates. So far, survival probabilities are not tested by any micro-level analysis, and mortality is uniformly distributed among ages and genders according to AWG 2015 projections (see Figure 5.3) . On the other hand, the birth process includes the consideration of certain parameters pertaining to women in fertile age, so that the most likely to give birth are selected. Fertility rates are aligned to those projected in the AWG 2015 projections (see Figure 5.4);

2. attribution of an educational level (compulsory, upper-secondary or university level) to young people (in education age), which is simulated on the basis of parental education. The shares of individuals assigned to the each education level are aligned to Istat official statistics and projected in the future through a logarithmic function[81] (see Figure 5.5 and 5.6);

3. events that affect the household structure, such as departure from the family of origin, cohabitation, marriage and separation. Both the matching process among singles and the divorce process among in-couple individuals are endougenously estimated via AD-SILC variables. Based on the baseline data, specific alignments are developed in order to keep the number of coupled individuals and of divorcees constant overtime. This "neutrality assumption" seems appropriate in a context where such demographic phenomena do not represent the core activity of the research.

80 See Chapter 4.

81 See Chapter 4, Paragraph 4.1.

FIGURE 5.3: LIFE EXPECTATION BY GENDER

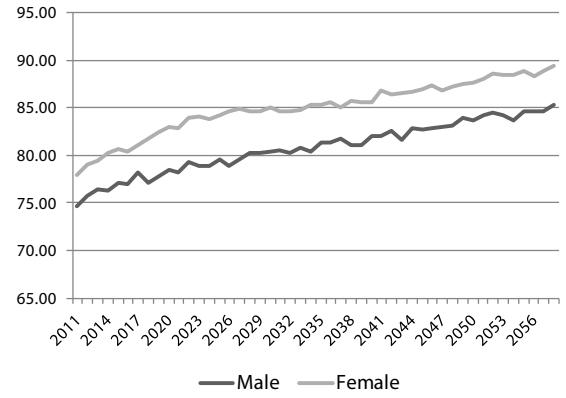
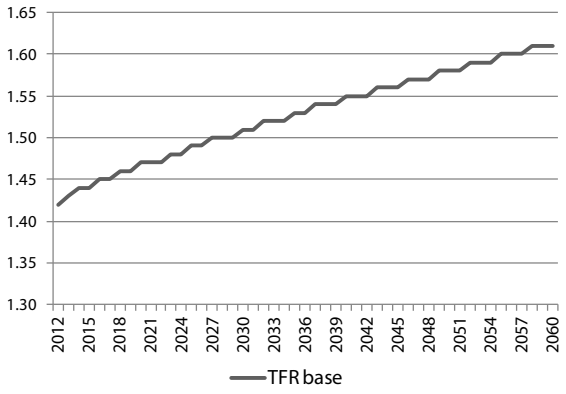


FIGURE 5.4: TOTAL FERTILITY RATES



Source: AWG 2015

FIGURE 5.5: TERTIARY EDUCATION GRADUATES BY GENDER

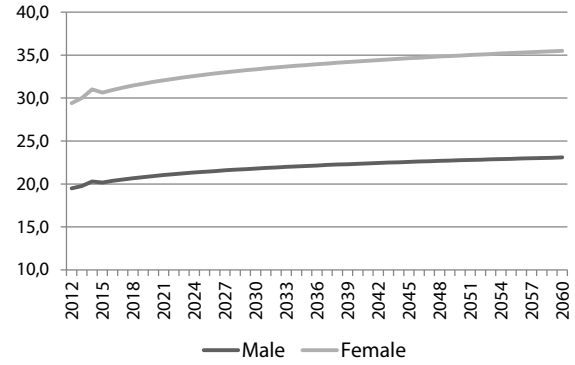
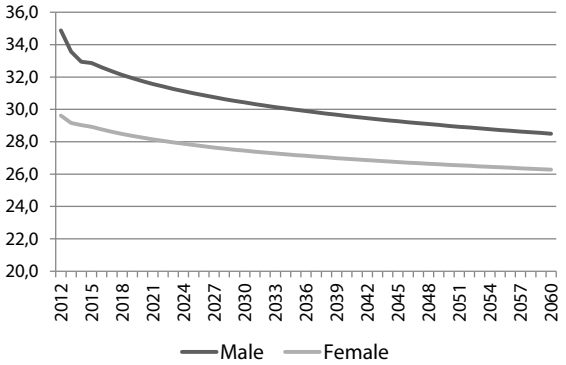


FIGURE 5.6: COMPULSORY EDUCATION GRADUATES (AT MOST) BY GENDER



Source: Istat – own elaborations

5.3.4 LABOUR MARKET MODULE

The labour market module has two main purposes: on one hand, it simulates the transitions between different employment statuses; on the other, once a labour market status is assigned, the corresponding level of income is imputed.

The labour market module is based on a sequence of nested binary choices, which are a series of logistic behavioural equations modelling employment decisions as well as choices about the features of the job. The module works by means of a binomial structure for discrete choices. This implies establishing a logical order for a decisional sequence, illustrates in Figure 5.9.

As shown in the flow chart (Figure 5.9), the very first step involves defining whether the individual is in work or out of work. Starting from individuals that at beginning of every year are not in education and not retired, the module probabilistically simulates who is expected to enter/stay in the labour market and who is expected to stay out of it[82]. Each year, the resulting share of working individuals by gender and age is aligned to AWG 2015 projections (see Figure 5.7 and 5.8).

82 See Chapter 4 for a detailed description of the econometric estimations.

FIGURE 5.7: EMPLOYMENT GROWTH RATE – MALE (15-64)

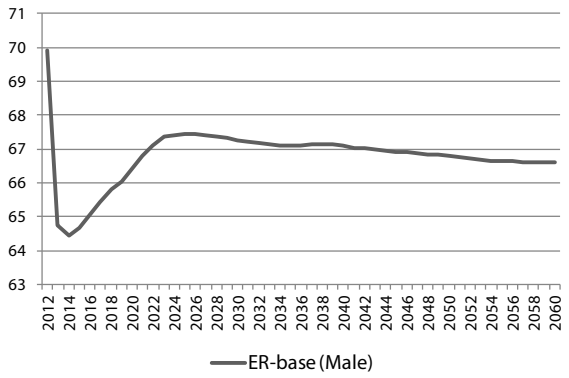
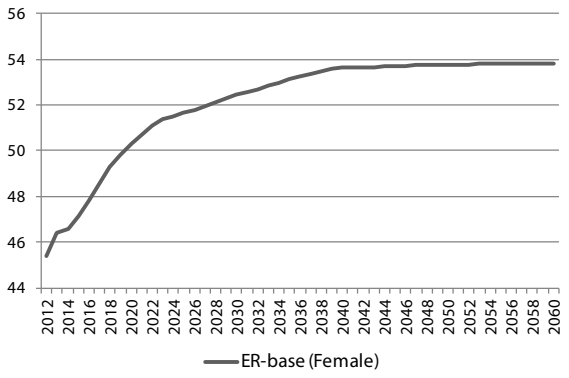


FIGURE 5.8: EMPLOYMENT GROWTH RATE – FEMALE (15-64)



Source: AWG 2015

For those who are simulated as being in work, the subsequent choice is on the three possible contractual statuses:

1. atypical workers: workers who pay their social contributions to INPS in the section of "*Gestione Separata*" (*parasubordinate* workers and "*Partite Iva*");
2. employees;
3. self-employed (residual category).

The distinction between these three groups is relevant, because retirement criteria and marginal contribution rates differ over time. Furthermore, individuals working with different contractual arrangements present peculiar features. First of all, they can differ in the levels of gross earnings, which implies very different patterns of pension benefit accrual. Secondly, they have a dissimilar probability to work all year, resulting in a different degree of fragmentation of their careers.

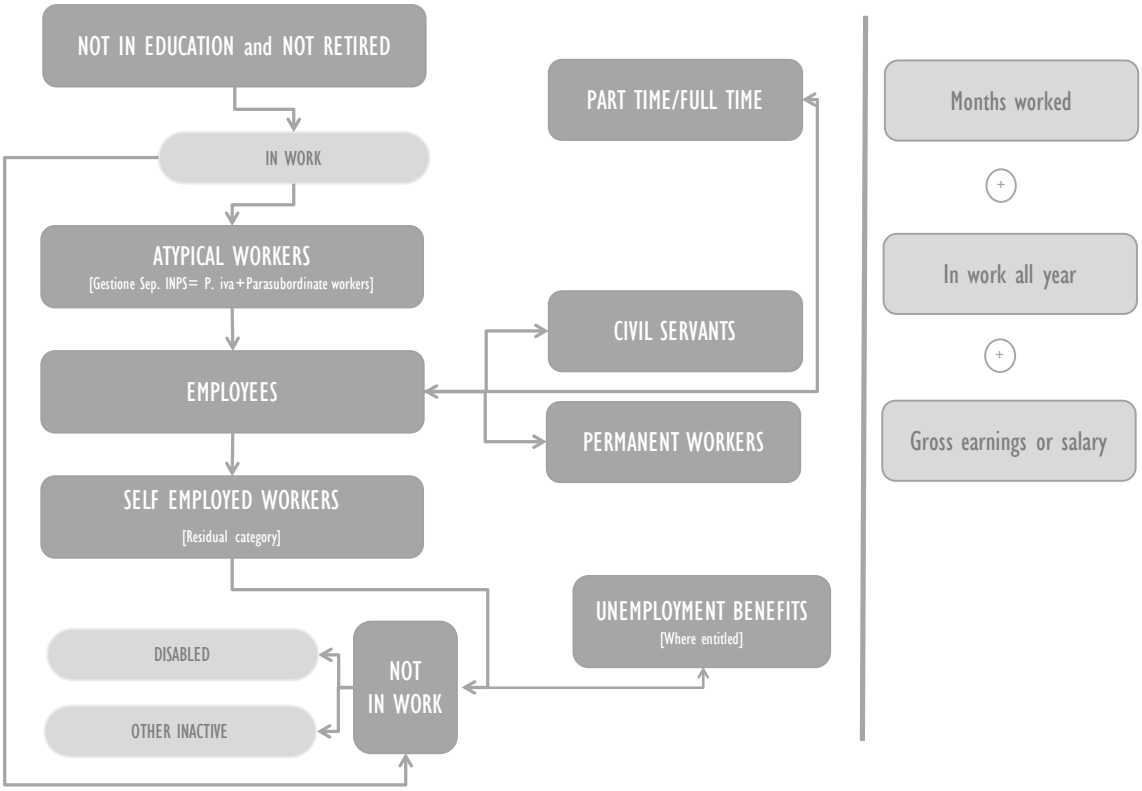
For employees, further job features need to be simulated. Once an individual is assigned the status of employee, the module simulates transitions among the following sub-statuses:

a. the type of economic activity, distinguishing between civil servants and private employees;

b. the duration of contract, distinguishing between permanent and temporary workers;

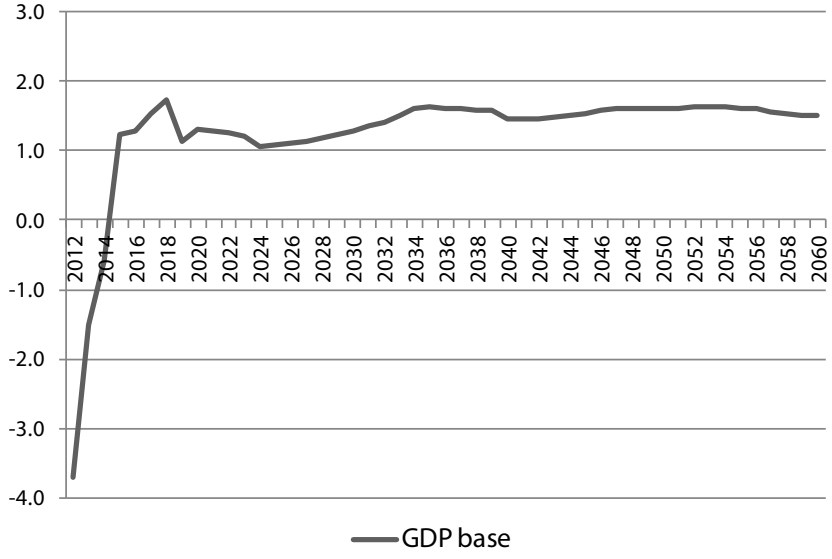
c. the working time arrangements, distinguishing between full-time and part-time.

FIGURE 5.9: LABOUR MARKET MODULE



Once an individual is assigned to a particular employment status, the following step is the simulation of a yearly labour gross income, that it is indexed to GDP real growth, as projected by AWG 2015 (see Figure 5.10). This is the measure of earnings that represents the base on which contribution rates have to be applied in order to calculate the contribution to future pension benefits[83].

FIGURE 5.10: GDP REAL GROWTH



Source: AWG 2015

83 See Chapter 4 for a detailed description of the gross income econometric estimations.

Finally, it is important to underline two aspects regard individuals out of work. On one hand, part of these individuals are assigned to the "disabled" category every year. For simplicity's sake, we assume that these workers are permanently out of the work force. Information on disability is extracted from AD-SILC, and in accordance with T-DYMM 1.0 ad hoc alignments are built in order to keep the number of disabled individuals constant over the simulation period. On the other hand, there are a part of unemployed (able to work) entitled to receive the unemployment benefits.

5.3.4.1 UNEMPLOYMENT BENEFITS

One of the most relevant improvements of T-DYMM 2.0 vis-à-vis the previous version o the model is the inclusion of unemployment benefits in the simulation process. On one hand, this allows for a more precise assessment on the impact of discontinuous careers on pension earnings, and on the other hand, it shows how T-DYMM 2.0 can effectively be employed for the assessment of policy scenarios on areas of social security outlays different form pensions entitlements.

It is crucial to stress that, when pensions are computed by means of NDC rules, the way unemployment spells are treated by the welfare system affects workers both when active and during their retirement. While different regulations may guarantee a different level of income replacement when unemployment benefits are paid out, the imputation of social contributions while in unemployment may determines variations in the eventual computation of pension benefits.

In T-DYMM 2.0, three scenarios are implemented on unemployment benefit regulations:

1. a counterfactual scenario called, *Ante Fornero*, which assumes that regulations in place before the implementation of the provisions established in the L. 92/2012 areholding for the whole simulation period;
2. a counterfactual scenario called, *Fornero*, which assumes that the provisions established by the L. n. 92/2012 are applied from 2013 onwards;
3. the *Jobs Act* scenario, which assumes that the provisions established by the Legislative Decree no. 22/2015 are applied from 2015 onwards. Because this legislation is in place as of today, the *Jobs Act* constitutes the baseline scenario. Paragraph 10.1 is devoted to an in-depth explanation of the assumptions underlying these scenarios and the presentation of relevant results.

5.3.5 PENSION MODULE

The pension module in T-DYMM 2.0 is divided into two sub-modules:

1. simulation of pensions of the first pillar (public pensions);
2. simulation of pensions of the second and third pillars (private pensions).

The second sub-module constitutes one of the main innovations of T-DYMM 2.0 *vis-à-vis* the previous version.

5.3.5.1 PUBLIC PENSION SUB-MODULE

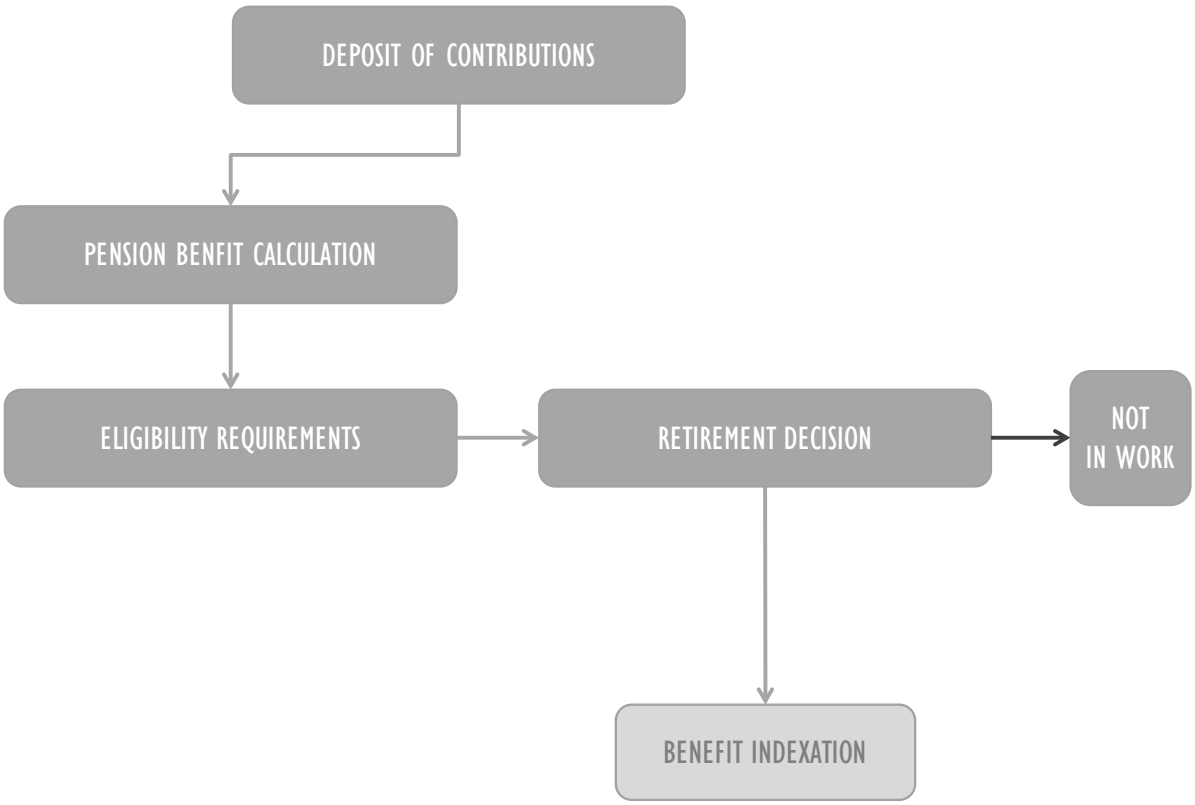
The public pension sub-module (henceforth, PubPM) comprises three main steps that define the sequence of the processes (Figure 5.11):

a. deposit of contributions;

b. pension benefit calculation;

c. verification of eligibility requirements and attribution of retirement decisions.

FIGURE 5.11: PUBLIC PENSION MODULE



The PubPM starts with the simulation of seniority and social contributions accrual. For each individual in work, seniority increases according to the time spent in employment during the year. For what concerns contributions accrual, the model applies the appropriate contribution rates (they vary over time and for different employment categories) to gross labour incomes in order to compute the notional annual savings for public pensions (see Table 5.3).

TABLE 5.3: SOCIAL SECURITY CONTRIBUTION RATES

Employment category	*Tax rates*			
	2012-2015(*)	2016	2017	2018 and over
Employees	33%	33%	33%	33%
Atypical workers	28.5%	31%	32%	33%
Self-employed workers	21.9%	23.1%	23.5%	24%

(*) These data correspond to the mean of social security contribution rates between 2012-2015.

The module classifies each worker in the appropriate pension scheme: "Mixed 2011", "Mixed 1995" or "NDC". In-sample individuals are assigned to their pension scheme according to their seniority level in 1995, new-borns are automatically assigned to the Notional Defined Contribution regime.

At the end of each simulation period, a potential pension benefit is computed for all individuals in the model. Computation rules differ according to the three different pension regimes that workers may be enrolled into:

1) The "Mixed 2011" regime

This regime includes workers who had at least 18 years of seniority in 1995. Defined Benefit rules are applied *pro quota* for the share of seniority accrued prior to Jan 1st 2012, while Notional Defined Contribution rules are applied for the remaining quota. The overall benefit is computed as:

$$P_{M2011} = coeff_a * S_A * QA + coeff_{b1} * S_B * QB1 + P_{NDC}$$

where $coeff_a$ and $coeff_b$ are the conversion rates[84], S represents contribution seniority respectively before (S_A) and after (S_B) 1992, QA is the average of yearly labour incomes over the last 5 years of work, and QB1 is the average of yearly labour incomes over the last 10 years of work[85]. For the purpose of the calculation, $S_{A+}S_B$ cannot exceed 40 years. P_{NDC} is the portion of benefit computed according to Notional Defined Contribution rules (see below).

2) The "Mixed 1995" regime

This regime includes workers who had less than 18 years of seniority in 1995. In the "Mixed 1995" regime, retirees receive a mixed benefit computed *pro quota*, according to the quota of working years spent before and after 1995 over the total seniority.

The Italian legislation distinguishes two cases according to the amount of seniority accrued by the end of 1992:

(a) if accrued seniority in 1992 is between 15 and 18 years:

$$P_{M95a} = coeff_a * S_A * QA + coeff_{b1} * S_C * QB1 + P_{NDC}$$

where P_{NDC} is the benefit as computed according to the NDC regime and applied to contributions accrued post-1995, and S_C represents contribution seniority accrued between 1993 and 1995.

(b) if accrued seniority in 1992 is smaller than 15 years (but positive):

$$P_{M95b} = coeff_a * S_A * QA + coeff_{b2} * S_C * QB2 + P_{NDC}$$

where $coeff_{b2}$ is a different version of a conversion rate and QB2 is the average annual earning computed on the entire working life.

3) The "NDC" regime

All the workers who retire during the simulation period compute a portion of their pension benefit by applying Notional Defined Contribution (NDC) rules, and individuals who have started working after 1995 compute all of their pension benefit by applying them. Every year, paid contributions are cumulated and virtually capitalized according to a specific rate of return; at the end of the working life, such capitalized amount is converted into an annuity stream by multiplying it with the appropriate conversion coefficient, computed according to life expectancy at retirement.

84 As explained in Chapter 4, these conversion rates represent the return for each year of contribution in a Defined Benefit scheme, and their values decrease with increasing income classes.

85 All quotas are calculated by properly revaluing past income flows according to the relevant legislation.

The benefit is computed as:

$$P_{NDC_{it}} = MC_{it} * c_x$$

where c_x is the conversion coefficient[86] and MC_{it} are pension savings, calculated as:

$$Mc_{it} = contrib(t) + \sum_{s=0}^{i=1} contrib(s) * (1 + \tau)$$

where *contrib(t)* is the amount of contributions accrued in period *t* and τ is the rate of return on the accrued stock of pension contributions *contrib(t)*, and according to the Italian legislation is set as the five-year moving average of the annual GDP growth rate.

Once the pension benefit is calculated, the eligibility requirements presented in Table 4.2 (see Chapter 4) are verified. Once requirements are met, retirement decisions are attributed in a deterministic way. In our *Baseline* scenario, individuals are assigned to retirement as soon as they fulfil any of the retirement requisites in Table 4.2. In our *Choice* scenario we assume that, if workers fulfil the criteria for early retirement but have not reached the age requirements for old-age retirement, they will retire only if their potential replacement rate exceeds 70.8%[87]. Once workers retire, they exit the labour market and cannot re-enter[88].

When one retires, the potential pension benefit calculated in the previous step becomes the actual pension benefit. The Italian pension system indexes pension benefits to inflation, but only up to a certain amount. Because T-DYMM 2.0 only computes real monetary values, such "partial indexation" translates into a discount rate for benefits exceeding a given threshold[89]. Benefits that are very distant in real values at their first "withdrawal" are bound to get closer as time goes by.

In addition to ordinary old-age and early retirement pension benefits, the pension module simulates other kinds of benefits:

i. survivor's pensions, paid to the retiree's widow/er;

ii. social pensions ("*assegno sociale*"), i.e. non-contributory means-tested social allowances paid to the elderly[90];

iii. minimum integrations ("*integrazione al minimo*"), e.g. non-contributory benefits – only available to individuals enrolled, entirely or pro quota, in the old Defined Benefit scheme – paid out whenever benefits are below the minimum level;

iv. disability pensions paid to workers whose earning capacity is reduced due to illness[91].

The procedure for the attribution of survivor's pensions and non-contributory pensions mirrors the Italian law requirements; eligibility for such benefits depends on both individual's and household's incomes of applicants.

86 Under the Italian legislation, conversion coefficients are periodically updated according to changes in life expectancy (see Chapter 4). Their computation up until 2059 has been carried out following Eurostat population projections (base year 2013). Because the Italian pension system pays out survivor's pensions, conversion coefficients have to take into account the probability of existence of a survivor and the average age-difference with the deceased. For what concerns these parameters, we have employed the data published by Istat (2012) and we have assumed they stay constant over the simulation period.

87 70.8% is the Theoretical Replacement Rate for workers with a 40-year career up to 65 years of age valid for Italy in 2013 according to the 2015 Adequacy Report (European Commission, 2015c).

88 This is a simplification of the Italian legislation on the matter. Pensioners are in fact allowed to keep working and earn additional pension rights. Future implementations of T-DYMM may include a category of retired workers.

89 A recent ruling from the Italian Constitutional Court (n. 70/2015) declared unconstitutional the discontinuation of indexation for pensions above 6 times the minimum and the partial indexation of the pension benefits from 3 to 5 times higher than the minimum established for years 2012-2013. With Decree Law n. 65/2015, pensions whose indexation was discontinued or partially indexed were to some extent reimbursed. This provision is simulated within T-DYMM 2.0, thus allowing for an evaluation of the actual impact in adequacy terms of Law Decree n. 65/2015.

90 The age requirement for the *assegno sociale* (65 years and 7 months as of 2016) will be aligned to that of Old age 2 retirement (see Table 4.2) starting from 2018.

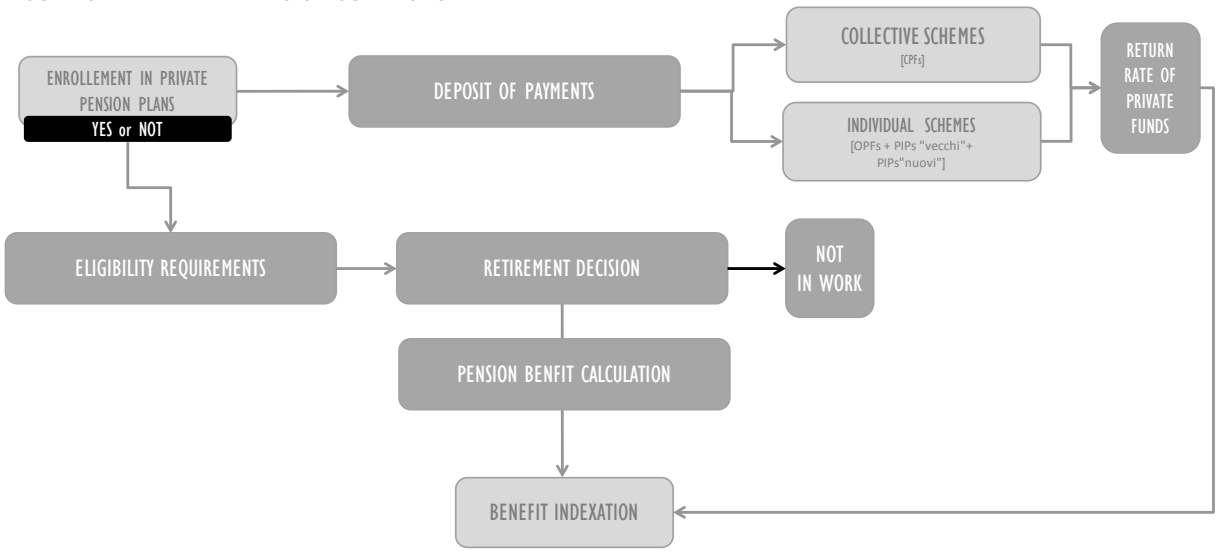
91 The model only corresponds disability pensions to 100% disable individuals. Partial disability is not simulated.

5.3.5.2 PRIVATE PENSION SUB-MODULE

T-DYMM 2.0 includes a new sub-module within the pension module aimed at simulating and projecting the evolution of private pension schemes (henceforth, PrivPS) over time. Private pension schemes constitute a way of transferring purchasing power over time, possibly competing with other types of investment.

The general structure of the sub-module is represented in Figure 5.12.

FIGURE 5.12: PRIVATE PENSION SUB-MODULE



The amount of individual benefits generated by investments in private pension funds depends on two fundamental elements: (i) payments accrued over time; (ii) rates of return on capital accrued.

Before the simulation starts, a certain level of stock investment in private pension funds to individuals included in our sample is attributed. Lacking reliable information on this issue on AD-SILC, the underlying assumption is that all individuals enrolled in private pension plans in 2011 have been contributing to private pension schemes for every year starting from 1999[92]. The income perceived on a given year (available for all years of work in AD-SILC) is employed to determine the amount of contributions deposited – according to the same rules employed during the simulation period.

Because no source of income other than work is simulated in T-DYMM 2.0, only employed individuals are allowed to be enrolled in private pension schemes.

When individuals are in work, a probabilistic routine enrols them in private pension funds, making use of external econometric estimates carried out on the new AD-SILC dataset. The share of workers to be enrolled in private pension plans is aligned to data from COVIP[93] and projected in the future with the use of a logarithmic function[94].

The module assumes that workers can participate in "collective" and/or "individual" schemes. "Collective schemes" correspond to collective occupational funds (CPFs)[95], while "individual schemes" include open funds

92 First year of activity of pension funds, previously instituted by the 1993 reform (Legislative Decree n. 124/1993).

93 About COVIP data see: http://www.covip.it/.

94 See Chapter 6 for probability estimations and alignment procedures.

95 CPFs, not-for-profit institutions, are set up within the frame of collective bargaining between employers and trade unions. They can be created at several levels: companies or groups of companies, industrial or economic sectors, geographical areas.

(OPFs)[96] and personal pension plans (*Piani Pensionistici Individuali*, PIPs "*vecchi*" and PIPs "*nuovi*")[97].

On the basis of a simplifying hypothesis, it is assumed that only employees can participate to "collective schemes" – whose only source of contribution is the TFR[98] –, while all types of workers can participate to "individual schemes".

The amount deposited in private pension funds ("collective" and/or "individual" schemes) is calculated in a deterministic way. The general theoretical rule adopted assumes that all enrolled workers are willing to invest up to the deductibility ceiling[99], according to marginal rates that simulate the devolution of the TFR. This means that workers are assumed to have the same preferences on the matter, whether they are employees and can actually dispose of a TFR or not. Annual TFR payments amount to 6.91% of gross wages, but workers can choose to contribute for an additional 1.3% (we assume they all do), and in the case of employees enrolled in collective schemes, employers can contribute for an additional 1.3%. The "base" TFR quota of 6.91% does not concur to the passage of the deductibility ceiling. Therefore, as a result of the different impact of incentive mechanisms, compared to other workers, in T-DYMM 2.0 employees can contribute to private pension plans with higher marginal rates.

TABLE 5.4: SIMULATION OF INVESTMENT PATTERNS IN PRIVATE PENSION FUNDS

Private schemes	Workers typology	Marginal contributions rate			Deductibility ceiling
		Worker	Employer	Tot	
Collective schemes	Employees	6.91%+1.3%	1.3%	9.5%	5,146.57 €
Individual schemes	Employees that don't participate in collective schemes.	6.91%+1.3%	-	8.2%	5,146.57 €
	Employees that participate in coll. schemes.	5,146.57 - gross income * 2.6	-	-	-
	▪ Atypical workers ▪ Self-employed workers	6.91%+1.3%	-	8.2%	5,146.57 €

The sub-module includes some assumptions on the rates of return of private pension funds, differentiating between "collective" and "individual" schemes. Thanks to the model's flexibility, such assumptions can easily be modified, allowing for comparative analysis on different case scenarios.

The different hypotheses on the rates of return of "collective" and "individual" schemes depend, first of all, on the portfolio composition of the two funds. Starting from COVIP data (between 2009 and 2014) it is possible to analyse the portfolio composition of private pension funds. For "collective schemes", 65.9% of the portfolio is

96 OPFs are promoted and managed by banks, insurance and investment companies. They can offer both personal and occupational (i.e. based on a collective enrolment) plans: the difference between occupational and personal schemes (i.e. second and third pillar) does not depend on the type of pension fund (closed or open), but on affiliation modalities (collective or individual).

97 Since 2000, personal pension plans can be offered also through life insurance contracts (PIPs), under the condition that benefits have to be paid according to the same rules applying to pension funds.

98 *Trattamento di Fine Rapporto* (end-of-service allowance) is a sort of mandatory severance payment for public and private employees; it is a deferred share of employees' wage with contributions (6.91% of gross amount) withheld and managed directly by the employer and added with an interest linked to inflation. The amount accrued can be partially redeemed in some special cases, and can be fully or partially transferred to complementary pension funds. A crucial change in the legislation concerning TFR took place in 2005, when the 'silent consent' formula was introduced (with the new regulations made executive from 2007 on): if a worker does not explicitly disagree, his/her TFR flows (not the stock already accrued by firms) are transferred from firms to pension funds.

99 Even though such ceiling has not changed since 2007, in T-DYMM its annual variations are aligned to GDP growth, assuming a periodical intervention by the policy maker.

invested in government bonds, 23.9% in stocks, and the residual part in corporate bonds. Instead, for "individual schemes", 31.0% is invested in stocks , 63.4% in government bonds and 5.6% in corporate bonds (Table 5.5).

TABLE 5.5: PORTFOLIO COMPOSITION OF PRIVATE FUNDS (2009-2014 AVERAGES)

	Government bonds	*Corporate bonds*	*Stocks*	*Total*
Collective schemes	65.9%	10.2%	23.9%	100%
Individual schemes	63.4%	5.6%	31.0%	100%

Source: COVIP (2010-2015)

Once the portfolio structures are analysed, the second step regards the assumptions on future interest rates for government bonds, corporate bonds and stocks.

For government bonds – in the medium run, from 2015 to 2024 – the return rate is assumed to correspond to the forecast of the real implicit rate on public debt, estimated by AWG 2015 projections; in the long run – from 2025 to 2059 – the rate of return converges to real GDP growth, again obtained from AWG 2015 projections.

For corporate bonds – in the medium term – the future values correspond to the sum of the real implicit rate on public debt (forecasted by AWG 2015) plus a spread calculated on the real interest rate of corporate bonds. This spread has been estimated as the difference between the time series of the real implicit rate on public debt and a benchmark of corporate bonds, corresponding to "*BofA Merrill Lynch Euro High Yield Index Effective Yield*"[100]. Conversely, in the long term, starting from 2025, the return rate is assumed to converge to real world GDP growth projected by OECD. For stocks, projections are based on time series of the S&P 350 index; in particular, in the short run (2015-2019) the rate of return is assumed to equalize the average interest rate from 2012 to 2014, while in the medium and long run (2020-2059) it is equal to the interest rate registered from 2005 to 2014 (Table 5.6).

TABLE 5.6: RATE OF RETURN– ADOPTED METHODOLOGY

	2012-2014	**2015-2024**	**2025-2059**
Government bonds	Actual data	Real implicit rate on public debt [AWG 2015]	real GDP growth [AWG 2015]
Corporate bonds	Actual data	Real implicit rate on public debt [AWG 2015] + Spread	real world GDP growth [OECD]
		2015-2019	**2020-2059**
Stocks	Actual data	Real interest rate (S&P 350, mean 2012-2014)	Real interest rate (S&P 350, mean 2005-2014)

The aggregate rates of return for "collective" and "individual" schemes are calculated as weighted averages of interest rates of different portfolio investments. Table 5.7 shows the results obtained.

100 For more details, see: https://research.stlouisfed.org/fred2/series/BAMLHE00EHYIEI.

TABLE 5.7: RATE OF RETURN ADOPTED - DATA

	2012-2014	2015-2024	2025-2059
Collective Schemes	5.8%	4.1%	3.1%
Individual Schemes	2.5%	4.7%	3.1%

As Figure 5.5 shows, once workers satisfy the eligibility requirements for public pension retirement, they are also entitled to integrations from private pension funds. Benefits are computed employing the same "conversion coefficients" (divisors) of the public Notional Defined Contribution schemes. That is equivalent to saying that all pensioners opt to withdraw their capital in the form of an annuity, anticipating future rates of return by 1.5% - such is the "anticipation rate" in the public scheme. Once computed, private pension benefits are not indexed to inflation like public benefits, rather they are indexed to the annual rate of return performed by the fund (in the simplified world of T-DYMM 2.0, we only have one fund per scheme, "collective" and "individual) minus 1.5%, the anticipated rate of return. In accordance to pension fund policies, this subtraction cannot cause a decrease in nominal values of the benefits. However, benefits can – and, quite often during the simulation period, do – lose real value if the indexation rate is inferior to the projected inflation rate for a given year.

5.3.6 TAXATION MODULE

As mentioned above, the fiscal module of T-DYMM 2.0 is a dynamic tax calculator, which allows to convert gross incomes to net values for each sample unit and each year of the simulation period. This module is considered external because it does not interact with the other modules of our dynamic micro-simulation model. Furthermore, it is not programmed in LIAM2 but in STATA, a flexible statistical package that is fully programmable, contains "state-of-the-art" statistical procedures and is fully integrated with a matrix language. The importance of implementing a fiscal module is twofold. First, redistributive effects of the simulated policy reforms can be evaluated on the basis of net rather than gross incomes. Second, if we assume that individual responses to fiscal policy reforms are not negligible, then one can provide an ex-ante evaluation of their first-order distributional effects by comparing our baseline scenario with alternative hypotheses about future developments of the fiscal system.

The basic structure of the taxation module can be summarised with the list of operations presented in Table 5.8, which describes the rules adopted in Italy.

TABLE 5.8: FROM GROSS TO NET INCOME

	Tax rules
▶	Gross income
-	Social contributions
-	Private pension contributions
=	Taxable income
-	Income tax (IRPEF)
+	Deductions
=	Net income

Source: Agenzia delle Entrate - Unico 2016

Starting from 2015 and for the whole simulation period (up to 2060), our baseline scenario assumes that the fiscal policy is constant over time, whereas all monetary variables – all income brackets and tax credit amounts – are updated using the expected real growth rate of the GDP, adopting the AWG 2015 forecast.

In any year of the simulation period, the starting point of the fiscal module is the vector of taxpayers' gross earnings and gross pensions simulated by the labour market and the pension modules, respectively. T-DYMM 2.0's fiscal module ignores some income deductions (e.g. social security contributions for housekeeping assistance, social security contributions paid by fiscally dependent relatives, health care expenditures of disabled relatives, supplementary pension premiums and alimonies) and assumes that the total gross income net of social security contributions coincides with the taxable income (Table 5.9).

TABLE 5.9: SOCIAL SECURITY CONTRIBUTION RATES

Employment category	**Tax rates**			
	2015	*2016*	*2017*	*2018 and over*
Employees	22%	22%	22%	22%
Atypical workers	25%	25.8%	26.6%	27.5%
Self-employed workers	22.6%	23.1%	23.5%	24%

Source: Agenzia delle Entrate

In 2015, the gross personal income tax is computed through a progressive taxation scheme using the income brackets and the marginal tax rates presented in Table 5.10. The fiscal model of T-DYMM 2.0 does not simulate local surcharge taxes computed at regional and municipal level, because there is no local differentiation within the State dimension in T-DYMM 2.0. Moreover, these taxes are known to play a minor role with respect to the gross personal income tax computed at the national level.

TABLE 5.10: INCOME BRACKETS, 2015

Income brackets (Euro per year)	Marginal tax rates
Up to 15,000	23%
15,001-28,000	29%
28,001-55,000	31%
55,001-75,000	39%
More than 75,000	45%

Source: Agenzia delle Entrate - Unico 2016

The net personal income tax is obtained by subtracting tax credits (deductions) from the gross personal income tax. According to Italian fiscal rules, such tax credits are non-refundable. Hence, any credit due to excess of tax liability is not refunded to the taxpayer. Our fiscal module includes two broad categories of tax credits: those for earned incomes and pensions and those for fiscally dependent relatives (Table 5.11). Another non negligible category of tax credits, namely those for expenditures that could be partly subtracted from the gross personal income tax (e.g. expenses for health care, secondary and tertiary education, life insurance premiums, mortgage payments, etc.), are instead omitted because our micro-data do not contain information on such expenditures, nor does the model simulate them.

TABLE 5.11: TAX CREDITS

Tax credit for income source
Employment income and assimilated
Pensions: Pensioners aged below 75
Pensions: Pensioners aged 75 and above
Self-employment income
Tax credits for dependent family members

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6. THE ESTIMATIONS EMPLOYED IN T-DYMM 2.0

As widely analysed in Chapter 1, one of the most significant innovations of T-DYMM 2.0 *vis-à-vis* its previous version is the use of a new and improved dataset to produce estimates that are used as basic parameters in the microsimulation model.

Because of the existence of a panel dimension not only on the administrative side, but also in the SILC portion of the dataset, T-DYMM 2.0 can make use of more solid estimations compared to the ones characterising the first version of the model for the purpose of the labour market module. Moreover, for what concerns the demographic module, T-DYMM 2.0 has now departed from MIDAS-IT and employs autonomous estimations on a number of demographic variables. As a complete innovation from T-DYMM 1.0, T-DYMM 2.0 also makes use of the panel information collected in SILC to estimate the probability of contributing to occupational and individual pension plans.

It should be noted that not all of the variables included in the AD-SILC dataset can effectively be utilised in the estimation. Specifically, we do not include in our regressions any variable that is not present in the "simulation world". For instance, while the dimension of the firm may have relevance in explaining the probability of a worker to contribute to occupational pension plans, we do not differentiate by firm dimension in the model and we have excluded this parameter from the external estimations, because we cannot project the evolution of such variable over the simulation period.

Omitting relevant variables may distort some of the estimates. Nonetheless, other than the impact of time dummies, we decided to maintain our coefficients unaffected in order to minimize the loss of other valuable information and to avoid counterintuitive results.

6.1 ESTIMATIONS IN THE DEMOGRAPHIC MODULE

It is crucial to understand that the scope of the regressions in the demographic module is not to provide a causal explanation of demographic phenomena such as giving birth, getting tertiary education, choosing a partner and divorcing, the feasibility of which is *per se* debatable. The goal here is to make the demographic evolution of the model endogenous – thus allowing T-DYMM to depart from previous microsimulation models – while leading the model to produce credible outcomes.

A review of the relevant literature has shown that two main approaches are generally employed in modelling demographic events: 1) if MSMs operate in continuous time, the demographic processes are simulated using survival functions (e.g. DYNAMOD in the USA, MICROHUS in Sweden), 2) if the models operate in discrete time, then simulations are carried out using transition equations (e.g. HARDING in Australia, Sfb3 in Germany). However, in some cases demographic characteristics such as fertility and mortality are not explicitly modelled due to lack of data, therefore such processes are driven by alignment procedures provided from external projections (e.g. MIDAS in Belgium). In this respect, T-DYMM 2.0 has made a step further with respect to its previous version, to the extent that many of the demographic processes are simulated using transition probabilities and not simply following the alignment mechanism, although alignments are still used in order to keep the model in line with official projections. A detailed description of the estimations employed in the demographic module is presented in the next four subsections.

6.1.1 GIVING BIRTH

Like in T-DYMM 1.0, the evolution of fertility rates is aligned to Eurostat's EUROPOP projections (2013), incorporated by the AWG 2015 Ageing Report.

Taking advantage of the new AD-SILC dataset, estimations have been carried out with the goal of in order to select the women with the highest probability to give birth in a given period and given a certain average fertility rate for each age between 14 and 50. The probabilities have been estimated using a logistic model (logit). As shown in Table 6.1, to-be mothers are essentially characterised by being in couple and without children born one year earlier. If a woman already has children, a stronger probability is attributed to the event of giving birth. Moreover, women seem more likely to have children in the first years of marriage.

Even though, as previously specified, the simulation employs alignment procedures that assign a given average fertility rate for each age between 14 and 50 over the simulation period, age variables are still included in the regression in order to reduce the bias of the other estimators.

TABLE 6.1: PROBABILITY OF GIVING BIRTH

	Female	
	B	*se*
age	0.5981***	0.069
age²	-0.0095***	0.001
in couple	3.7887***	0.162
already mother	1.5083***	0.099
has children aged 0-1	-2.8693**	0.339
years of marriage	-0.3576***	0.026
years of marriage²	0.0080***	0.001
constant	-14.1710***	1.107
N. obs.	33,200	
AIC	4591.598	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

6.1.2 EDUCATION

Four levels of education achievements are codified within the model: 1) Elementary; 2) Lower secondary (compulsory); 3) Upper secondary; 4) Tertiary. Because the attainment of lower secondary education is mandatory in Italy for the underage, the "Elementary" achievement is not attributed in the simulation period, so that by 2059 that category is nearly extinguished.

The probability of attaining tertiary education is the first to be processed, and it is modelled as a function of one's parents' education achievement[101]. For that purpose, 7 dummies are generated and employed as explicative variables in a logit model.

101 The stochastic attribution of education achievements within the model is applied to individuals born during the simulation period or aged 16 or younger when the simulation starts. For older individuals that are still in school when the simulation begins, probabilities to complete their secondary or tertiary studies are attributed according to data from Istat and the Italian Ministry of Education, Universities and Research (ANVUR, 2013).

TABLE 6.2: DUMMY VARIABLES FOR PARENTAL EDUCATION

Parental education achievement (categorical variable)	***Level of education***
pareduach=1	Both parents with at most a lower secondary degree
pareduach=2	At least one parent with an upper-secondary degree
pareduach=3	One parent with a tertiary degree, the other with any lower level degree
pareduach=4	Both parents with a tertiary degree
pareduach=5	Single parent with at most a lower secondary degree
pareduach=6	Single parent with an upper secondary degree
pareduach=7	Single parent with a tertiary degree

TABLE 6.3: PROBABILITY TO ACHIEVE TERTIARY EDUCATION

	***Male* (1)**		***Female* (2)**	
	b	*se*	*b*	*se*
pareduach=2	1.1118***	0.112	1.1107***	0.108
pareduach=3	1.9920***	0.157	1.9129***	0.178
pareduach=4	2.7233***	0.260	2.6963***	0.310
pareduach=5	-0.3675**	0.161	-0.2995**	0.140
pareduach=6	1.0800***	0.159	0.7320***	0.169
pareduach=7	2.3939***	0.256	1.4866***	0.279
constant	-2.3354***	0.151	-1.4344***	0.145
N. obs.	4,072		2,086	
AIC	3456.679		3218.225	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.
Pareduach=1 is the reference category.

Source: elaborations on AD-SILC data

The amount of individuals attaining tertiary education is aligned to probabilities extracted by Istat data. Such amount evolves in the simulation period by means of a logarithmic scale. As a consequence, the share of individuals aged between 30 and 34 holding a university degree raises from 25.2% in 2012 to 28.7% in 2059, exceeding the Europe 2020 goal of 27% by 2040. The share of women holding tertiary education is 10 percentage points higher than that of men over the historical sample. By assumption, this feature is kept constant throughout the whole simulation period.

If individuals are assigned a tertiary education achievement, a random process determines at what age they exit the education module and access the labour market. If individuals are not assigned a tertiary education achievement, a random process assigns them either a lower or upper secondary degree, according to probabilities that evolve in the simulation period by means of a logarithmic scale.

The transition from education to work is irreversible, and student-workers are not simulated in T-DYMM at this time.

6.1.3 MARRIAGE MARKET

In accordance with the procedure proposed by LIAM2 developers, the coupling process is articulated in three steps:

1. Individuals (male and female) to be coupled are selected amongst all singles aged between 18 and 65 via a logit regression;
2. The selected females are ordered by the difference between their own age and the average age of their male counterparts (the oldest females get the highest scores, so that they are sure to be selected first);
3. The selected males are ordered by means of a score, estimated with a logit regression.

An *ad hoc* alignment process is implemented with the scope of maintaining an equal share of coupled adults in the simulation period. Since no difference could be observed in the AD-SILC dataset between married and cohabiting couples, those processes are not dealt with separately[102]. Instead, a portion of newly formed couples is randomly assigned to marriage every year. An alignment procedure has been implemented that, with the use of a logarithmic function, predicts the evolution of the quota of marriages on overall unions, thus depicting the decreasing trend in marriages observed over the past 20 years (Istat)[103].

For the purpose of selecting individuals to be coupled, the parameters in Table 6.4 are imported in the model.

TABLE 6.4: PROBABILITY OF INDIVIDUALS TO BE COUPLED

	***Male* (1)**		***Female* (2)**	
	b	*se*	*b*	*se*
age25-29	1.8071***	0.279	1.4614***	0.187
age30-34	2.5910***	0.271	1.6437***	0.194
age35-39	2.4427***	0.280	1.5318***	0.206
age40-44	2.1113***	0.299	1.1189***	0.231
age_over44	1.9391***	0.275	0.4934**	0.198
in work (lag)	0.3561***	0.107		
constant	-5.2589***	0.273	-4.4473***	0.183
N. obs.	15,266		14,309	
AIC	3777.6		3472.9	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Not surprisingly, it is more unlikely for women to start a family than for men when aged over 44. Having been employed in the previous period only proved to be significant for males when choosing to form a family.

Once individuals to be coupled are selected, the matching process in force in T-DYMM 2.0 can operate: the selected females are ordered by the difference between their own age and the average age of their male counterparts, while the selected males are ordered by means of a score, estimated with the logit regression whose parameters are outlined in Table 6.5. Furthermore, the difference in education achievement is also considered, following the literature on educational assortative mating[104].

102 It is however of some relevance to treat married couples separately. For what concerns labor choices, it is conceivable that a legal commitment impacts such decisions, and we have verified that it does in our labor market estimations (see further). For what concerns pensions, married couples are the only ones who can access survivor's pensions. It is also relevant to keep cohabiting individuals into consideration, mainly for what concerns the "giving birth" process.

103 However, the quota of married couples on overall couples decreases very slightly in the simulation period, from 92.93% in 2011 to 90.26% in 2059.

104 See among other studies Kalmijn (1994), Pencavel (1998), Schwartz and Mare (2005).

TABLE 6.5: MATCHING PROCESS

	Male	
	b	*se*
age difference	0.0908***	0.021
age difference²	-0.0167***	0.002
age difference³	0.0002***	0.000
partner's age	-0.3611***	0.032
partner's age²	0.0074***	0.001
partner's age³	-0.0000***	0.000
educ. difference =0*	1.8535***	0.362
educ. difference=1*	1.5435***	0.364
N. obs.	21,025	
AIC	1432.8	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Not unexpectedly, the signs of the coefficients for the variables concerning the age differential and partner's age imply that men tend to form families with younger women (within the simulation period, this happens over 70% of the times).

6.1.4 DIVORCE

Within the model, a similar "divorce" process is implemented for both typologies of cohabiting couples (married and not married). The estimation, however, could only be carried out considering underlying data on actual divorces.

In order to simulate divorces, the female side of the couple has been assumed as the "active agent". If the woman is assigned to be divorced – by means of a logit model –, the household link is broken and her partner is sequentially assigned to the new civil status as well[105].

TABLE 6.6: PROBABILITY OF GETTING DIVORCED

	Female	
	B	*se*
age40-44	1.3130***	0.280
age45-49	1.4082***	0.330
age50-54	1.8742***	0.370
age_over54	1.0751**	0.428
years of marriage	-0.3041***	0.026
years of marriage²	0.0037***	0.001
has children aged 0-7	-1.1182***	0.300
constant	-2.7610***	0.286
N. obs.	21,053	
AIC	969.7	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

105 Our choice is purely conventional, nearly identical results are obtained if the estimation is carried out on men.

Females between the age of 50 and 54 seem more susceptible to the phenomenon of divorce, while marriage duration is inversely related to divorce, in its linear form. Females with children under 7 years of age are less likely to divorce.

6.2 ESTIMATIONS IN THE LABOUR MARKET MODULE

A crucial step in building the labour market module is the estimation of conditional probabilities of transition across alternative employment statuses[106]. Modelling the labour force statuses among individuals and in time is of a prime importance since it reflects the labour market features (i.e. employment mobility, stability, out-of-employment spell, segmentation, etc.) and determine individual conditions relevant for the definition of future pensions. Moreover, predicting future employment states is necessary to predicting future earnings. Simulation processes of both labour force and earnings have as input variables observable individual socio-economic and background characteristics. Different approaches have been found to be used in modelling labour force status: *1*) the choice of nested bivariate logit (or probit) models, where the probabilities of the employment states are defined in a sequential manner (e.g. DYNACAN in Canada, HARDING and DYNAMOD in Australia), *2*) the choice of multinomial logit (or probit) models where the probabilities of the employment states are defined in one step (e.g. CORSIM in the US, SAGE in the UK), *3*) the choice of time duration in a given employment state rather than explicitly use labour force transitions (e.g. PENSIM in the UK)[107]. Analogously to the first approach we modelled the employment states in a multi stage process using logit functions separately for men and women.

First, as explained in Section 3, we estimate the conditional probability to be employed, thus determining who is actually employed, and then assign as not employed the rest of the working age population. Once the individual has been included in the labour market as employed, it is necessary to determine whether he/she is an employee, or independent worker. Differently from the previous version of T-DYMM, here the first work choice is ascribed to the "atypical workers'" status (e.g. those workers registered in *Gestione Separata* of INPS)[108]. The rationale behind this choice is that the atypical workers, in particular the parasubordinate workers, represent a particular category of the Italian labour market and we need to define a share that suitably reflects the employment composition as it is in the labour market. Starting with the estimation of the probability of ending up in the "atypical workers'" state allows to set up its share and thus to prevent the risk of extremely reducing it in the upcoming years. If the worker is not assigned to this work state the propensity of being an employee is determined. This is the prevalent category and the probability that a worker becomes an employee is far greater than those of the other two states, therefore there is no need to make further adjustments. If the worker does not go into this status either, then he/she is assigned to the self-employed state which represents a residual category. The need of decomposing the employment in these three states is due to the fact that they implicate different career paths as well as different pension schemes and contributions.

Second, once an individual is assigned the status of employee, the subsequent choices concern: a) the type of economic activity (private or public); b) duration of contract (permanent or temporary); and c) working time arrangements (full-time or part-time). These job characteristics exert an impact both on the probability of transition across employment states, and on the level of earnings.

Finally, once the working condition has been determined, the following step is the simulation of months worked and a yearly labour income, gross of personal income taxation. Such a measure of earnings represents the base on which contribution rates have to be applied, in order to calculate the contribution to future pension benefits.

106 A detailed description of the labour market module is presented in section 3.2.2.

107 See also O'Donoghue (2001) and Higgins (2011).

108 Specifically, this work category includes parasubordinate workers and self-employed who do not contribute in any association's fund. It is worth noting that, differently from what is generally meant by "atypical workers" in the literature, here, this work category does not comprise temporary workers.

6.2.1 TRANSITIONS AMONG EMPLOYMENT STATUSES

This section presents the estimation results of the regressions of the employment transitions, whereas the estimated parameters are used in the T-DYMM model to simulate the labour market conditions. The entire AD-SILC dataset and not only a single vintage is used for the estimation (e.g. all IT-SILC waves merged with the INPS archives). As long as INPS considers only statuses of individuals paying contributions, it is not possible infer the reason why individuals are recorded in some years and not present in others, i.e. we cannot ascertain whether their absence from administrative records is due to exit from the labour force for unemployment without being entitled to benefits, entry in the shadow economy, discouragement, and so on. Therefore, those individuals that are not assigned to any employment status are de facto considered as inactive[109].

As in most MSMs, it is assumed that the characteristics of the employment are 'decided' by the individual and therefore do not depend on demand-side factors. Also, similarly to the models DYNAMOD, DYNACAN, CORSIM, SAGE and MOSART, beyond the standard explanatory variables (e.g. age, educational attainment, marital status, children) we also include lagged labour force state as well as the respective duration and its quadratic form whenever possible. The inclusion of lagged states can be justified by the fact that being in a particular current employment condition may influence individual preferences and constraints for being in a particular future state[110].

The sample size amounts to 1,105,456 observations for 82,137 individuals, followed over the time span 1998-2011. We focus on individuals aged 16-69, whereas almost 53 percent are men and the rest 47 percent women. Behavioural equations are estimated using random effects logistic models[111] separately for men and women, in order to account for individual unobserved heterogeneity.

a) Employment

The first event simulated in the labour market module is employment. This is modelled separately for males and females, and the reference group is all individuals aged 16-69 who were employed or not in education nor retired at time *t-1*[112]. The resulting employment rates are then aligned with gender and age-group specific of the AWG 2015 Ageing Report projections (with the first years of simulation adjusted using the actual figures from Eurostat). This implies a two-step procedure; in the first step, individuals are ranked according to decreasing propensity to the event (here, probability of being in formal employment), depending on their characteristics; once this ranking is built, by using the regressions reported below, the number of individuals simulated as actually being in work is established so that the resulting employment rates are consistent with the alignment data; for each gender/age group subgroup, *n* individuals will be imputed an in-work status, and these will be persons in the top *n* positions in the ranking.

Table 6.7 reports the estimated parameters for the regression concerning the probability of being employed, both for men and women. Regardless of the gender, the higher the education level the higher the probability of being employed. There are more chances to be employed with the increase of age and the overall work experience, albeit at decreasing rates. Similarly, the higher the number of years the individual has been employed without spells, the higher the probability of being in work also at time *t*. Being employed in *t-1* increases the likelihood of being again employed the period after whereas employees and self-employed (at time *t-1*) are more advantaged than atypical workers.

109 As far as our purpose is to study the contribution accumulation of different working career patterns and the redistributive effects of the Italian pension system, and given that an individual working in the shadow economy by definition does not pay any contribution, it is not of a great concern that this individual is assigned as inactive rather than as a worker with undeclared job relationship. The drawbacks come up if one wants to study in-depth the labour market dynamics.

110 In that case, literature consider the incorporation of state dependence among individuals (Hsiao, 2003). On the other hand, lagged employment states can be used as proxy for unobserved individual heterogeneity, although the inclusion of multiple lags would be recommended in order to get a superior proxy. An alternative way to account for unobserved individual heterogeneity is the use of random or fixed effects models.

111 In the previous project two procedures have been employed: random effects logistic models, whenever the sample size was large enough, and simple logistic regressions in all the other cases. In particular, given the relatively small sample size of the old version of AD-SILC the first type of regressions has been used only to estimate the probabilities of being in work having been in work in the previous year, and the probability of being an employee having been an employee at time t-1 as well. The new AD-SILC is almost four times larger than its old version (that used in the previous project) which allows to apply the same regression technique for all employment states.

112 We recall that education, employment and retirement are three mutually exclusive statuses in the model.

Also, factors related to family background appear to be relevant for women; being married/cohabiting and the number of children up to 11 years of age reduce the chances of a woman to maintain her employment. Yet, having a spouse in work rises her likelihood to work, too.

TABLE 6.7: PROBABILITY OF BEING IN WORK

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	0.8031***	0.028	1.0231***	0.026
upper-sec. degree	0.3617***	0.018	0.5917***	0.018
age	0.0462***	0.005	0.0780***	0.005
age²	-0.0016***	0.000	-0.0019***	0.000
work experience	0.0930***	0.003	0.0684***	0.003
work experience²	-0.0014***	0.000	-0.0013***	0.000
duration in empl. (lag)	0.0973***	0.002	0.0864***	0.002
duration in empl.²	-0.0005***	0.000	0.0003***	0.000
employee (lag)	2.4125***	0.019	2.9202***	0.020
self-employed (lag)	3.1312***	0.032	3.6938***	0.037
parasubordinate (lag)	2.2258***	0.043	2.2280***	0.042
partner in work (lag)	0.2945***	0.020	0.1668***	0.018
married	0.2391***	0.019	-0.1914***	0.020
children aged 0-3			-0.5402***	0.019
children aged 4-11			-0.1783***	0.014
constant	-0.9616***	0.086	-2.0118***	0.095
N. obs.	473,828		400,014	
AIC	204367.2		203297.7	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

b) Work status among individuals in employment

Once established whether an individual is employed, the subsequent choice that has to be modelled is between the alternative work conditions: atypical workers, employees or self-employed. We first model whether a worker is an atypical worker or not, as previously mentioned. As for the in-work status, the regressions are carried out separately for men and women. Differently from the previous version of the dynamic microsimulation model, here we do not disaggregate the sample of interest in subgroups by employment status at time *t-1* (e.g. in work as an employee, self-employed, atypical worker or out of work) but use such statuses as explanatory variables. Therefore, only two regressions are made, as shown in Table 6.8.

TABLE 6.8: PROBABILITY OF BEING AN ATYPICAL WORKER

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	1.4255***	0.054	1.5226***	0.062
upper-sec. degree	0.8411***	0.043	0.7657***	0.052
age	0.0967***	0.011	0.0705***	0.014
age²	-0.0008***	0.000	-0.0007***	0.000
employee (lag)	-2.0598***	0.067	-2.0331***	0.068
self-employed (lag)	-1.3664***	0.077	-1.4964***	0.114
atypical worker (lag)	2.8063***	0.076	2.4278***	0.064
years as employee (lag)	-0.1617***	0.013	-0.2207***	0.017
years as employee2	0.0023***	0.001	0.0034***	0.001
years as atypical worker (lag)	0.3222***	0.037	0.1654***	0.019
years as atypical worker.²	-0.0116***	0.003		
years as self-empl. (lag)	-0.1624***	0.015	-0.2724***	0.028
years as self-empl.²	0.0031***	0.001	0.0058***	0.001
married	-0.2389***	0.039	-0.1801***	0.051
partner in work			-0.0995*	0.047
children aged 4-11			-0.1361***	0.039
constant	-5.6818***	0.221	-4.9657***	0.263
N. obs.	396,963		288,113	
AIC	42217.6		35442.5	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Similarly to the case of employment, a higher education level and age increase the likelihood of being a parasubordinate worker, both for men and women. This probability is unsurprisingly higher if the worker was in the same work state the previous year and with the increase of duration of this state. The opposite results are obtained for the other categories of work and duration. Having a partner reduces the probability of being atypical worker, whereas having spouse in work and children up to 11 years of age further reduce this probability for women.

Table 6.9, instead, shows the likelihood of being an employee at time *t*. The reference sample includes those workers established in the first step (Table 6.7) and not assigned to the category of parasubordinate workers (Table 6.8). Again, two regressions – for men and women – are carried out.

TABLE 6.9: PROBABILITY OF BEING AN EMPLOYEE

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	-0.2769***	0.042	-0.1875***	0.044
upper-sec. degree	-0.2721***	0.029		
age	-0.1207***	0.009	-0.0657***	0.012
age²	0.0014***	0.000	0.0007***	0.000
years as employee (lag)	0.0870***	0.003	0.0869***	0.005
years as self-empl. (lag)	-0.1266***	0.005	-0.1311***	0.007
employee (lag)	2.0654***	0.037	2.3371***	0.051
self-employed (lag)	-4.6065***	0.044	-4.9355***	0.058
atypical worker(lag)	-1.3984***	0.061	-0.6446***	0.077
married	0.1008**	0.032	-0.1686***	0.038
partner in work	-0.1219***	0.031		
children aged 0-3			-0.1917***	0.043
constant	4.3640***	0.164	3.7542***	0.224
N. obs.	383,344		278,476	
AIC	65595.9		38936.0	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Interestingly, the higher the education level the lower the probability of being an employee, regardless of the gender. This result might seem counterintuitive at first glance. A first explanation is the presence of professionals – who have the highest degrees of educational achievement – amongst self-employed workers, the reference group of the regression. More in general, educated individuals are often found to have flexible careers: there is a rich evidence that highly-educated individuals in Italy are increasingly entering the labour market with fragmented, precarious forms of employment[113], which tend to stabilise later on[114]. Similarly, age negatively affects the probability of being an employee but this effect is counterbalanced by the duration in the state of employee. Moreover, the higher the years spent as self-employed the lower the probability to become an employee. Indeed, workers who were atypical or self-employed at time *t-1* are less likely to be employees at time *t*. Being married/cohabiting increases the likelihood of being an employee for men, but reduces it for women. Finally, as long as female partners are in work, men are less likely to be employees probably because, in general, more challenging jobs are more present as atypical work relationships and without including any forms of subordination.

Once defined parasubordinate workers and employees, the remaining workers are assigned to the self-employed category, as previously mentioned.

113 This is also confirmed from the results reported in Table 6.8.

114 See, among others, Barbieri and Scherer (2009); Lucidi and Raitano (2009); Barbieri and Sestito (2008).

c) Job characteristics for employees

All workers have been assigned to one of the three above-mentioned employment states, while the remaining individuals of the sample can be: *i*) in education if still studying or below 16 years of age; ii) retired if they have a pension allowance; or *iii*) other inactive, namely not belonging to either of the alternative states.

For those assigned to the status of employees, some main features of the job have to be also determined: type of economic sector (private or public), duration of contract (permanent or temporary), working time arrangement (full-time or part-time). Albeit such features are not relevant for the requirements to be entitled to a pension, they are of some importance as far as the number of months worked per year and the level of earnings are concerned.

For instance, Table 6.10 shows the probability of being a public employee given some individual characteristics[115]. Holding tertiary education as well as being somehow "aged" increase the probability of working in the public sector. Work experience negatively affects the propensity of being a public employee. However, if the worker was a public employee at time *t-1*, then he/she has more chances to be it again at time *t*, and the probability increases with the duration of years spent in the public sector, for both men and women. Also, having a partner working in the public sector is positively associated to the likelihood of being a public employee. In the case of women, having children up to 3 years of age is also positively correlated to the state of a public employee[116].

TABLE 6.10: PROBABILITY OF BEING A PUBLIC EMPLOYEE

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	3.2464***	0.105	4.9152***	0.114
upper-sec. degree	1.4042***	0.084	2.3648***	0.096
age	0.6056***	0.029	0.6793***	0.030
age²	-0.0050***	0.000	-0.0064***	0.000
work experience	-0.2668***	0.006	-0.2325***	0.013
work experience²			0.0014**	0.000
years in public (lag)	1.7026***	0.059	1.7034***	0.057
years in public²	-0.0318***	0.002	-0.0334***	0.002
public employee (lag)	3.9236***	0.180	3.3542***	0.139
married	0.2984***	0.077	0.1559*	0.069
partner in public (lag)	1.4800***	0.115	1.9027***	0.118
children aged 0-3			0.1831**	0.065
constant	-21.7877***	0.571	-22.2058***	0.581
N. obs.	291,189		231,490	
AIC	28292.8		32583.6	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

115 It has to be remarked that by law the minimum age of entry in the public administration with a permanent contract is 18, therefore the sample of reference comprises employees aged 18-69.

116 This result might seem counterintuitive, but it has to be borne in mind that it represents a correlation rather than a causal effect; indeed, it is more likely to have children if being a public employee as far as, at least in Italy, working in the public administration offers more stability and social security for women than the private sector and other types of job normally do.

Table 6.11 shows the results of the regressions relative to the probability of having an open-ended rather than a temporary contract. Employees who already had a permanent contract at time *t-1* are far more likely to maintain it. Generally, holding a high level of education positively affects the probability of being a permanent employee, although having tertiary degree is negatively associated to this work condition for men. Surprisingly, age and overall work experience are negatively associated to the probability of having an open-ended contract; yet, the longer the duration as a permanent employee the higher the chance to maintain this condition in the coming year, as well. The negative effects of age and experience are probably influenced by the inclusion of duration of permanent contract among the explanatory variables which basically counterweights the other two effects. Being married is positively associated to permanent contract for men but negatively for women, whereas having a partner with a permanent contract at time *t-1* positively affects the probability of being a permanent employee for both men and women. Women with very young children are less likely to have a permanent contract.

TABLE 6.11: PROBABILITY OF BEING A PERMANENT EMPLOYEE

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	-0.1901***	0.042	0.2394***	0.041
upper-sec. degree	0.1553***	0.029	0.3483***	0.033
Age	-0.0221***	0.002		
age²			-0.0005***	0.000
work experience	-0.0266***	0.005	0.0235***	0.002
work experience²	0.0011***	0.000		
years as perm. (lag)	0.2559***	0.011	0.2270***	0.006
years as perm.²	-0.0031***	0.001		
perm. Employee (lag)	2.4788***	0.041	3.1175***	0.038
Married	0.1368***	0.033	-0.1116***	0.034
partner as perm (lag)	0.2971***	0.038	0.1322***	0.034
children aged 0-3			-0.2669***	0.036
Constant	0.5981***	0.068	-0.5299***	0.047
N. obs.	142,189		118,595	
AIC	59520.0		54687.5	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

The last condition that has to be established is whether the employee works full- or part-time. For this case, the regression coefficients are reported in Table 6.12. The higher the education level the lower the probability of being a part-time worker. Age is positively associated to part-time working arrangements, while work experience is negatively associated. Having been a part-time worker at time *t-1* and duration of the part-time condition augment the probability to have the same working arrangement at time *t*, as well. Public employees are less likely to work part-time, whereas having a permanent contract affects it positively for men but negatively for women. Being married is negatively associated to part-time arrangements for men but positively for women. Also, women with partner in employment and/or with young children are more likely to work as part-time employees.

TABLE 6.12: PROBABILITY OF BEING A PART-TIME EMPLOYEE

	***Males* (1)**		***Females* (2)**	
	b	*Se*	*b*	*se*
tertiary degree	-0.6915***	0.089	-0.7934***	0.058
upper-sec. degree	-0.2719***	0.053	-0.2033***	0.040
age	0.0659***	0.004	0.1446***	0.014
age²			-0.0017***	0.000
work experience	-0.2419***	0.009	-0.1647***	0.007
work experience²	0.0035***	0.000	0.0026***	0.000
years as part-time (lag)	0.6135***	0.053	0.5085***	0.022
years as part-time²	-0.0170***	0.004	-0.0151***	0.001
part-time employee (lag)	3.4448***	0.107	3.2583***	0.057
public	-1.3312***	0.105	-1.8486***	0.058
permanent contract	-0.6323***	0.053	0.3552***	0.037
married	-0.5943***	0.059	0.3679***	0.045
partner in work			0.1133**	0.042
children aged 0-3			0.3281***	0.038
constant	-4.2938***	0.134	-4.6399***	0.260
N. obs.	142,189		118,595	
AIC	26557.3		56335.9	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

6.2.2 ESTIMATING GROSS EARNINGS AND MONTHS WORKED

Yearly individual labour income gross of personal income taxation is the product of two components: monthly gross income and months worked.

a) Monthly earnings

Most MSMs use a series of regression equations to project future individual earnings based on explanatory variables such as age, sex, education, marital status and so on. The modelling of earnings process typically is inspired on the seminal Mincer wage equation, yet, further extending it by explicitly incorporating the idiosyncratic component of earnings. These regression models often use complex error structures decomposing the error term into two components: one accounting for individual heterogeneity and the other for variability over time.[117] As Harris and Sabelhaus (2003) specified, "Essentially, the significant unexplained variability in earnings is decomposed into "permanent" and "transitory" deviations from predicted values that evolve over time. In the simulation model, the two components are "shocked" in each year, generating the sort of longitudinal and cross-sectional variability observed in historical data". In line with the majority of the most influential MSMs, a similar earnings structure is used in our estimates in order to project longitudinal individual earnings with T-DYMM 2.0.

In particular, the availability of panel microdata allows us to estimate earnings, conditional on a series of time-variant and time-invariant individual characteristics, and modelling the residual term by decomposing it into a

117 So far, empirical studies have shown that observed characteristics explain a relative small portion of earnings variability (Swan, 1997), whereas unobserved differences can arise due to permanent differences such as ability and motivation and due to temporary variation such as illness, overtime and bonus.

permanent and temporary component. Furthermore, we assume some degree of autocorrelation in the error component, allowing for more precise predictions about future earnings[118]. Earnings profiles can be analytically represented by the following equations:

$$y_{it} = x_{it}\beta + u_i + v_{it}$$

$$v_{it} = \rho v_{i,t-1} + \varepsilon_{it}$$

y_{it} is the natural logarithm of monthly gross earnings of the *i*-th individual at time *t*; the vector of observable variables, x_{it} , includes a constant, a polynomial in age, work experience, educational attainment, job and household characteristics, and time dummies; the last two members of the right-hand side stand for the permanent and temporary error term respectively. The first error term, u_i, reflects persistent differences between individuals and does not vary over time, while is the stochastic term which is also individual specific and varies over time. As specified and presented in the second equation, the transitory term follows AR(1) process, where ρ is the autoregressive parameter capturing the autocorrelation with the shock from the previous period and ε_{it} is an error term normally and identically distributed with zero mean and constant variance, $\varepsilon \sim N(0,\sigma_{\varepsilon}^2)$. Similarly to Borella (2004) and Borella and Coda-Moscarola (2009), estimations of earnings are carried out through a random effects panel data estimator[119] on the retrospective AD-SILC panel. To this aim, it is assumed that individual random effects u_i are i.i.d. (*e.g.* $u \sim N(0,\sigma_u^2)$) and independent from the regressors. We are aware that random effects model has to be treated with caution as long as the exogeneity hypothesis might not always hold and that it would be preferable to use a fixed effect estimator. However, the fixed effects estimator does not allow to consistently estimate the variance of the fixed effect and rules out out-of-sample simulations (Wolf, 2001). Moreover, the fixed effects models leave out the estimation of time-invariant characteristics, such as education[120].

In the simulation program we use predicted values of the random effects and the transitory error term for in sample individuals, while for new-born or out-of-sample individuals we impute these values. The first term is drawn from a normal distribution with the estimated standard deviation.at the beginning of the active life, while the second component is formed from the shock at time t-1multiplied by the autoregressive coefficient plus an error term drawn from a normal distribution with estimated standard deviation. Since each individual can potentially be employed in more than one category over the life cycle, the fore-mentioned procedure of imputation is carried out for each work category .

Estimates are carried out, separately for the three main typologies of workers as well as for men and women, using an AD-SILC sample collectively composed of 671,662 observations for 50,819 workers aged 20-60, once again followed over the time span 1998-2011. In the retrospective panel the work typology of a formally

118 The simplest permanent-transitory model decomposes the residual of earnings into a permanent component which remains constant over time and a transitory component which has no memory and is i.i.d. More complex structure of the error components relax these assumptions allowing the permanent component to change over time and the transitory component to follow AR, MA or ARMA stochastic process of first, second or higher order. For further details see Lillard and Willis (1978), MaCurdy (1982), Moffitt and Gottschalk (2002), Baker and Solon (2003), Dickens (2000).

119 With the previous version of T-DYMM another method (fixed effects model) of estimating individual earnings was adopted. In particular, to account for the role of time invariant observed characteristics, which is prevented when using a Fixed Effect (FE) estimate, T-DYMM 1.0 relied on a three stage procedure Fixed Effects Vector Decomposition (FE-VD) as in Plümper and Troeger (2007) for the estimation of time invariant variables. As explained by the authors, the FE-VD technique involves the following three steps: in the first step, the procedure estimates the unit FE by running a FE estimate of the baseline model. In the second step, the procedure splits the unit effects into an explained and an unexplained component by regressing the unit effects of the time-invariant […] explanatory variables of the original model. Finally, the third stage performs a pooled-OLS estimation of the baseline model by including all explanatory time-variant variables, the time-invariant variables, […] and the unexplained part of the FE vector.

However, the technique previously used prevents from any variability in earnings due to some type of shocks which is unlikely to be realistic. Indeed, in T-DYMM 1.0 earnings evolve only deterministically through the observed characteristics included in the regression, while the residual term is constant over time. As long as we need to recreate the dynamic process of earnings we opted for modelling earnings by including both deterministic (explained part of the model through the regressors) and stochastic components (unexplained part of the model represented by the residuals). Specifically, we decompose the error term into a permanent and transitory, where the last one varies stochastically.

120 For further discussion about pros and cons of random and fixed effects models see Emmerson, Reed and Shephard (2004), Higgins (2011), Knoef *et al.* (2009)

employed individual was established mainly according to the prevalence of earnings from one of the three work categories. It should be noted, however, that once a worker is assigned to a category in a given year, the overall income he/she earned over that period is attributed to that category. In other words, even if an individual earned a part of his/her labour income from a different typology of work, when estimating earnings equations the sum of incomes from all typologies is used as the dependent variable. Since the model excludes the possibility of a worker having more than one job or type of job over a year, this was the only way to avoid an underestimation of yearly labour incomes.

As already mentioned, the dependent variable is the logarithm of monthly gross earnings[121]; these are clearly an average of annual earnings, computed as the ratio between overall labour income earned over the year and the number of months worked over the period. It should be noticed that this measure of time spent in employment is not based on the actual duration of a contract but rather on the number of weeks of contribution to pension funds, as the latter is the relevant information as far as the accumulation of pension contributions is concerned.

Table 6.13 reports the estimated parameters of earnings equation for male and female employees. The higher the education level the higher the earnings, where the return of tertiary degree is more than twice larger than that of employees having a diploma. Age and work experience positively affect earnings although both at decreasing rates; also, the more the years spent as an employee the greater the monthly wage. Employment characteristics, such as contract type, activity sector and time arrangements play a significant role in determining earnings: currently having a permanent contract and working in the public sector decisively contribute for higher wages, while being part-time worker penalises his/her monthly pay. Not surprisingly, the current employment status is much more relevant for earnings than that of the previous year, although the last still exhibits some influence on earnings. Accordingly, having been employed the previous year adds up to higher earnings for men[122]. Married men are likely to earn more, especially if their partner is employed too, than their unmarried colleagues, while the opposite is true for women. Also, women are likely to earn less when with young children.

121 In the simulation process, real monthly earnings increase with labour productivity over time, through an alignment with macroeconomic AWG 2015 projections.

122 The coefficient of the dummy indicating if the worker was employed in the previous year appeared insignificant for women, thus it was excluded from the regression.

TABLE 6.13: EARNINGS EQUATION – EMPLOYEES (DEPENDENT VARIABLE LOG MONTHLY GROSS WAGES)

	Males (1)			Females (2)		
	b		se	b		se
tertiary degree	0.5450	***	0.006	0.4411	***	0.007
upper-sec. degree	0.2088	***	0.004	0.2027	***	0.005
age	0.0893	***	0.003	0.0381	***	0.005
age²	-0.0022	***	0.000	-0.0011	***	0.000
age³	0.0000	***	0.000	0.0000	***	0.000
work experience	0.0227	***	0.001	0.0241	***	0.001
work experience²	-0.0003	***	0.000	-0.0004	***	0.000
years as employee (lag)	0.0082	***	0.000	0.0113	***	0.000
permanent contract				0.0508	***	0.003
permanent contract (lag)	0.0137	***	0.001	0.0371	***	0.003
part-time	-0.3741	***	0.003	-0.3225	***	0.003
part-time (lag)	-0.0391	***	0.003	-0.0645	***	0.003
public	0.1118	***	0.004	0.1057	***	0.007
public (lag)	0.0109	***	0.004	0.0977	***	0.006
in work (lag)	0.0314	***	0.002			
married	0.0098	***	0.002	-0.0281	***	0.004
partner in work	0.0055	***	0.002			
children aged 0-3				-0.1881	***	0.003
constant	5.9656	***	0.038	6.4820	***	0.066
σ_u	0.2812			0.2974		
σ_v	0.1719			0.3242		
ρ	0.4638			0.2878		
R^2-within	0.1955			0.1220		
R^2-between	0.4704			0.4902		
R^2-overall	0.3998			0.3837		
N.obs.	272,072			217,742		

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Table 6.14 shows the results of the estimates of monthly earnings of self-employed workers. Education level positively affects earnings. Its effect is much stronger and much more differentiated in the education levels for men than for women. Interestingly, age exhibits a negative (and nonlinear) effect for both genders; this suggests some collinearity with work experience and duration in the self-employment state, which are likely to increase earnings at decreasing rates. Being married is associated to higher wages: more intensively for men and less for women. Finally, mothers with young children tend to earn less than women without or with grown-up children.

TABLE 6.14: EARNINGS EQUATION – SELF-EMPLOYED (DEPENDENT VARIABLE LOG MONTHLY GROSS WAGES)

	Males (1)		Females (2)	
	b	*se*	*b*	*se*
tertiary degree	0.3625 ***	0.014	0.0699 ***	0.016
upper-sec. degree	0.1309 ***	0.009	0.0544 ***	0.011
age	-0.0249 ***	0.010	-0.1230 **	0.050
age²	0.0005 **	0.000	0.0051 ***	0.002
age³	0.0000 *	0.000	-0.0001 ***	0.000
age⁴			0.0000 ***	0.000
work experience	0.0268 ***	0.001	0.0168 ***	0.001
work experience²	-0.0004 ***	0.000	-0.0003 ***	0.000
years as self-empl. (lag)	0.0053 ***	0.001	0.0011 *	0.001
years as self-empl.²	-0.0001 **	0.000		
married	0.0302 ***	0.006	0.0179 **	0.008
children aged 0-3			-0.0131 ***	0.005
constant	7.4673 ***	0.127	8.1689	0.475
σ_u	0.3646		0.3110	
σ_v	0.2443		0.2078	
ρ	0.4603		0.4405	
R^2-within	0.0330		0.0159	
R^2-between	0.0964		0.0560	
R^2-overall	0.0806		0.0370	
N.obs.	81,695		41,179	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

The last two earnings regressions concern atypical workers, which are presented in Table 6.15. Again, the higher the education level the higher the earnings, especially for men. Age and overall work experience positively affect earnings regardless the gender and at decreasing rates for men. Similar positive effect, albeit smaller, is found for the years spent as atypical worker. Married men and women are likely to earn more, whereas it is more noticeable for the first. For women, working the whole year implies better earnings.

TABLE 6.15: EARNINGS EQUATION – ATYPICAL WORKERS (DEPENDENT VARIABLE LOG MONTHLY GROSS WAGES)

	Males (1)		Females (2)	
	b	*se*	*b*	*se*
tertiary degree	0.1631 ***	0.031	0.0331 **	0.014
upper-sec. degree	0.1283 ***	0.027		
age	0.0310 ***	0.007	0.0030 ***	0.001
age^2	-0.0004 ***	0.000		
work experience	0.0424 ***	0.003	0.0083 ***	0.001
work experience^2	-0.0005 ***	0.000		
years as atypical (lag)	0.0161 ***	0.002	0.0164 ***	0.002
in work all year			0.2724 ***	0.008
married	0.0587 ***	0.017	0.0268 **	0.013
constant	6.7067 ***	0.140	7.1458 ***	0.034
σ_u	0.4350		0.2480	
σ_v	0.2782		0.2370	
ρ	0.4851		0.4024	
R^2-*within*	0.0329		0.1056	
R^2-*between*	0.2882		0.4024	
R^2-*overall*	0.2336		0.3879	
N.obs.	11,960		8,114	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

b) Months worked

Once a monthly wage has been assigned to a worker, in order to compute the amount of yearly earnings it is necessary to establish whether the individual worked for the whole year and, if not, for how many months.

We first assume that self-employed and employees with a permanent contract work all year so automatically assigning them a whole year of work (e.g. 12 months). For the other workers (parasubordinate and temporary employees) a random effect logistic regression establishes the probability of working the whole year, separately for men and women. As shown in Table 6.16, education level positively affects the likelihood of working all year; age is negatively associated while work experience is positively associated to the state 'work all year'. In addition, those employed in the public administration are more likely to work all year, especially men. Similarly, atypical workers are more likely to work the whole year than workers holding a temporary contract, again especially for men. Also, having been employed at time *t-1* and having been in work for twelve months the previous year positively affect the probability of working the whole year also at time *t*. Married women are less likely to work all year. For them the probability further reduces if they are mothers of young children. On the other hand, having a partner in work implies a higher probability to work all year for both men and women.

TABLE 6.16: PROBABILITY OF BEING IN WORK ALL YEAR

	***Males* (1)**		***Females* (2)**	
	b	*se*	*b*	*se*
tertiary degree	1.7137***	0.075	1.4674***	0.067
upper-sec. degree	0.8359***	0.049	0.7343***	0.050
age	-0.0414***	0.003	-0.0401**	0.014
age^2			0.0005**	0.000
work experience	0.0559***	0.004	0.0236***	0.003
public	1.3854***	0.089	0.2755***	0.060
atypical worker	1.2598***	0.050	0.2413***	0.050
in work (lag)	1.2437***	0.056	1.1627***	0.050
in work all year (lag)	1.8912***	0.041	1.7085***	0.039
married			-0.5491***	0.049
partner in work	0.3554***	0.044	0.2636***	0.044
children aged 0-3			-0.1823***	0.046
constant	-1.9061***	0.115	-2.2981***	0.262
N. obs.	46,108		50,825	
AIC	39573.31		45963.77	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

For individuals who are not assigned to a 'work all year' status, a specific equation determines the number of months worked. The technique used is the same adopted for the estimation of monthly wages. As for earnings, actual predicted error terms are then imputed to in-sample workers to account for the permanent and transitory unobserved variability in the simulation. For new-born and for out-of-sample individuals, the two error terms are generated as a random draw from a normal distribution with the estimated standard deviation.

Table 6.17 presents the results from the two regressions, for men and women. A higher level of education and having been in work at time *t-1* tend to be positively associated to a longer period of work over a year for both genders. Being an atypical worker reduces the number of months worked for women but it is likely to increase it for men. Age and experience increase the number of months worked, with the first showing a non-linear effect (i.e. an increase in the number of months at decreasing rate). Married women and mothers with young children tend to work less time over a year.

TABLE 6.17: NUMBER OF MONTHS WORKED (ONLY ATYPICAL AND TEMPORARY WORKERS)

	Males (1)			Females (2)		
	b		*se*	*b*		*se*
tertiary degree	0.9439	***	0.098	1.2189	***	0.068
upper-sec. degree	0.5582	***	0.059	0.7249	***	0.050
in work (lag)	1.0391	***	0.039	1.1893	***	0.031
atypical worker	0.1602	**	0.067	-0.518	***	0.052
age	0.0736	***	0.015	0.1165	***	0.015
age^2	-0.0015	***	0.000	-0.0017	***	0.000
work experience	0.0385	***	0.004	0.0207	***	0.003
married				-0.3407	***	0.045
children aged 0-3				-0.1238	***	0.024
constant	4.0006	***	0.280	3.0609	***	0.278
σ_u	1.2559			1.1586		
σ_v	1.9158			1.9685		
ρ	0.4194			0.3997		
R^2-*within*	0.0638			0.0771		
R^2-*between*	0.0928			0.1243		
R^2-*overall*	0.0871			0.1170		
N. obs.	20,137			30,127		

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

6.2 ESTIMATIONS IN THE PENSION MODULE

One of the main improvements introduced in T-DYMM 2.0 concerns the implementation within the pension module of a sub-module on private pension plans.

First, the probability to contribute to private pension plans had to be estimated. We have taken separate consideration of occupational pension plans (meaning pension plans to which TFR[123] is devolved), only available to employees, and individual pension plans, available to all workers. Because no difference could be observed between male and female contributors, they are considered together in the regressions. Also, as the gender dummy is not significant when accounting for earnings, the gender component is not considered at all in the estimations. Because the enrolment in individual pension plans concerns all workers, it is the first to be estimated.

123 For a definition of the TFR, see Chapter 4, Paragraph 4.4.

TABLE 6.18: PROBABILITY TO ENROL TO INDIVIDUAL PENSION PLANS

	b	*se*
tertiary degree	0.3445***	0.057
upper-sec. degree	0.2490***	0.045
age	0.0863***	0.019
age²	-0.0011***	0.000
enrolled in private pension plans (lag)	3.0039***	0.038
log wage	0.4032***	0.030
self-employed	0.4559***	0.044
atypical worker	0.4016***	0.085
constant	-9.2276***	0.057
N. obs.	42,605	
AIC	21377.3	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

The probability of being enrolled in individual pension plans is mostly explained by the lagged independent variable. Having been enrolled in previous years has a strong incidence on the probability to contribute in period *t*. Other significant variables are the degree of education and the wage. Holding a tertiary education increases the probability of enrolling in complementary individual pension scheme.

TABLE 6.19: PROBABILITY TO ENROL TO OCCUPATIONAL PENSION PLANS

	b	*se*
age	0.0666***	0.023
age²	-0.0009***	0.000
enrolled in private pension plans	0.6583***	0.064
enrolled in occupational pension plans (lag)	3.7099***	0.049
log wage	0.6056***	0.043
duration as employee	0.0163***	0.003
permanent employee	0.3876***	0.086
constant	-10.1863***	0.626
N. obs.	31,321	
AIC	14791.2	

Note: * p<.10, ** p<.05, *** p<.01. Time dummies are also included in the regressions, not presented here.

Source: elaborations on AD-SILC data

Similarly to the case of individual pension plans, contribution to occupational pension plans is mainly explained by the fact that an employee was already enrolled in the previous period. Because the process on the probability to participate to occupational pension plans operates after the one for individual pension plans, we could add the variable *"enrolled in private pension plans"* as explicative, while we could not do *vice versa*. Not surprisingly, employees that contribute to individual pension plans are likely to also be enrolled into occupational plans. Permanent employees are more likely to contribute, and the duration in employment is positively correlated as well. Educational variables are not significant in explaining the participation to occupational pension plans, which is easily explained by the fact that the element of choice is less present.

While the workers that are most likely to contribute to private pension plans are defined by the logistic regressions presented above, the share of workers enrolled in private pension plans is determined by alignment procedures. Taking into account data on enrolment rates registered by COVIP from to 2008 to 2014 and extrapolating the trend with logarithmic functions, the participation rate of employees to occupational pension plans is projected to stay constant at 15% from 2012 to 2059, while the quota of overall workers enrolled in individual pension plans is projected to raise from 14% in 2012 to 24% in 2059.

Table 6.20 shows in the first two columns the differences between the official data and those resulting from the simulation in 2014. The third column shows the increase in enrolment rates on the last year of T-DYMM simulations. Self-employed workers are expected to experience a steeper growth in coverage rates. That is because, following the fast growth of the past 6 years, the participation to individual pension plans is expected to rise significantly, as mentioned above. This phenomenon concerns self-employed workers more than employees.

TABLE 6.20: EVOLUTION IN ENROLMENT RATES PER EMPLOYMENT CATEGORY[124]

	2014 (COVIP)	**2014 (T-DYMM)**	**2059 (T-DYMM)**
Private employees	27.2%	25.8%	28.9%
Self-employed	20.6%	25.2%	32.5%
Tot	22.3%	26.4%	31.9%

Source: COVIP (2015), T-DYMM – own elaborations

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7. SIMULATION RESULTS: BASELINE SCENARIO

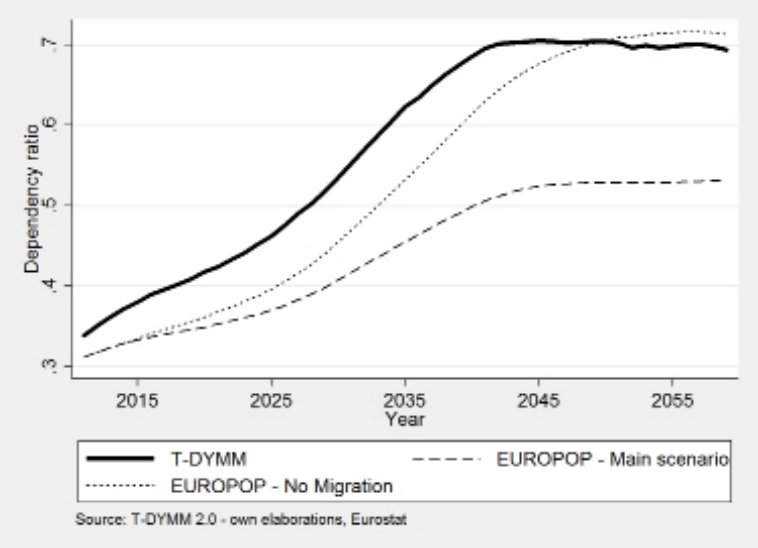
In this chapter, the main findings of our baseline simulations in T-DYMM are presented.

In the following sections, it is first shown how the demographic structure of the sample changes throughout the simulation period. Secondly, an illustration of how the estimations on labour market transitions, labour earnings and number of months in work carried out on the AD-SILC dataset impact our sample from 2012 to 2060 is presented. The final section focuses on the results in terms of the evolution of pension adequacy indicators and poverty, with a focus on the impact of private pension plans, one of the relevant novelties of T-DYMM 2.0.

7.1 SAMPLE EVOLUTION IN THE DEMOGRAPHIC STRUCTURE

Since T-DYMM is a zero-migration model that does not account for migration flows, the implications of the fast ageing process that Italy is experiencing are heightened. Compared to EuroPop (2013) projections, the old age dependency ratio[125] computed in T-DYMM is similar to the one computed by Eurostat in the *no-migration* scenario, while quite different from the one computed in the *main* scenario.

FIGURE 7.1: OLD AGE DEPENDENCY RATIOS (65+/15-64). T-DYMM SIMULATIONS, EUROPOP MAIN SCENARIO, EUROPOP NO-MIGRATION VARIANT. 2011-2059



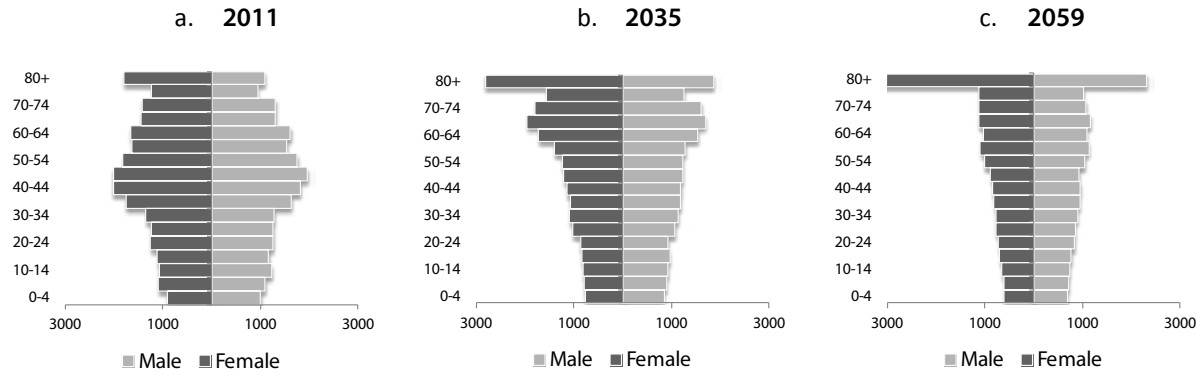
The differences between Eurostat demographic projections and those obtained through T-DYMM are attributable to discrepancies between the AD-SILC sample that is employed for the simulations and the actual Italian population. In all three indicators, a steeper increase is observed in the central part of the simulation

125 The old age dependency ratio is obtained as the ratio between the age cohorts over 65 years and those between 15-64 years.

period, when the large cohorts of baby boomers are expected to enlarge the number of individuals over 65 years of age. After 2035, the baby boomers start exiting the simulation and the indicator stabilizes at 70%.

The population pyramids produced based on T-DYMM 2.0 demographic module show the progressive enlargement of old-age cohorts compared to the overall population (Figure 7.2). Such a process is accelerated by the non-consideration of migration flows.

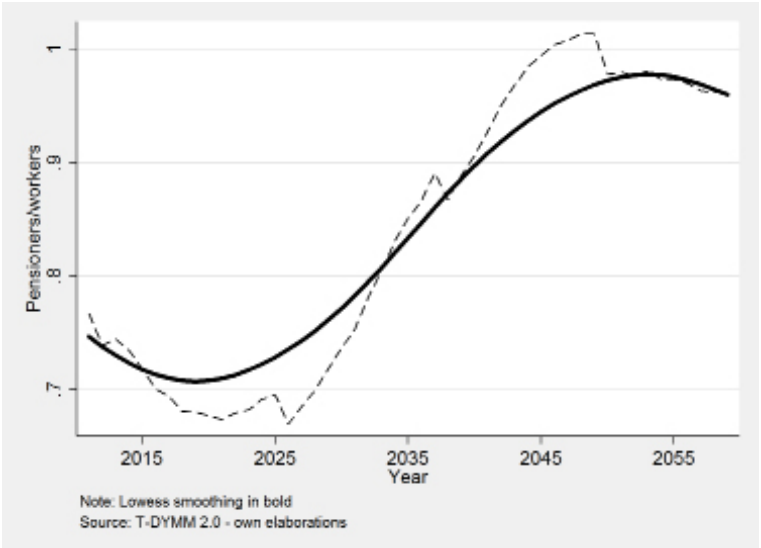
FIGURE 7.2: POPULATION PYRAMIDS (UNITS), 2011-2059



Source: T-DYMM 2.0 – own elaborations

When examining the ratio between pensioners and workers observed in T-DYMM 2.0 over the 2012-2060 period (Figure 7.3), the demographic implications have to be integrated with the changes in retirement regulations (e.g. the general tightening of access rules) and the growth in employment rates foreseen according to AWG projections. The combination of these two factors allows the ratio to decrease in the first 10 years of the simulation period. By 2060, we observe an overall increase in the pensioners/workers ratio amounting to almost 20 percentage points so that, at the end of the projection period, there is nearly one pensioner for each person in working age. However, because of retirement regulations, the increase in the pensioner/worker ratio projected over the medium/long run is significantly lower than the one observed in the old-age dependency ratio (Figure 7.1). In addition, by the end of the simulation period the trend in the pensioner/worker ratio seems to be inverting.

FIGURE 7.3: PENSIONERS ON WORKERS RATIO, 2011-2059

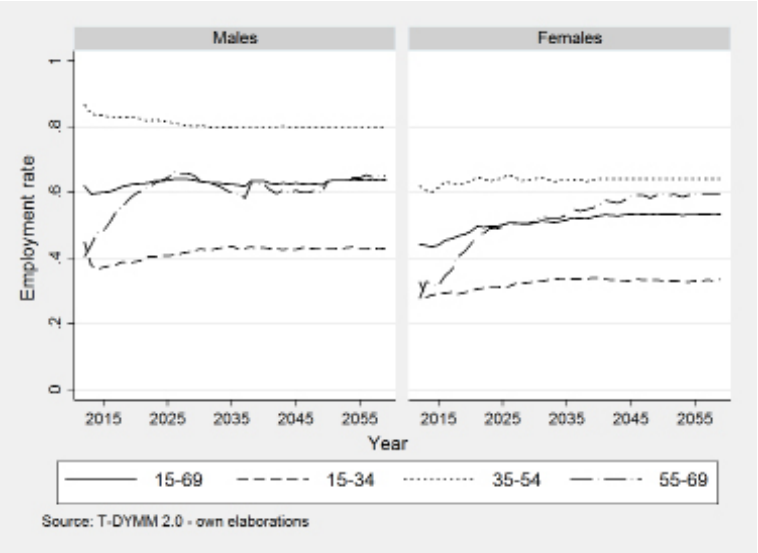


7.2 SAMPLE EVOLUTION IN THE LABOUR MARKET

7.2.1 EMPLOYMENT

The overall employment rate simulated by the model follows the path traced by the alignment process described in Chapter 5[126]. In the baseline scenario, as shown in Figure 7.4, a slight increase in the employment rate for the young cohorts (aged between 15 and 34) occurs, regardless of the gender, in the first years of projection followed by a constant trend in the years after 2035. On the contrary, for prime-age male workers (aged between 35 and 54), the employment rate shows a decreasing trend in the first 10-15 years of the simulation, while afterwards it remains relatively constant. For female workers of the same age group no particular trend is displayed. The most pronounced trend is observed for the older workers. For men, the employment rate increases quickly in the first fifteen years of projections and then hover around 65 per cent until the end of the time horizon. For old age women, the employment rate increases very fast and almost doubles over the whole projection period.

FIGURE 7.4: EVOLUTION IN THE EMPLOYMENT RATES BY AGE GROUP



Further decomposing the employment rates of old age cohorts (Figure 7.5) shows that for women, no particularly significant differences appear in the trends but only in the starting levels. For all age groups considered, the employment rates are increasing. The cohort 65-69, showing the fastest increase relatively to the others, is projected to catch up vis-à-vis younger old age cohorts. Males aged between 55 and 64 show first increasing, then slightly decreasing and at the end constant trends in the employment rates[127]. Conversely, males aged between 65 and 69 largely exhibit an increasing trend. This evolution of the employment rate is clearly a result of the recent pension reforms, which have tightened pension eligibility requirements and have linked age and seniority requirements to changes in life expectancy[128].

126 If alignment procedures are not implemented, the total employment rates in the simulation reflect those pertaining to the sample employed for the estimations. At the end of the simulation period, the total employment rate for the 15-64 group would rise up to 80%, instead of the 59% projected by AWG (2015) as part of the baseline assumptions.

127 It has to be remarked that in the simulated world an individual can be either student, worker, disable, inactive or retired but can never be assigned to two (or more) work statuses at the same time. Consequently, the employment rates of older workers suffer from a negative bias due to the fact that an individual, once retired, definitely exits the labour market.

128 The observed downturns are most likely subject to the exhaustion of the older groups of workers (in some periods) as long as a worker who just reached the requisites of retirement exits the labour market.

FIGURE 7.5: EVOLUTION IN THE EMPLOYMENT RATES FOR OLD WORKERS BY AGE

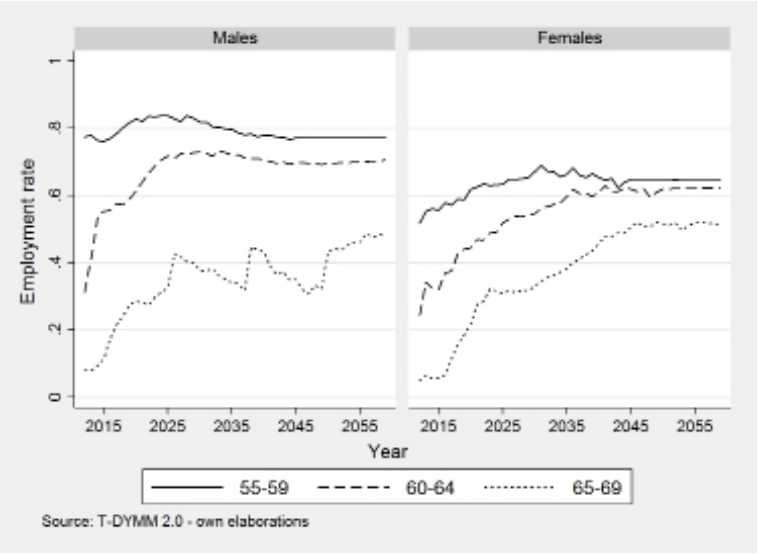
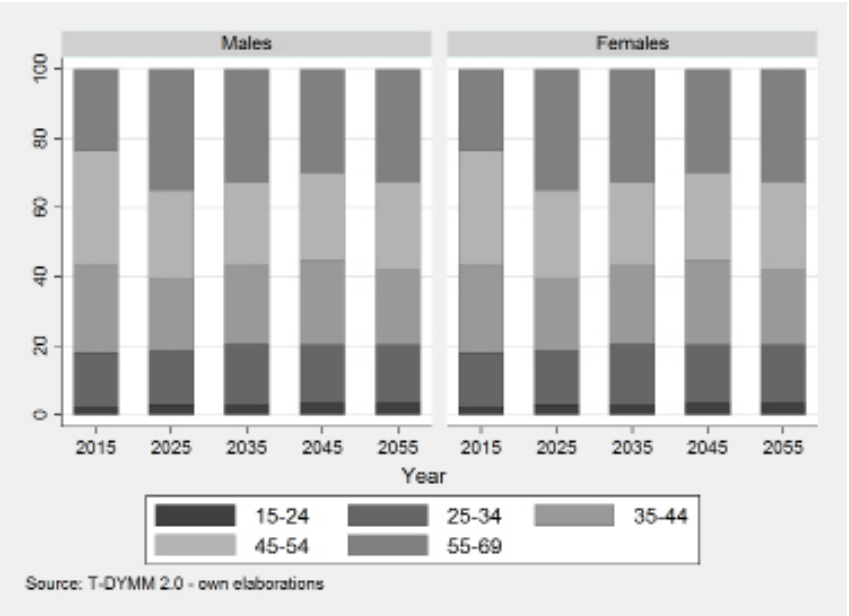


Figure 7.6 illustrates a detailed age decomposition of the working population in five points of time over the projection period. Taking into account the population aged between 15 and 69, the share of working individuals aged 55 and above increases significantly between 2015 and 2055, more for women than for men. Among men, a slight increase in the two youngest age groups is observed, while among women the share of workers aged between 15 and 34 presents some small variations. Not surprisingly, the share of the prime-age groups (aged between 35 and 54) significantly declines between 2015 and 2025 (afterwards it remains relatively stable) due to the fact that T-DYMM is a closed model (e.g. migration flows are not considered) and because the entry of the (previously) younger cohorts does not completely compensate the exit of the prime-age workers.

FIGURE 7.6: AGE STRUCTURE OF THE WORKING POPULATION

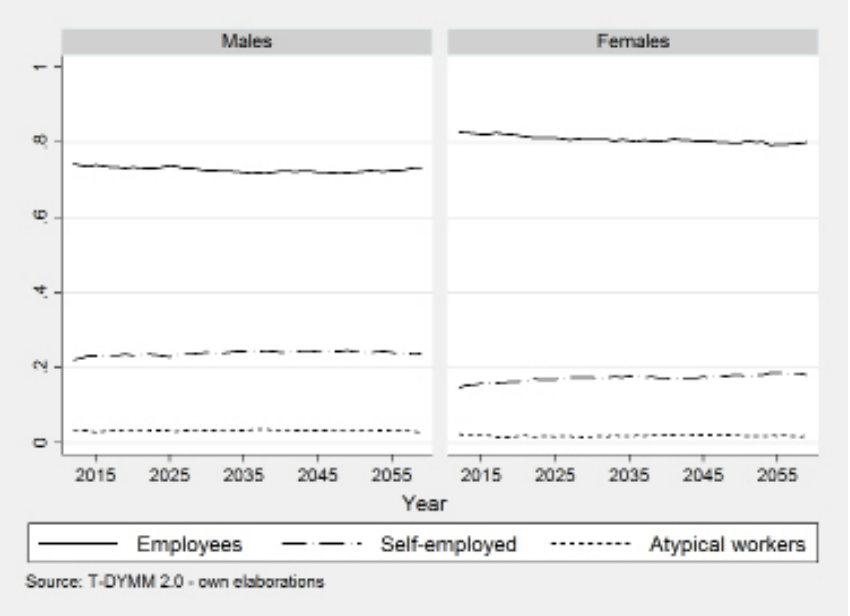


7.2.2 WORK STATUS

As far as the composition of employment by work category is concerned, no exogenous pattern has been imposed in the simulation.

The relative share of each of the three categories in total employment is, therefore, free to adjust according to the individual propensities estimated through the equation parameters illustrated in Chapter 6. As shown in Figure 7.7, no significant changes in the shares emerge for men, while a small decline in the share of employees, compensated by a similar increase in the share of self-employed, occurs for women. Some gender differences are also observed: the share of employees appears higher for women, while that of self-employed is higher for men[129]. The share of male employees is nearly 10 per cent lower than that of female employees; about 40 per cent difference between men and women emerges in the share of self-employed, whereas the gender gap in the share of atypical workers varies between 40 and 90 per cent over the period[130].

FIGURE 7.7: EMPLOYMENT COMPOSITION BY WORK TYPOLOGY



Figures 7.8 and 7.9 illustrate how the three work typologies are distributed among the different age classes in five points of time, for both men and women. Clearly, the biggest work category is represented by the employees, followed by the self-employed and lastly by the atypical workers, regardless of both the age group and the gender. However, the shares are not constant neither over the age nor between genders: indeed, the share of employees is likely to reduce with the increase of age, more intensively for men (where for young workers the share of employees is around 80-86 per cent, while at the age of 35 and above it reduces to 70-75 per cent) and less for women (where for workers aged up to 34 the share is between 85 and 90 per cent, while for older age cohorts it diminishes to 77-82 per cent). Moreover, the changes in the shares of employees among the age groups are more pronounced in the second half of the simulation period; for instance, in 2015 the share of male employees declines by about 15 p.p., whereas in 2055 by 19.5 p.p., when the youngest age group is compared to the oldest one; for women, the reduction is of 7 p.p. in 2015 and 12 p.p. in 2055.

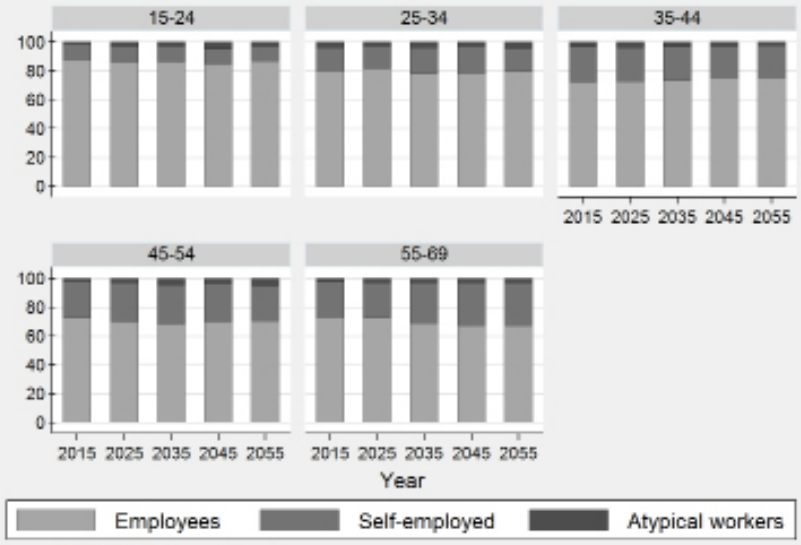
On the contrary, the shares of self-employed are likely to increase with age and in some cases over the period, again for both genders. The youngest workers are less likely to be self-employed and this tendency does not seem to change over time. The oldest workers instead are more prone to be self-employed, and their share

129 Additionally, the lower share of employees is likely to be compensated also by that of atypical workers among men.

130 The percentage difference is calculated with respect to the shares for women.

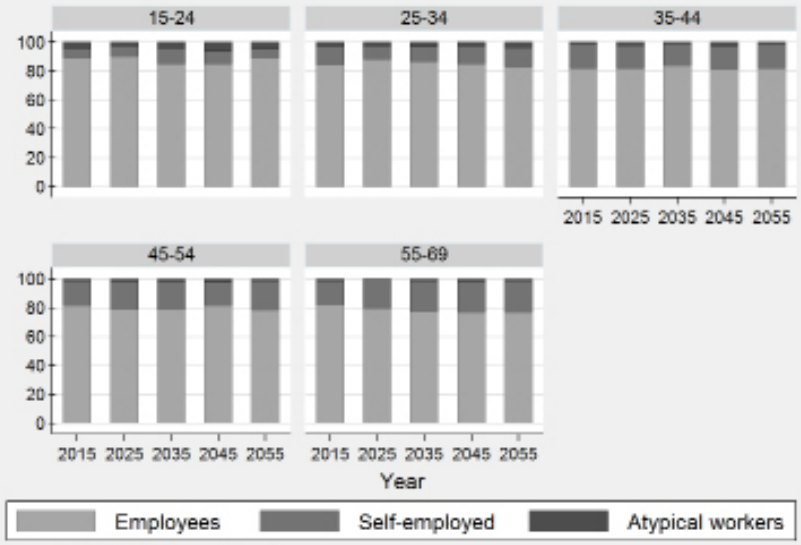
tends to increase over time, albeit more for men than for women. The share of atypical workers seems to be relatively stable over the projection period and among age groups for men; for women, it is likely to reduce with age and to be more fluctuating over time, but with no particular trend.

FIGURE 7.8: DISTRIBUTION OF THE THREE WORK CATEGORIES BY AGE GROUP – MALES



Source: T-DYMM 2.0 - own elaborations

FIGURE 7.9: DISTRIBUTION OF THE THREE WORK CATEGORIES BY AGE GROUP – FEMALES

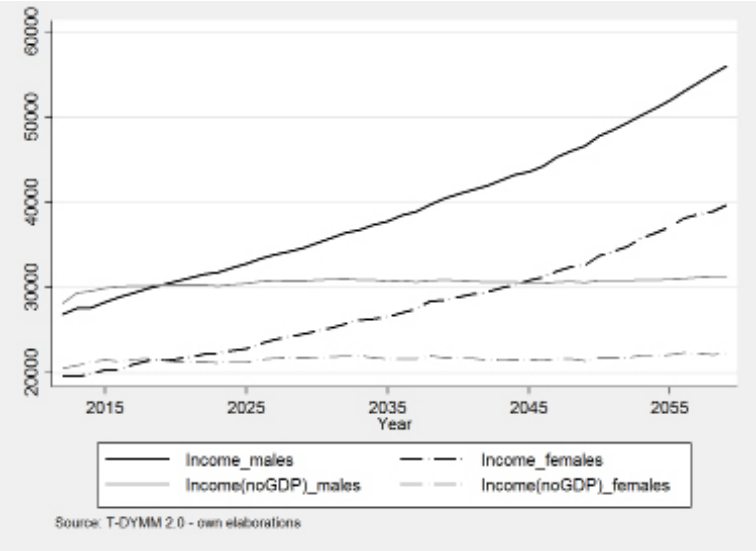


Source: T-DYMM 2.0 - own elaborations

7.2.3 EARNINGS

This section presents the evolution of earnings throughout the simulation period. Figure 7.10 shows the evolution of gross yearly earnings for men and women, where the grey lines report yearly earnings as modelled in T-DYMM[131], while the black lines illustrate the trend of the same earnings but aligned to the GDP growth index[132]. As far as no macroeconomic shock[133] is included in the modelling of individual earnings, average earnings are not expected to vary over the period except for the GDP growth and to a lesser extent for the employment rates. Therefore, the average labour income without GDP growth is fairly constant over the time span for both genders. Conversely, when the GDP growth is incorporated, it increases for males and females.

FIGURE 7.10: EVOLUTION OF AVERAGE LABOUR INCOME (WITH AND WITHOUT GDP GROWTH)



It is interesting to observe that the gender gap seems to upsurge at the end of the simulation period when incomes linked to GDP growth are compared (slightly differently from what occurs for incomes without GDP growth). The increase in the earnings differential between men and women appears when the levels are compared, while if reported as a percentage share no difference is observed between the gap of incomes without GDP growth and the gap of incomes with GDP growth. Indeed, the gender gap seems to oscillate around a constant trend with a range between 27 and 30 percent.

Examining the earnings evolution more in details, as shown in Tables 7.1 and 7.2, it clearly emerges that, independently from the age group, the gender, and the indexation to GDP growth, median labour incomes are always lower than mean incomes.

Concerning men, the average income increases non-linearly with age as has been modelled in T-DYMM 2.0. The differences between the mean and median incomes are more pronounced in the second and third age group, but interestingly in the last one these differences reduce over time and get closer to the differences of the second age group. Analogous patterns emerge when incomes are aligned to the GDP growth, as expected.

131 See Chapter 6, Paragraph 6.2.2., for details.

132 Most MSMs first model earnings processes on a micro-level base (e.g. individual earnings) and then align them to external macro projections in order to take earnings growth into account. Since the welfare parameters (for which a periodical intervention of the policy maker in setting the amounts is likely) employed in T-DYMM are aligned to GDP growth, earnings have been aligned to the same parameter in order to ensure conformity between these indicators and earnings.

133 The only shocks that we considered are those representing the unexplained term of earnings (e.g. the residuals), which can generally reflect macroeconomic shocks (strictly related to the labour market) but, as long as the residuals are modelled using a constant variance of the error term over time, prevents from any significant changes in the average levels during the simulation period. Furthermore, time dummies has been included in the earnings estimations which generally account for unobserved macroeconomic differences between years (e.g. (un)employment down(up)turns, institutional changes, cyclical effects) thus attenuating earnings variability due to similar shocks.

TABLE 7.1: LABOUR INCOMES WITH AND WITHOUT GDP GROWTH BY AGE GROUP – MALES

	Income (no GDP growth)				Income (with GDP growth)		
year	mean	median	std. dev.		mean	Median	std. dev.
				15-34			
2015	22,500	21,503	10,959		21,281	20,339	10,365
2025	22,090	20,372	11,421		23,745	21,898	12,276
2035	23,028	21,388	11,636		28,289	26,274	14,294
2045	23,178	21,015	12,568		33,121	30,030	17,960
2055	23,301	21,137	12,485		39,079	35,449	20,940
				35-54			
2015	30,400	27,073	16,850		28,753	25,607	15,937
2025	30,450	28,031	15,871		32,731	30,131	17,060
2035	30,281	27,708	15,511		37,199	34,039	19,055
2045	30,707	27,645	16,114		43,879	39,504	23,026
2055	31,341	28,187	16,654		52,562	47,274	27,931
				55-69			
2015	34,494	29,314	21,891		32,625	27,726	20,705
2025	35,103	30,298	22,686		37,733	32,568	24,386
2035	36,252	32,745	20,685		44,535	40,227	25,411
2045	35,124	32,512	18,766		50,192	46,459	26,816
2055	35,250	31,707	19,263		59,118	53,176	32,305

Source: T-DYMM – own calculations

Regarding women, incomes increase at decreasing rates in line with what projected for men. Also, differences between mean and median incomes are less marked for the youngest age group, whereas they are fairly similar comparing the second and third age group. Finally, female workers earn between 27 and 35 percent less than their male colleagues, and the older age the greater the gender gap.

TABLE 7.2: LABOUR INCOMES WITH AND WITHOUT GDP GROWTH BY AGE GROUP – FEMALES

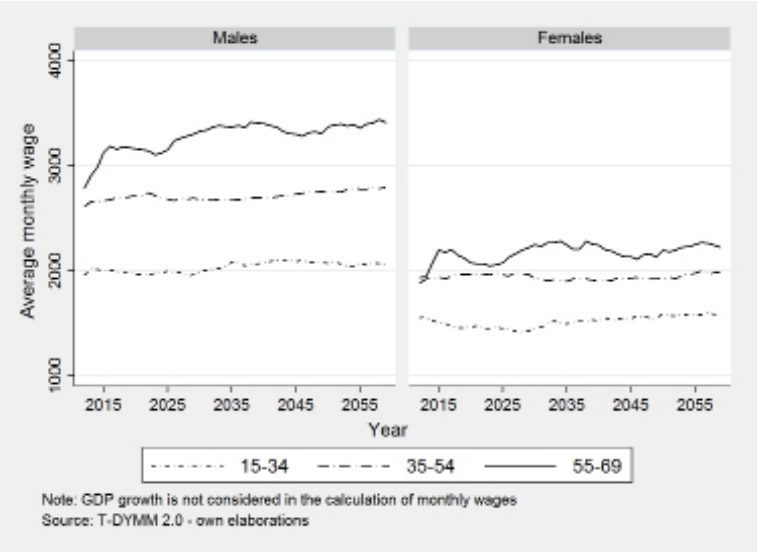
	Income (no GDP growth)			Income (with GDP growth)		
year	mean	median	std. dev.	mean	median	std. dev.
			15-34			
2015	16,400	15,348	8,760	15,511	14,517	8,286
2025	15,762	14,329	9,178	16,943	15,402	9,865
2035	16,335	14,957	9,061	20,068	18,375	11,131
2045	16,720	14,917	9,456	23,892	21,316	13,512
2055	17,071	15,290	10,083	28,630	25,644	16,910
			35-54			
2015	21,992	19,774	12,840	20,800	18,703	12,145
2025	22,037	19,620	13,126	23,688	21,090	14,110
2035	21,327	19,328	12,447	26,199	23,744	15,291
2045	21,840	19,656	12,668	31,209	28,089	18,102
2055	22,118	19,368	13,359	37,095	32,483	22,405
			55-69			
2015	24,477	22,507	15,833	23,151	21,288	14,975
2025	22,860	20,410	15,228	24,572	21,940	16,369
2035	24,483	21,735	16,097	30,077	26,701	19,774
2045	23,590	21,411	14,363	33,710	30,596	20,524
2055	24,806	22,405	14,801	41,602	37,576	24,823

Source: T-DYMM – own calculations

Since earnings have been modelled separately for the three main work typologies, it is also worthy, to examine them by work status. As far as individual yearly earnings are obtained by the product of monthly wages and months worked gross monthly wages instead of yearly incomes for the three work states are analysed.

Figure 7.11 reports average gross monthly wages for male and female employees by age group. Among men, wages seem to follow a slightly increasing trend in all age groups, where the oldest one is likely to present more distinct variability from year to year. Women do not present large differences in the trend with respect to men (albeit somehow more stable), except for the oldest age group where women's wages are less likely to increase over time. The major difference between men and women is in the levels, as expected and previously illustrated with yearly incomes.

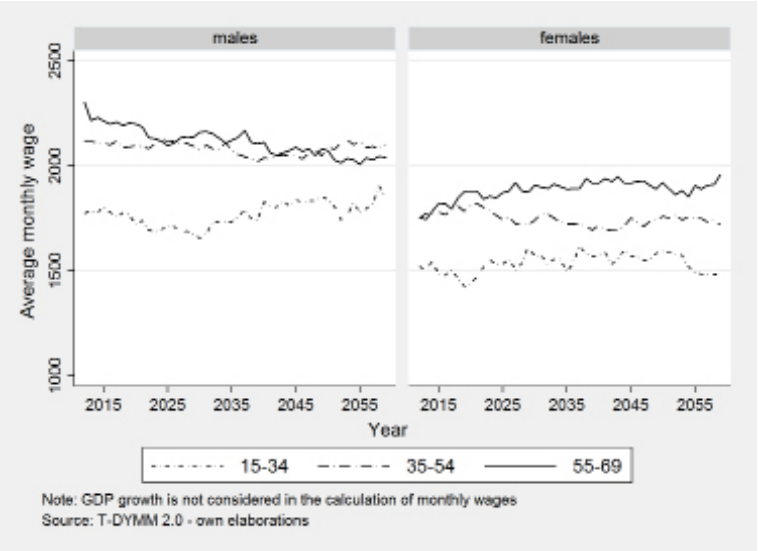
FIGURE 7.11: EVOLUTION OF AVERAGE MONTHLY WAGES BY GENDER – EMPLOYEES



Since monthly wages with no GDP growth indexation are considered, we do not expect any increasing or decreasing trend of wages, independently from the work category. Yet, some changes in the average levels of wages are likely to emerge, as far as the composition of employment can significantly vary from one year to another and the sample size can be extremely heterogeneous among the different sub-groups and in some cases very small. For instance, the variability observed among the oldest age class of employees may reflect the changes in age composition due to the gradual rise of statuary retirement age due to the link to life expectancy.

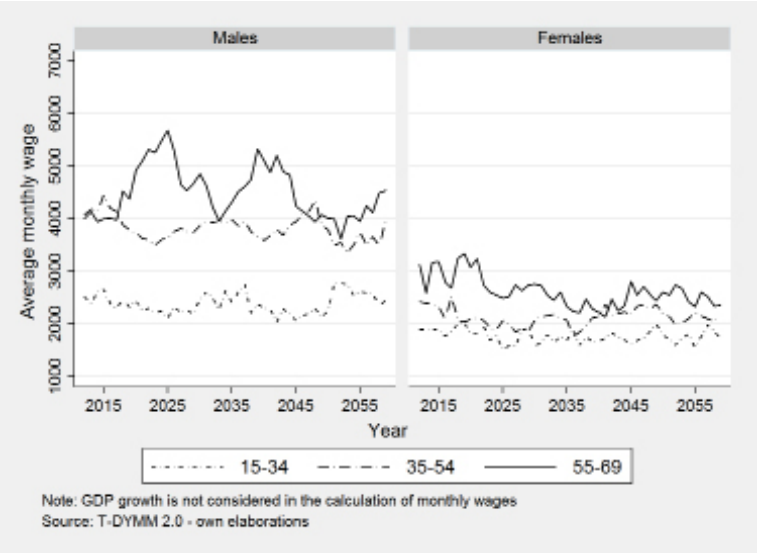
Figure 7.12 reports the gross monthly wages of self-employed workers by age group, for men and women. This work category is represented by substantial variability among all age groups and for both genders. If no particular trends, but just yearly variation, are observed for women, in the case of men the youngest age group is likely to increase in the second half of the simulation period, while the trend of the oldest age group is decreasing. As previously remarked, as the sample size of the specific sub-groups are relatively small and the age composition changes (generally in favour of older ages) in all age groups the size is decreasing for the first two classes but increasing for the last one. All these elements affect the wage levels, also in their averages. This is the main reason explaining the observed volatility over the projected time horizon.

FIGURE 7.12: EVOLUTION OF AVERAGE MONTHLY WAGES BY GENDER – SELF-EMPLOYED



Finally, Figure 7.13 shows the evolution of monthly wages of atypical workers among the sub-groups (by age and gender). The marked fluctuations that emerge in all age groups and for both genders are not a surprise. The share of this work category is extremely small – around 3 per cent of the total employment for men and even less for women, as illustrated in Figure 7.7. With few observations per year, even small changes in the age composition can actually affect the average wage levels. Similar changes are particularly noticeable in the last age group, due also to the increase in the retirement age.

FIGURE 7.13: EVOLUTION OF AVERAGE MONTHLY WAGES BY GENDER – ATYPICAL WORKERS



Average wages notably differentiate between work typologies. For instance, self-employed workers report the lowest value of average wages, as shown in Figure 7.12. However, on this point the category presents rather particular features in Italy, because of high levels tax elusion, which in turn translates in risk of underreporting in the dataset. Moreover, the category is an approximate aggregate of rather heterogeneous workers, since professionals, retailers, craftsmen and farmers are part of the same work group; some of these categories (e.g. craftsmen and retailers) often pay the minimum contribution. However, this should not be of great concern (at least not for the matter of this project) as long as labour incomes are relevant only for the pension contribution they generate.

On the other hand, atypical workers exhibit the highest levels of average wages especially in the case of men, as shown in Figure 7.13. We need to keep in mind, however, that this category presents as many peculiarities as the self-employed, although of a different kind. In particular, some bias may arise from the definition of the three work categories: as the work category is decided according to the prevalent job held in a given year, if a worker holds two jobs, one as an employee (or self-employed) another as an atypical worker, then he/she will be most likely assigned as an employee (or self-employed)[134]. Therefore, those individuals who are assigned as atypical workers are expected to have a relatively convenient contract (e.g. that can prevail on other work types and most probably with better pay premium). Furthermore, high-qualified workers such as professionals, consultants and researchers typically have such a typology of contract, which explains higher compensations[135].

134 The choice between two jobs is made through the number of weeks worked or earnings, choosing the higher ones (weeks or earnings, respectively).

135 See also the discussion on the estimation results of this category presented in Chapter 6 for further clarification.

7.2.4 MONTHS WORKED

The last equation parameters employed in T-DYMM relative to the labour market module concern the number of months worked during the year. As previously explained in Chapter 6, the simulation strategy is to first identify workers who worked the whole year and then, for those who do not belong to this group, those who worked for some months and the number of months worked[136]. Figure 7.14 shows the share of workers who worked all year, considering the working population aged 15-69.On average 95 percent of the men work all year, while the share of women being at work the whole year is around 85 percent. The shares of both men and women present a rather smooth and constant trend over time.

FIGURE 7.14: SHARE OF WORKERS BEING IN WORK ALL YEAR BY GENDER

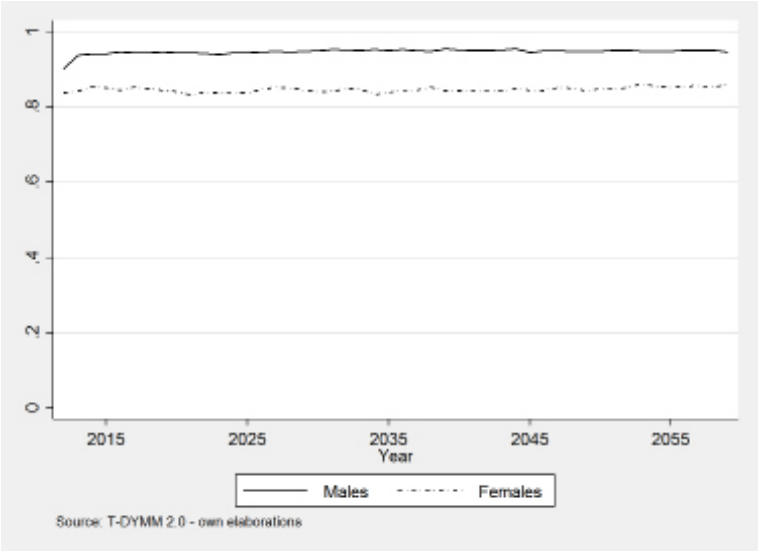
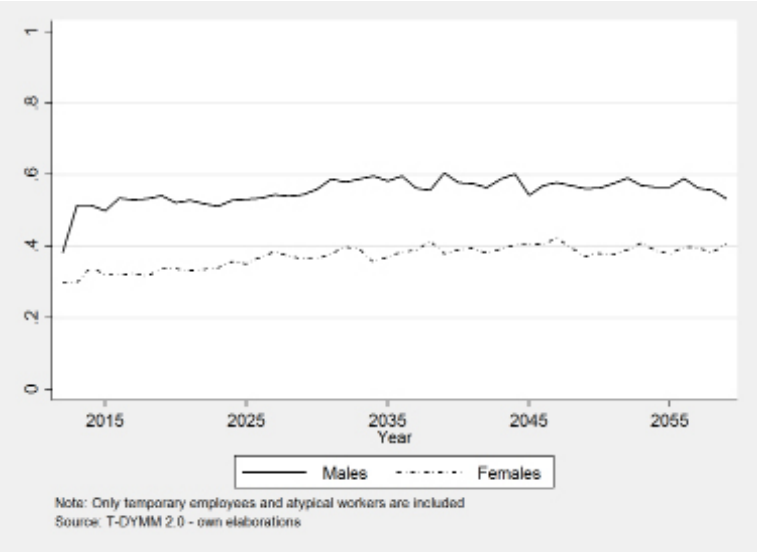


Figure 7.15 reports the shares of the workers being in work all year, considering only temporary employees and atypical workers. On average, 55 percent of men and 37 percent of women of these work categories work all year. Differently from what is observed for the whole working population, the shares of the temporary and atypical workers follow first a slightly increasing (up until 2030-2035) and then relatively constant trend over the simulation period. The relatively small sample size of these categories makes the relative ratios more sensitive to variation, which is why fluctuations are observed.

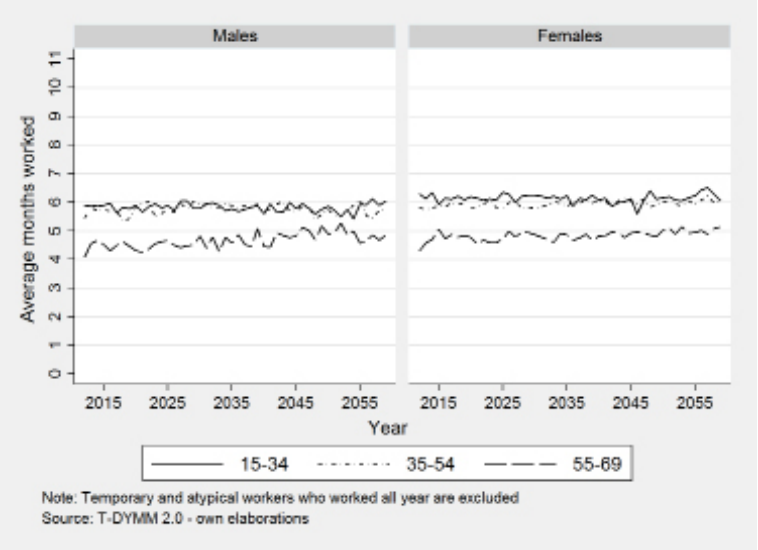
136 In T-DYMM permanent employees and self-employed work all year by definition. Consequently, the definition of the number of moths worked concerns only temporary employees and atypical workers.

FIGURE 7.15: SHARE OF TEMPORARY EMPLOYEES AND ATYPICAL WORKS BEING IN WORK ALL YEAR BY GENDER



Finally, Figure 7.16 reports the average number of months worked for those temporary employees and atypical workers who do not work all year, by age group and gender. Overall, no significant differences between men and women appear. Workers aged 15-54 on average work 5.5-6 months a year, while older workers on average are likely to work 1.5-2 months less than their younger colleagues. Yet, in the last part of the simulation period the gap in the months worked between the young and the old workers slightly reduces.

FIGURE 7.16: AVERAGE MONTHS WORKED BY AGE GROUP



7.3 SAMPLE EVOLUTION AT RETIREMENT

Before analysing the main outcomes of T-DYMM 2.0's baseline simulations in terms of adequacy and poverty indicators, it is useful to sum up the key assumptions underlying the results. We can identify demographic, macroeconomic and microeconomic assumptions.

a. *Demographic assumptions on fertility rate, migration and life expectancy.*

Assumptions on fertility rate and migration have an impact on sustainability indicators, which are outside of the research scopes of T-DYMM.

Changes in life expectancy affect eligibility requirements as well as the computation of pension benefits, through the mechanism of automatic adjustment to changes in longevity of the age requirements and of the conversion coefficients (see Chapter 4).

b. *Macroeconomic assumptions on GDP growth, employment rate and inflation rate.*

In T-DYMM, GDP growth affects the level of wages and the notional rates of return on contributions paid to the public pension system under the NDC regime. Because of the intrinsic characteristics of NDC pension systems, workers' condition is affected by employment rates not just while individuals are active, but also during retirement, since possible unemployment spells have an impact on the accrual of notional contributions and on the eventual level of pension benefits.

Since pension benefits in Italy are indexed to inflation (according to given thresholds), assumptions on inflation rates define how much and how fast, during retirement years, do pensions lose purchasing power compared to wages.

c. *Microeconomic assumptions on career patterns and retirement choices.*

Because of the mirroring characteristics of NDC pension schemes, stability and dynamics of working careers – whose patterns are estimated on AD-SILC – have an impact on workers' income conditions when retired.

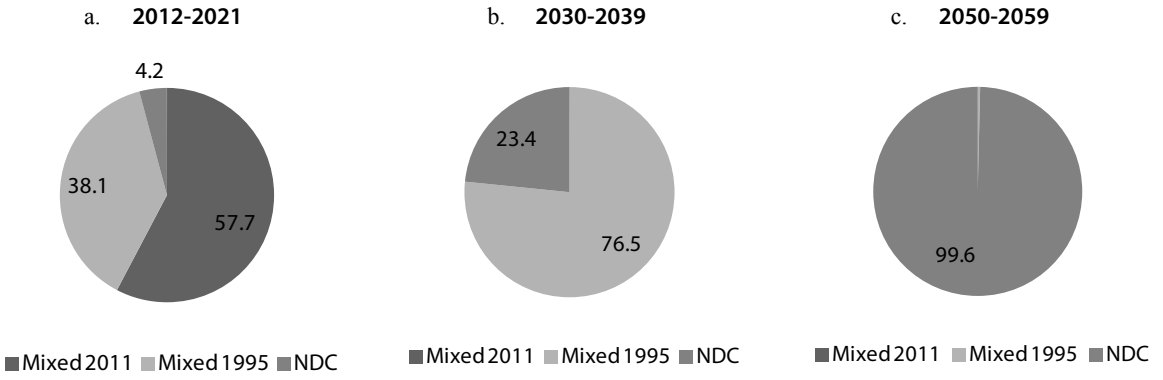
Following principles of actuarial fairness, the age at which individuals choose to retire is directly related to the amount of benefit they will receive. As far as retirement choices are concerned, in the baseline scenario we assume that individuals retire as soon as they fulfil the necessary requirements. We are not therefore considering flexible access to retirement, typical of NDC pension schemes (present, albeit limited, in the Italian variant). Paragraph 9.2 (see further) is explicitly devoted to this issue.

Against this backdrop and given such assumptions, the following section examines the main outcomes of T-DYMM 2.0's simulations.

As anticipated in Chapters 4 and 5, workers belonging to the "Mixed" regimen are entitled to pension benefits "pro quota". For those belonging to the "Mixed 2011" category – who had at least 18 years of seniority in 1995 – Defined Benefit rules are applied for the quota of seniority accrued prior to Jan 1st 2012. Notional Defined Contribution rules are applied for the remaining quota. Those classified as "Mixed 1995" – who had less than 18 years of seniority in 1995 – employ NDC rules starting from Jan 1st 1995. For workers belonging to the NDC regime – who have started working after 1995 – only NDC rules are applied.

Figure 7.17 shows how new pensioners are characterized by different computation rules over the years of simulation.

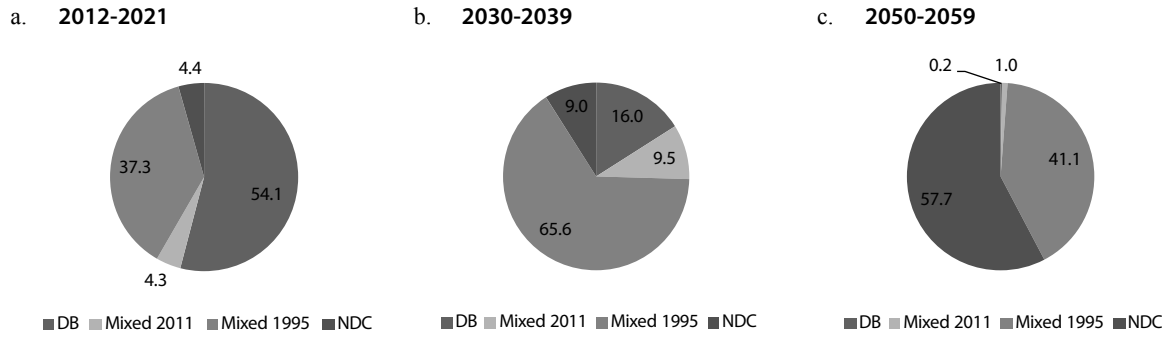
FIGURE 7.17: SAMPLE EVOLUTION BY COMPUTATION RULE (%). NEW PENSIONERS



In the first years of the simulation, the majority of new retirees belongs to the "Mixed 2011" category. New pension benefits are therefore still mostly computed with the use of Defined Benefit rules. As time goes on, more and more new pensioners compute the largest part of their benefit with NDC rules.

Carrying out the same analysis on the stock of pensioners, a few differences emerge (Figure 7.18). Because we are considering all pensioners, we have to include those who were already in retirement before the start of the simulation period, whose benefit had been computed with Defined Benefit rules alone. As a consequence of the gradual phasing-in process established by the 1995 "Dini Reform", we can observe how, by the end of the simulation, about 60 years after Law n. 335/1995 entered into force, more than one third of the stock of pensioners still receives benefits partially computed with the use of Defined Benefit rules ("Mixed 1995" component).

FIGURE 7.18: SAMPLE EVOLUTION BY COMPUTATION RULE (%). STOCK OF PENSIONERS



In light of the relatively recent 2011 "Fornero Reform", it is also interesting to analyse the evolution of retirement criteria[137] for new pensioners over the course of the simulation period (Figure 7.19).

137 For simplicity's sake, a schematization of the retirement criteria is proposed here:

Old Age 1: 63 years of age, 20 years of contribution, 2.8xAS;

Old Age 2: 66 years of age, 20 years of contribution, 1.5xAS;

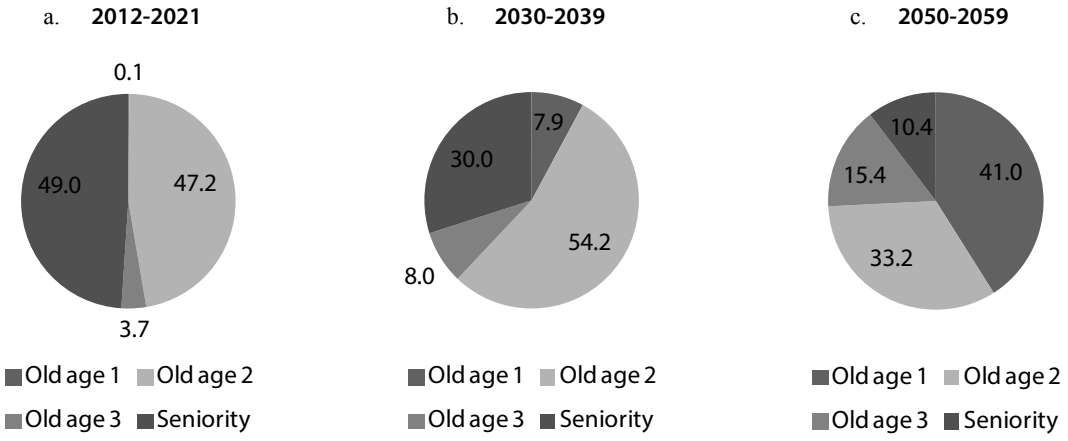
Old Age 3: 70 years of age, 5 years of contribution;

Seniority: 41 years 1 month of contribution (F), 42 years 1 month of contribution (M).

These are the requirements in place as of 2012 (start of the simulation). All age requirements and the seniority requirement for Seniority retirement are indexed to changes in life expectancy.

For an outline of the different retirement criteria outlined by the 2011 Reform, see Table 4.2 in Chapter 4.

FIGURE 7.19: SAMPLE EVOLUTION BY RETIREMENT CRITERIA (%). NEW PENSIONERS



At the beginning of the simulation period, new pensioners are equally split between "Seniority" and "Old Age 2" access criteria. Because "Old Age 1" and "Old Age 3" criteria are only available to workers pertaining to the NDC regime, their role is nearly null in the 2012-2021 decade[138]. It is visible how the role of seniority pensions decreases sharply by the end of the simulation period. The periodical update of retirement criteria set by the 2011 Reform will increase the seniority requirement to 46 years of contribution for men and 45 for women by 2060. According to our simulations, based on Eurostat demographic projections (EUROPOP, base year 2013), the fulfilment of early-retirement requirements (before old-age retirement is available) will be very hard to attain in the medium-long term. The role of both "Old Age 1" and "Old Age 3" criteria increases visibly by the end of the simulation period. While 15% of the elderly workers in the 2050-2059 decade will not be able to access retirement before they fulfil "Old Age 3" criteria (which will have risen to 74 years of age), as many as 41% of new pensioners in the 2050-2059 period will be able to access retirement with the "Old Age 1" criteria (67 years of age).

Differentiating by gender, women fare consistently worse in terms of fulfilment of retirement eligibility requirements: 79% of the workers who can only access retirement once they reach the most demanding age requirements ("Old Age 3") are women (Table 7.3).

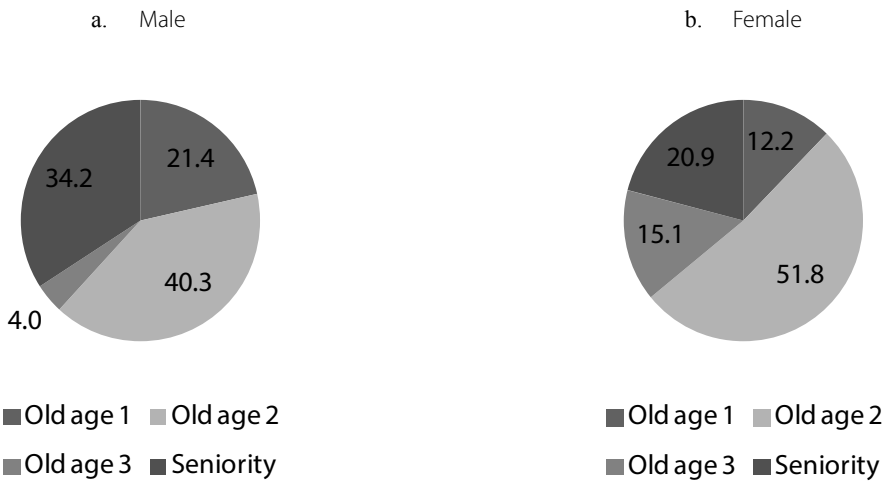
TABLE 7.3: RETIREMENT CRITERIA BY GENDER (%), 2012-2059. NEW PENSIONERS

Gender / Retirement criteria	*Old age 1*	*Old age 2*	*Old age 3*	*Seniority*	*Total*
Male	63.56	43.55	20.9	61.86	49.77
Female	36.44	56.45	79.1	38.14	50.23

Correspondingly, fewer women are eligible for early retirement ("Old Age 1" and "Seniority"): 33.08% of the female workers vs 55.64% of the male workers, throughout the whole simulation period (Figure 7.20). Evidently, women's weaker position in the labour market affects their chances to retire.

138 Those NDC workers who do retire in the first years of simulation are people that made a very late entry in the labour market and can therefore only access retirement with the "Old age 3" criteria.

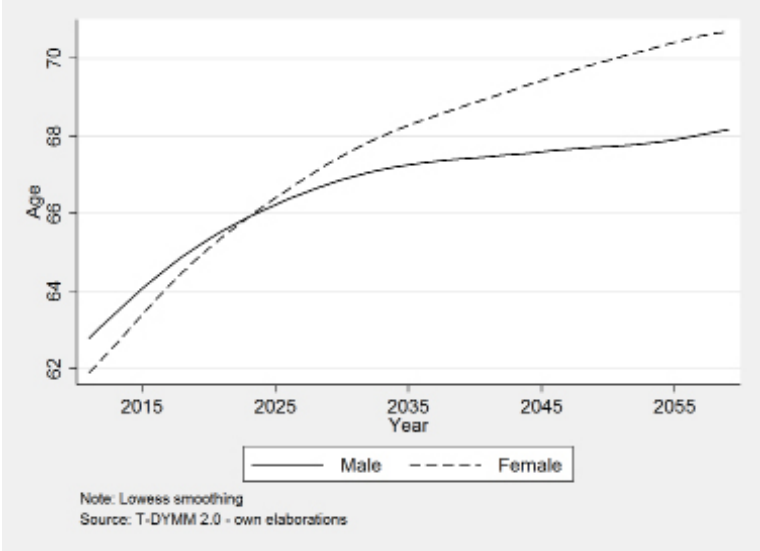
FIGURE 7.20: RETIREMENT CRITERIA BY GENDER (%), 2012-2059. NEW PENSIONERS



The average effective retirement age grows by around 7 years over the simulation period, with the fastest increase happening in the first 15 years of the simulation. The raise in retirement age is due both to normative changes and to the automatic alignment of age requirements to changes in life expectancy.

Figure 7.21 shows how, albeit the average effective retirement age for women is lower at the beginning of the simulation period by about a year, it increases much faster compared to the same parameter for men and it exceeds it by over 2 years by 2060. Again, this is because women generally fare worse than men in the labour market, in terms of both wages and stability of careers and, therefore, are projected to struggle more to meet the seniority and amount criteria for retirement established by the 2011 Reform.

FIGURE 7.21: AVERAGE EFFECTIVE RETIREMENT AGE, 2012-2060



A point can be made on the opportunity to exclude "Old Age 3" criteria from the computation of the average effective retirement age. Indeed, as noted in Chapter 4, when the age requisite for "Old Age 2" is met, the elderly are entitled to a means-tested social benefit allowance (*assegno sociale*). If "Old Age 3" criteria are not considered (Figure 7.22), the gap between male and female pensioners is reduced to a little over a year.

FIGURE 7.22: AVERAGE EFFECTIVE RETIREMENT AGE EXCLUDING "OLD AGE 3" CRITERIA, 2012-2059

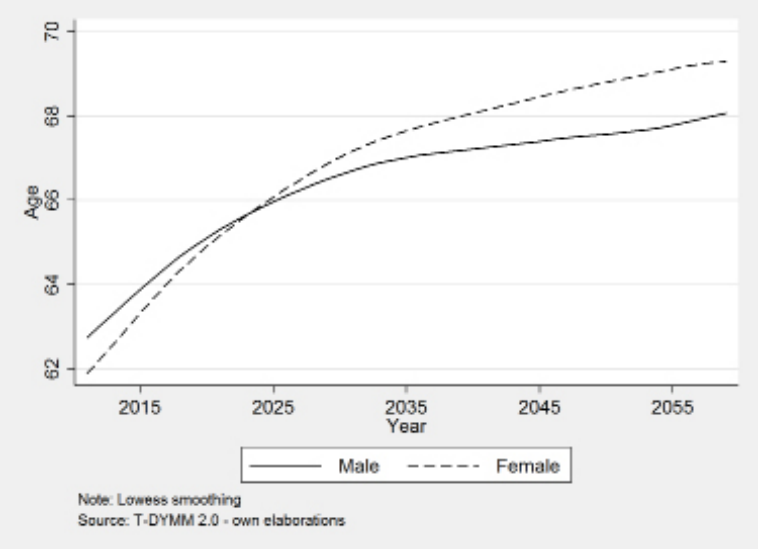
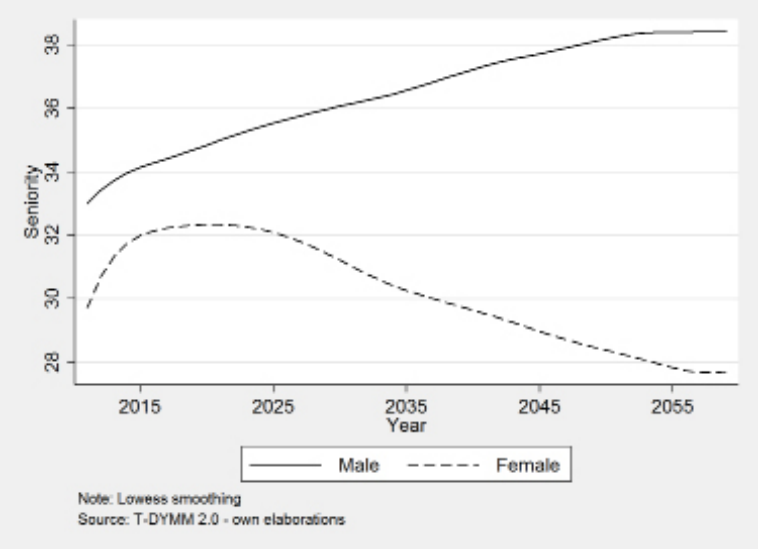


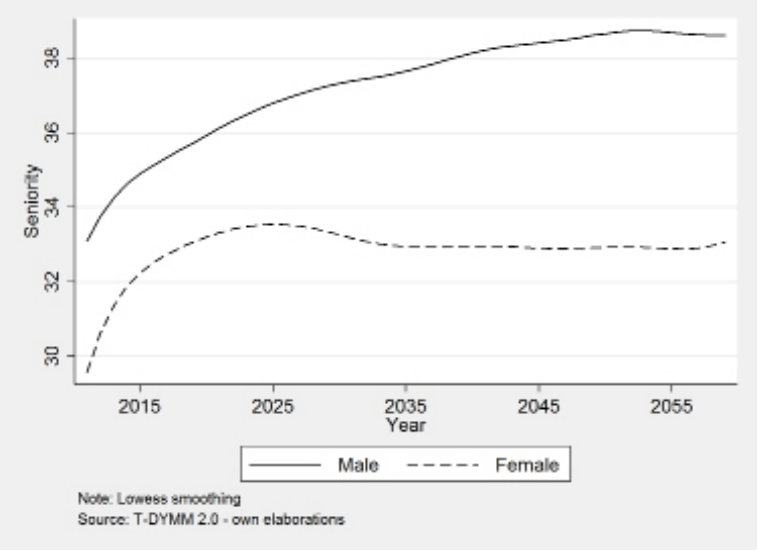
Figure 7.23 shows an apparently counterintuitive result: the average seniority at retirement for female workers only increases in the first years of the simulation, then decreases by about 4 years between 2025 and 2059. That is because more and more women can access retirement by means of the "Old Age 3" criteria (with only 5 years of seniority required) as the simulation goes on, thus influencing the average value for the category.

FIGURE 7.23: AVERAGE SENIORITY AT RETIREMENT, 2012-2059



However, even if "Old Age 3" criteria are excluded, the evolution in terms of seniority at retirement shown in Figure 7.24 brings to similar conclusions in terms of the consequences of the existing gender gap in the labour market. While the average seniority at retirement for male workers increases in accordance with the average effective retirement age throughout the whole simulation period, the average seniority for women only increases in the first years and then stays constant overtime. It seems that the combination of the projected employment rates assumed (AWG, 2015) and the career patterns simulated on the AD-SILC dataset design a scenario were women would not be able to adapt to the steep increases in retirement age requirements that will take place in the coming years.

FIGURE 7.24: AVERAGE SENIORITY AT RETIREMENT EXCLUDING "OLD AGE 3" CRITERIA, 2012-2059



7.3 THE EVOLUTION OF ADEQUACY INDICATORS

In order to assess the adequacy of pensions awarded[139], four typologies of indicators are derived: 1) the gross replacement rate, computed as the ratio between the first pension and the last salary; 2) the gross pension on average career wage ratio, computed as the ratio between the first pension and the average individual career wage; 3) the gross pension on average wage ratio, computed as the ratio between the first pension and the average wage in the labour market in the first year of retirement; 4) the gross pension on *assegno sociale* ratio, computed as the ratio between the first pension benefit and the amount of the *assegno sociale* in the first year of retirement[140].

With NDC computation rules, a growth in wages higher than the notional return rate on contributions (in Italy equalled to the GDP growth rate) translates into higher benefits but also into lower replacement rates. That is the rationale behind the choice of adding "objective" indicators (the gross pension on average wage ratio and the gross pension on *assegno sociale* ratio) to go together with the most widely known "subjective" indicator (the replacement rate).

In Paragraph 7.3, we have showed how the sample of new pensioners evolves in terms of the rules employed to compute benefits. Table 7.4 compares their conditions at retirement.

TABLE 7.4: AVERAGE CONDITION AT RETIREMENT BY COMPUTATION RULE, 2012-2059

	Mixed 2011	Mixed 1995	NDC	TOT
Age	63.6	66.9	68.9	67.5
Seniority	40.2	36.3	30.6	34.0
Gross replacement rate	79%	57%	47%	54%
Gross pension on average career wage ratio	100%	84%	76%	82%
Gross pension on average wage ratio	92%	64%	52%	61%
Gross pension on *assegno sociale* ratio	4.6	3.4	2.8	3.2

139 Unless otherwise specified, disability pensions are excluded from our analysis.

140 In T-DYMM's simulations, the amount of the *assegno sociale* (social allowance for the elderly) – like all other parameters for which a periodical intervention of the policy maker in setting the amounts is likely – is indexed to the GDP growth rate.

73% of the workers that retire during the simulation period belonging to the "Mixed 2011" category are estimated to receive pension amounts over three times the amount of the *assegno sociale*. The quota decreases to 49% for "Mixed 1995" pensioners and to 32% for "NDC" pensioners.

It is important to understand that the "Mixed 2011" category has a rather distinct composition compared to the other two, being essentially populated by senior workers. These workers had a seniority of at least 18 years in 1995, therefore, if they are still working when the simulation starts, they have already had long careers and are close to retirement (the average age of workers pertaining to "Mixed 2011" in the first year of simulation is 56). Such a feature is witnessed by the significantly higher level of average seniority at retirement for individuals retiring under the "Mixed 2011" category. The much lower level in the NDC group is instead attributable to the growing number of pensioners accessing retirement through "Old Age 1" and "Old Age 3" criteria (see Figure 7.19 above).

Workers who satisfy the eligibility requirements of "Old Age 1" are generally the ones who have had the steadiest and wealthiest careers, and they generally experience a relevant increase in their salaries throughout their working lives. As already noted, such career dynamics tend to be penalized in terms of replacement rates by the adoption of NDC computation rules. In addition, by assuming that all workers invariably access retirement as soon as the possibility materializes, we do not allow the wealthiest workers to reach significantly high levels of pension incomes in our simulations. The underlying working assumption is that they would all prefer earlier retirement rather than higher benefits. Such an assumption may be too restrictive for the high percentiles of income distribution.

Table 7.5 shows the same adequacy indicators seen in Table 7.4, this time computed taking into consideration only workers with full careers (over 39 years of seniority).

TABLE 7.5: AVERAGE CONDITION AT RETIREMENT BY COMPUTATION RULE. FULL CAREERS (SENIORITY>39), 2012-2059

	Mixed 2011	Mixed 1995	NDC	TOT
Age	62.8	65.8	67.1	65.8
Gross replacement rate	82%	62%	54%	62%
Gross pension on average career wage ratio	103%	90%	86%	90%
Gross pension on average wage ratio	102%	79%	67%	79%
Gross pension on *assegno sociale* ratio	5.1	4.2	3.6	4.1

As anticipated, the slightest differences with Table 7.4 are observed for "Mixed 2011" pensioners, since the average seniority at retirement for that category of workers is already greater than 39 years. It is interesting to observe how the average age at retirement for workers with at least 40-year careers (Table 7.5) is lower than that computed over the whole sample (Table 7.4): late retirees are not making the choice to leave the labour market later on, but are rather compelled to keep active, pending the fulfilment of retirement criteria.

The differences among pensioners pertaining to different pension regimes are reflected on the generations populating the model. Indeed, a 3-year-gap in average effective retirement age and a 13% difference in replacement rates emerge between the model's new pensioners born in the '50s and those born in the '80s, as shown in Table 7.6-a.

Examining the poorer (Table 7.6-b) and the richer (Table 7.6-c) pensioners separately, we notice that the situation for the former does not seem to variate much in terms of pension amounts. It is visible how, among the 4 generations observed, the gap in pension benefits between the poor and the rich is projected to decrease over time. However, poorer pensioners will in general stay active longer than the richer, whatever generation they may pertain to, because they may have more trouble satisfying income and seniority eligibility requirements.

TABLE 7.6: AVERAGE CONDITION AT RETIREMENT BY BIRTH COHORT, 2012-2059

a. All pensions

	1950-59	*1960-69*	*1970-79*	*1980-89*
Age	65.9	67.2	68.1	68.6
Seniority	33.2	34.3	34.1	34.3
Gross replacement rate	63%	55%	50%	50%
Gross pension on average career wage ratio	86%	81%	80%	82%
Gross pension on average wage ratio	70%	61%	56%	56%
Gross pension on *assegno sociale* ratio	3.6	3.2	2.9	3.0

b. Pensions up to 3 times greater than the *assegno sociale*

	1950-59	*1960-69*	*1970-79*	*1980-89*
Age	67.3	68.2	69.3	69.9
Seniority	26.4	29.0	30.0	31.3
Gross replacement rate	51%	49%	48%	50%
Gross pension on average career wage ratio	73%	73%	77%	82%
Gross pension on average wage ratio	35%	36%	38%	41%
Gross pension on *assegno sociale* ratio	1.8	1.9	2.0	2.2

c.* Pensions more than 3 times greater than the *assegno sociale

	1950-59	1960-69	1970-79	1980-89
Age	64.6	65.9	66.3	66.4
Seniority	39.7	41.0	40.5	39.5
Gross replacement rate	72%	62%	53%	50%
Gross pension on average career wage ratio	97%	91%	85%	81%
Gross pension on average wage ratio	104%	92%	84%	82%
Gross pension on *assegno sociale* ratio	5.3	4.9	4.4	4.3

51% of the workers that retire during the simulation period belonging to the 1950-59 birth cohort are estimated to receive pension amounts over three times the amount of the *assegno sociale*. The quota decreases to 44% for the 1960-69 cohort, to 39% for the 1970-79 cohort and to 37% for the 1980-89 cohort.

In order to assess the position of workers with less stable careers, Table 7.7 shows the evolution in the condition of workers at retirement partitioning new pensioners into 3 categories according to the quota of time spent as temporary workers during their careers.

TABLE 7.7: AVERAGE GROSS REPLACEMENT RATE AND AVERAGE GROSS PENSION ON ASSEGNO SOCIALE RATIO BY BIRTH COHORT AND QUOTA OF CAREER SPENT AS TEMPORARY WORKER, 2012-2059

a. 1950

	Age	Gross replacement rate	Gross pension on *assegno sociale* ratio	Gross pension on average wage ratio
>66% of working history as temporary worker	64.5	62%	2.7	53%
33%-66% of working history as temporary worker	64.1	66%	4.3	84%
<33% of working history as temporary worker	65.6	65%	4.6	89%

b. 1960

	Age	Gross replacement rate	Gross pension on *assegno sociale* ratio	Gross pension on average wage ratio
>66% of working history as temporary worker	67.7	49%	1.7	31%
33%-66% of working history as temporary worker	64.5	55%	2.9	55%
<33% of working history as temporary worker	66.3	56%	4.1	78%

c. 1970

	Age	Gross replacement rate	Gross pension on *assegno sociale* ratio	Gross pension on average wage ratio
>66% of working history as temporary worker	70.0	48%	1.9	36%
33%-66% of working history as temporary worker	68.1	50%	2.4	45%
<33% of working history as temporary worker	66.2	50%	3.6	68%

d. 1980

	Age	Gross replacement rate	Gross pension on *assegno sociale* ratio	Gross pension on average wage ratio
>66% of working history as temporary worker	70.2	49%	2.2	42%
33%-66% of working history as temporary worker	69.2	50%	2.5	47%
<33% of working history as temporary worker	66.7	48%	3.4	64%

Note: Only individuals who have spent over 80% of their working lives as employees and have had working lives of at least 20 years of duration are considered.

Expectedly, the position of employees characterized by less stable working lives worsens for the younger generations. The biggest change is observed in terms of average age at retirement rather than the average amount of pension benefits.

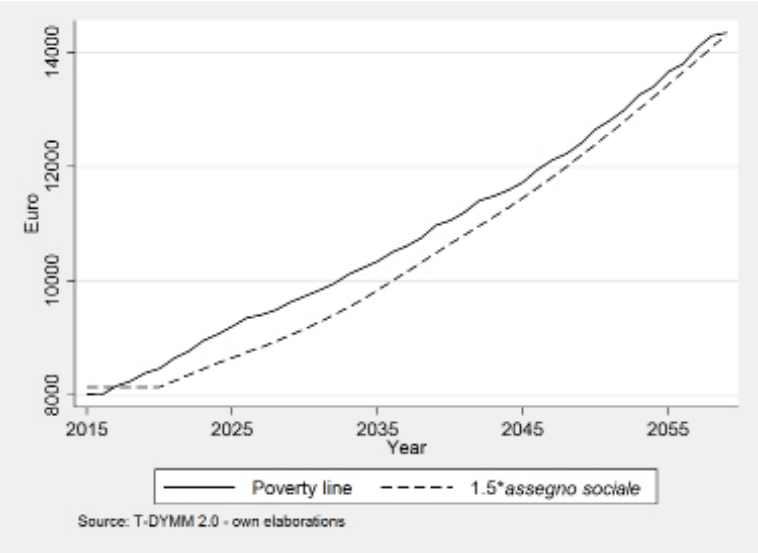
7.5 THE EVOLUTION OF POVERTY AND INEQUALITY INDICATORS

When assessing the evolution of poverty indicators, it is appropriate to take into consideration an "objective" indicator to go together with the traditional poverty rate, which is computed as the share of population (in our case, pensioners) with a level of equivalised disposable income[141] beneath the so-called poverty line[142]. We set this objective indicator to be 1.5 times the level of the *assegno sociale*, which is also the legislated amount requirement for NDC workers under "Old Age 2" criteria.

Since poverty indicators are better assessed employing net values, and the taxation module only produces results from 2015 forth, our poverty indicators are also built from that date onwards.

Figure 7.25 illustrates how the two poverty thresholds evolve overtime. It is evident how their values are overall rather close. However, while in the first years of the simulation period the amount of the *assegno sociale* is kept equal to the level set in 2011, the median equivalised disposable income still grows and a visible shift emerges between the two indicators.

FIGURE 7.25: "SUBJECTIVE" AND "OBJECTIVE" POVERTY THRESHOLDS, 2015-2060



As a result, Figures 7.26 and 7.27 show a different dynamic in the poverty indicators, and the overall variation differs by about 1 percentage point.

141 The equivalised disposable income is the total income of a household, after tax and other deductions, that is available for spending or saving, divided by the number of household members converted into equalised adults; household members are equalised (or made equivalent) by weighting each according to their age, using the so-called modified OECD equivalence scale. The following scale gives a weight to all members of the household: 1.0 to the first adult; 0.5 to the second and each subsequent person aged 14 and over; 0.3 to each child aged under 14 (Eurostat).

142 Set at 60 % of the national median equalised disposable income after social transfers.

FIGURE 7.26: POVERTY RATE, 2015-2059

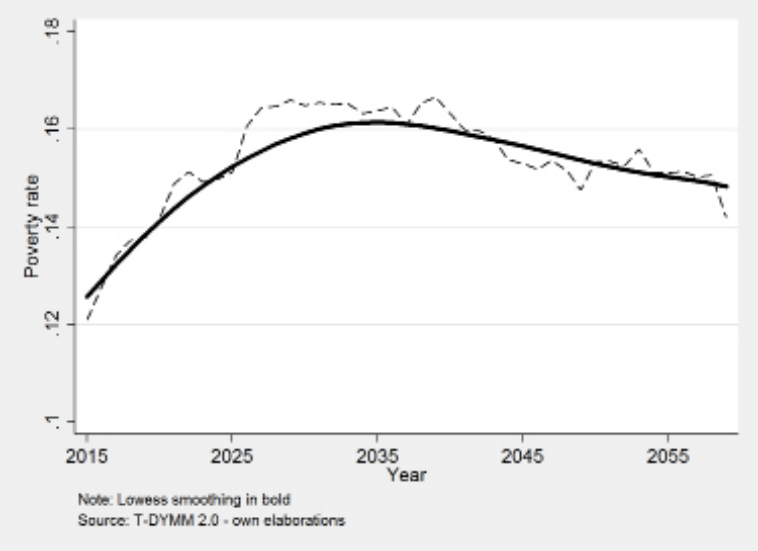
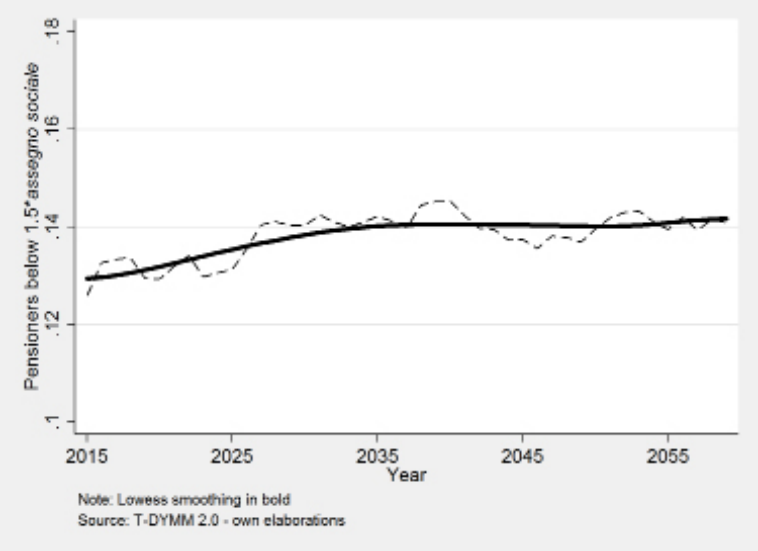
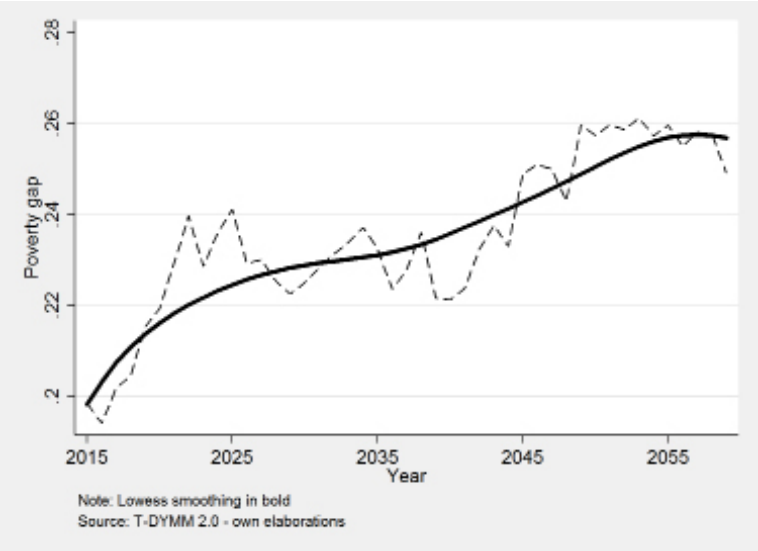


FIGURE 7.27: QUOTA OF PENSIONERS BENEATH 1.5 TIMES THE ASSEGNO SOCIALE, 2015-2059



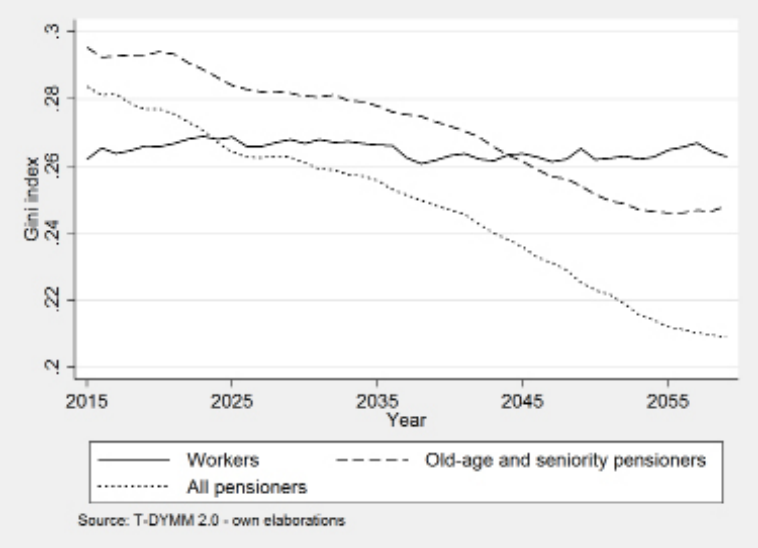
The intensity – or depth – of poverty for pensioners is assessed by the poverty gap indicator, a measure that reflects how far the poor are from the poverty line, and is computed as the difference between the poverty line and the median income of pensioners below the poverty line, divided by the poverty line.

FIGURE 7.28: POVERTY GAP, 2015-2059



For what concerns inequality, Figure 7.29 shows the evolution of the Gini index over the simulation period, separately for old-age and seniority pensioners and for all pensioners (including those receiving social benefits and integrations from social assistance). Because inequality indicators are better observed on net incomes, results are presented from 2015 onwards.

FIGURE 7.29: INCOME INEQUALITY AMONG PENSIONERS. GINI INDEX, 2015-2059

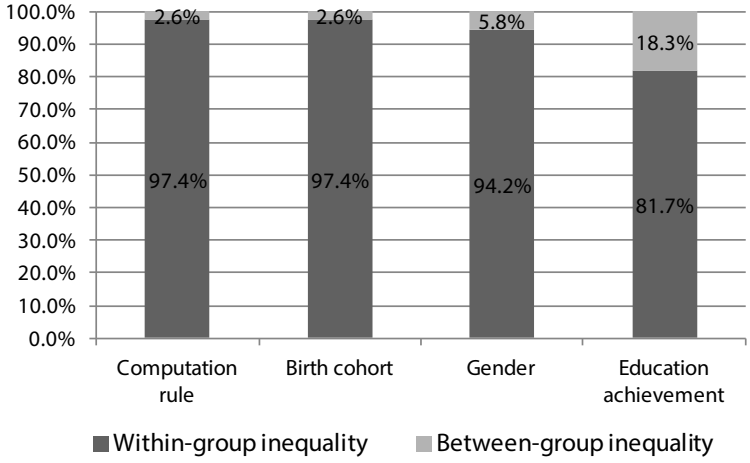


We have already noted how the introduction of NDC computation rules penalises richer careers more than it does flat careers; therefore, the general decrease in the Gini index does not come as a surprise. The steeper decrease when considering all pensioners is explained by the increasing role of social assistance observed in T-DYMM during the simulation period: the quota of pension benefits that receive at least a social assistance integration rises from 5% in 2012 to 10% in 2059. The reduction in dispersion is related to an overall reduction of the amounts.

For what concerns between and within-group inequality, observed on all pensioners, we have employed the Theil index, a special case of the General Entropy index where the parameter α – the weight given to dis-

tances between incomes at different points of the income distribution – is set equal to 1. We have divided the population in groups according to different characteristics and Figure 7.30 shows that most of the inequality is observed within, not between groups. The highest values of within-group inequality are detected when the sample is divided by gender and level of education.

FIGURE 7.30: INCOME INEQUALITY AMONG PENSIONERS BY COMPUTATION RULE, BIRTH COHORT, GENDER AND EDUCATION. THIEL INDEX, 2015-2059

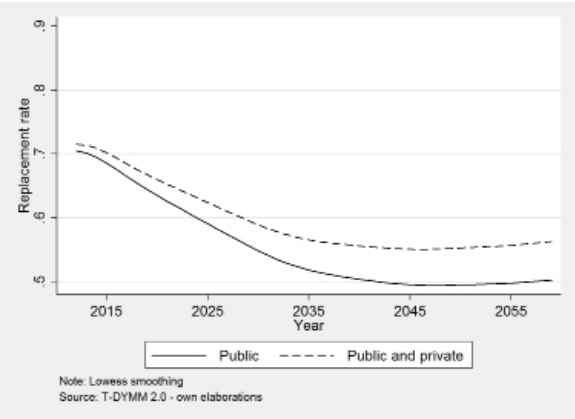


7.6 THE IMPACT OF PRIVATE PENSION PLANS

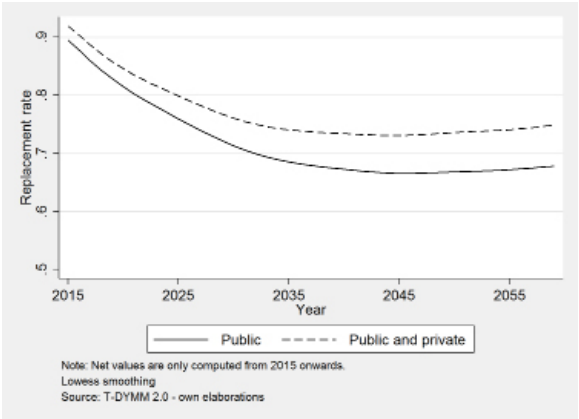
One of the main innovations of T-DYMM 2.0 is the estimation of the impact of private pension plans on benefit levels and adequacy indicators. Chapters 5 and 6 have provided details on the features of T-DYMM's submodule on private pensions. This section is devoted to examine the results of the simulations.

FIGURE 7.31: AVERAGE REPLACEMENT RATE. THE IMPACT OF PRIVATE PENSIONS. 2012-2059

a. **Gross**



b. **Net**

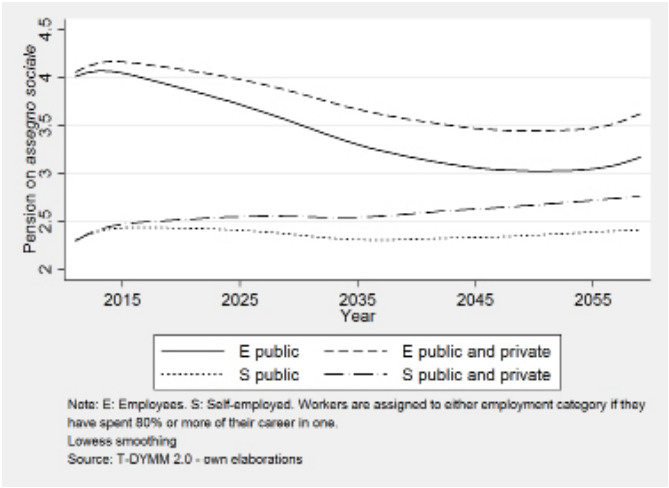


As visible from Figure 7.31 and Figure 7.32, private pension benefits have a great impact on replacement rates over time: accrual of private contribution is a recent phenomenon in Italy and it is expected to increase

in the upcoming years (see Chapter 6, Paragraph 6.3). If first pillar benefits are considered alone, the quota of pensioners earning benefits up to 3 times the *assegno sociale* amount rises from 49.2% for the 1950-59 birth cohort to 63% in the 1980-89 birth cohort. If the second and the third pension pillars are taken into account, these figures change to 47.4% and 46.9% respectively. The development of private pension schemes effectively offsets the decrease of public benefits when average values are considered.

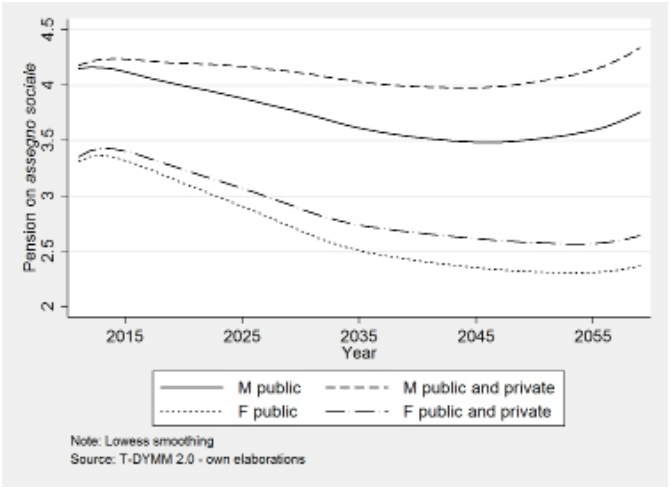
Analysing the impact by employment category (Figure 7.32), we notice a larger impact in absolute terms for employees rather than independent workers: because of the possibility to devolve the TFR to pension funds (see Chapter 4, Paragraph 4.4), employees generally invest a larger part of their gross wages on pension funds. This slight difference in the incidence of private pension benefits, however, does not significantly influence the gap reduction in terms of average pension amounts between the two employment categories that is visible when public pensions are considered alone.

FIGURE 7.32: AVERAGE GROSS PENSION ON ASSEGNO SOCIALE RATIO BY EMPLOYMENT CATEGORY. THE IMPACT OF PRIVATE PENSIONS. 2012-2059



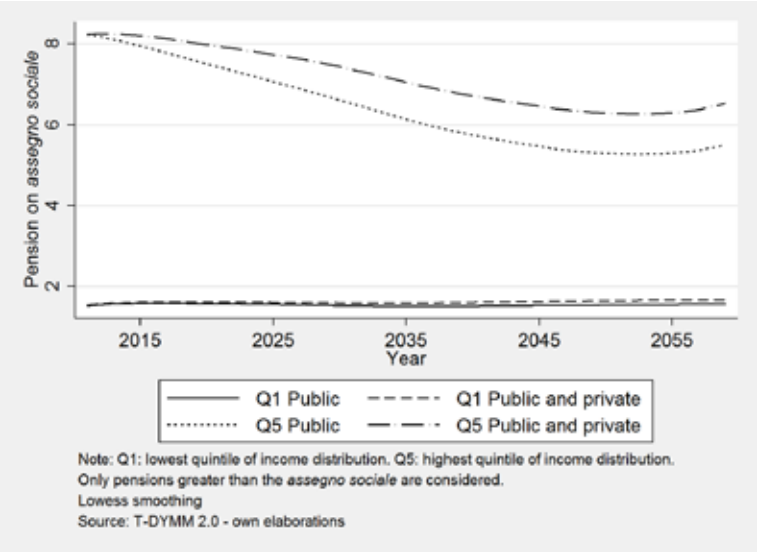
When genders are considered separately, according to T-DYMM 2.0 projections, the development of private pension schemes will favour male workers more than female workers. Figure 7.33 shows how the gender gap is bound to widen further.

FIGURE 7.33: AVERAGE GROSS PENSION ON ASSEGNO SOCIALE RATIO BY GENDER. THE IMPACT OF PRIVATE PENSIONS. 2012-2059



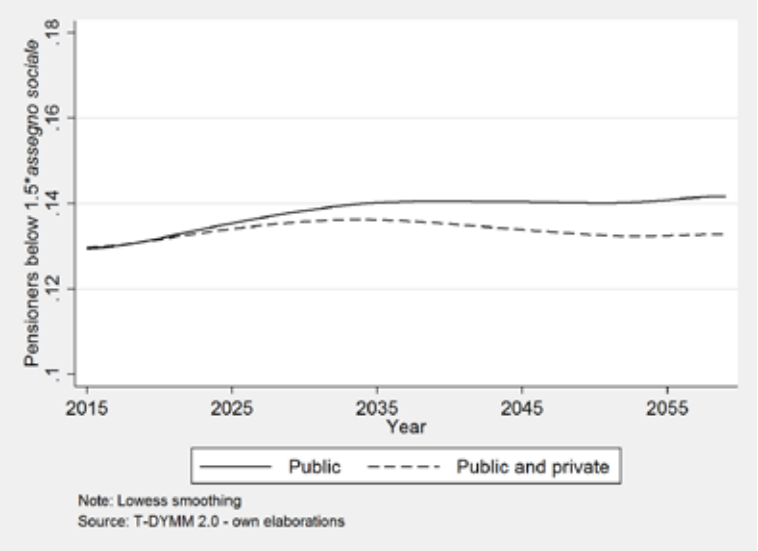
Expectedly, the strongest differences emerge when different income classes are considered. Figure 7.34 compares the impact of private pensions on the first and last quintile of gross income distribution for new pensioners. The richer are more likely to enrol in private pension plans and to contribute with larger sums.

FIGURE 7.34: AVERAGE GROSS PENSION ON ASSEGNO SOCIALE RATIO BY INCOME CATEGORY. THE IMPACT OF PRIVATE PENSIONS. 2012-2059



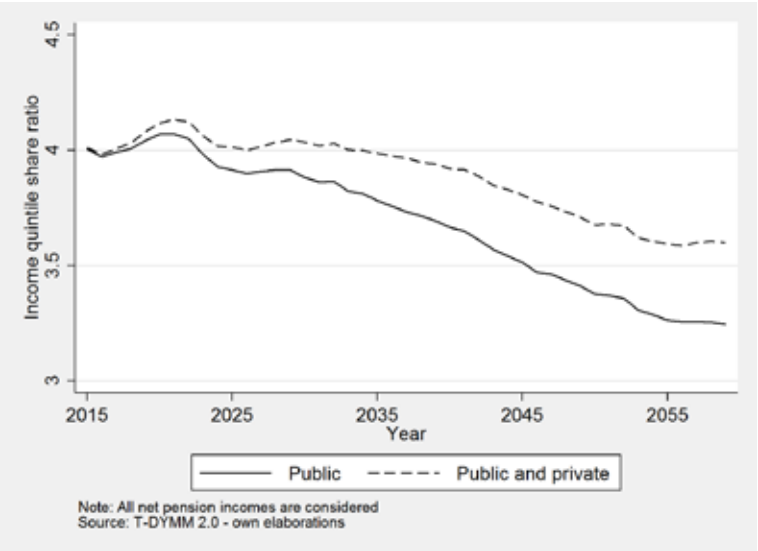
As a consequence, the consideration of private pension benefits has a rather mild effect over the poverty indicators observed in Paragraph 7.5, as shown by the dynamics of the quota of pensioners beneath 1.5 times the *assegno sociale* in Figure 7.35.

FIGURE 7.35: QUOTA OF PENSIONERS BENEATH 1.5 TIMES THE ASSEGNO SOCIALE. THE IMPACT OF PRIVATE PENSIONS. 2015-2059



Because of the further advantage attributed to the wealthiest workers, a scenario with private pension funds presents a less equal income distribution among pensioners compared to a scenario where only public pensions are considered. Figure 7.36 shows the evolution of the income quintile share ratio during the simulation period.

FIGURE 7.36: INCOME QUINTILE SHARE RATIO (P80/P20) FOR PENSIONERS, THE IMPACT OF PRIVATE PENSIONS. 2015-2059



REFERENCES

European Commission - Directorate-General for Economic and Financial Affairs (2015), "The 2015 Ageing Report: Economic and budgetary projections for the EU28 Member States (2013-2060)".

8. SIMULATION RESULTS: SENSITIVITY ANALYSES

In order to test the volatility of the model and perform some validation of the estimates, different sensitivity tests have been carried out with respect to the key underlying macroeconomic and demographic assumptions underpinning the *Baseline* scenario. The sensitivity tests provide useful information on the robustness of the projections to changes in the key underlying assumptions. The relative impact can be considered as an "elasticity" parameter.

The demographic and macroeconomic key assumptions underlying the *Baseline* scenario are summed up in Table 8.1.

TABLE 8.1: KEY ASSUMPTIONS: DEMOGRAPHIC AND MACROECONOMIC

	Key Assumptions	*Data source*
1	Mortality rates	AWG 2015
2	Fertility rates	AWG 2015
3	Employment rates	AWG 2015
4	GDP growth rates	AWG 2015
5	Private pension returns	Our hypothesis

The sensitivity tests have been carried out foreseeing four alternative scenarios *vis-à-vis* the *Baseline*. The alternative scenarios have been applied as follows:

1. Shocks on labour and Total Factor Productivity;
2. Shocks on employment rates, so as to produce a higher/lower employment rate scenarios;
3. Shocks on the rates of return of private pension funds, combined with a consistent GDP growth rate scenario;
4. Shock on fertility rate.

Paragraph 8.1 describes more in details the assumptions that have been used to build the alternative demographic and macroeconomic scenarios. The following paragraphs illustrate the main findings and the relevant discrepancies in comparison to the *Baseline* scenario presented in Chapter 7.

8.1 SENSITIVITY TESTS: ASSUMPTIONS

8.1.1 SHOCKS ON PRODUCTIVITY

The GDP growth rate has a crucial role in determining the notional rate of return for the first pillar's pensions. In order to assess the sensitivity of pension adequacy to changes in the underlying GDP growth rates projections, a double shock on GDP growth rate has been simulated by modifying the assumptions related, respectively, to labour and total factor productivity (TFP). Figures 8.1 and 8.2 show two different hypotheses on GDP growth rates: (a) a "higher GDP growth rate" obtained increasing labour productivity and (b) a "lower GDP growth rate" resulting from lowering TFP converging rates.

Under the positive growth shock, presented in Figure 8.1, labour productivity growth converges linearly to a higher rate in 2025 (+0.25 percentage points *vis-à-vis* the *Baseline*) and then remains constant to this higher rate afterwards. Accordingly, GDP growth already accelerates in 2016, reaching a rate of 1.7% at the end of projection period, 0.3 percentage points higher than the *Baseline*.

FIGURE 8.1: HIGHER GDP GROWTH RATES (+0.25 PP HIGHER LABOUR PRODUCTIVITY)

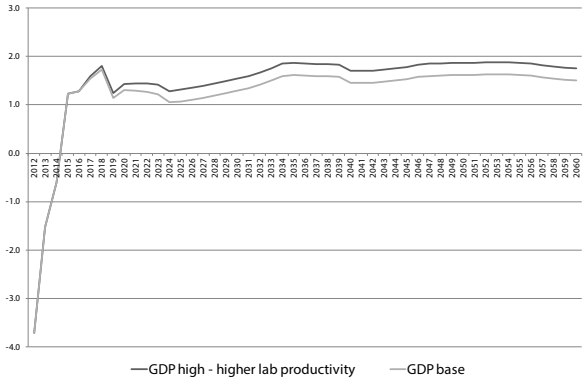
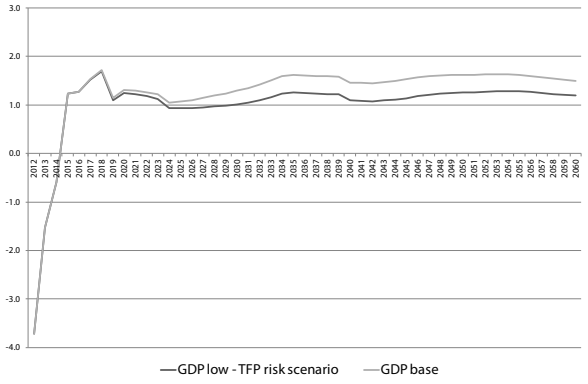


FIGURE 8.2: LOWER GDP GROWTH RATES (0.2% LOWER TFP GROWTH)



Under the negative growth shock, presented in Figure 8.2, in line with the AWG 2015 assumptions, Total Factor Productivity growth would converge to 0.8% (instead on 1%) in 2035. Figure 8.2 shows the resulting lower GDP growth rate over the whole projection period. GDP growth is expected to be -0.2 percentage points lower on average than the *Baseline* over the period 2016-2060.

8.1.2 SHOCKS ON EMPLOYMENT RATES

As described above, T-DYMM 2.0 probabilistically simulates the individuals who are supposed to participate in the labour market and those who stay out of it. The percentage of working individuals by gender and age each year is aligned to AWG 2015 *Baseline* projections.

In order to test the relevance of such assumption, a double shock on employment rates has been introduced: (a) a higher employment rate and (b) a lower employment rate. In both scenarios, the employment rate is assumed to be 2 p.p. higher/lower compared with the *Baseline* projection for the age group 20-64 starting from 2025. The increase/decrease is linear over the period 2016-2025 and the difference remains constant at 2 p.p. thereafter[143].

143 This sensitivity scenario corresponds to AWG 2015 sensitivity test scenario labeled "Higher employment rate scenario".

For simplicity's sake, in Figures 8.3 and 8.4 only the change of employment rates (15-64) by gender is presented, even if in the simulation model we introduce employment rates by gender relative to each age.

FIGURE 8.3: HIGHER EMPLOYMENT RATES – MALE (15-64)

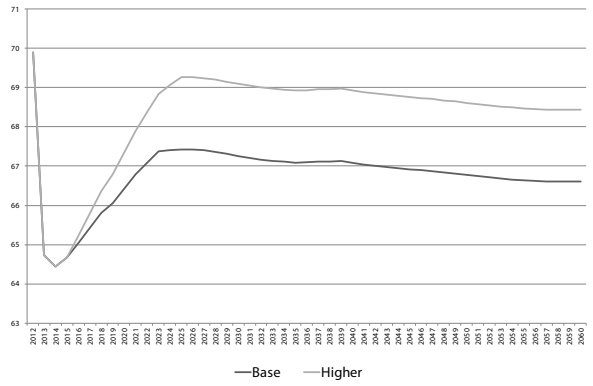


FIGURE 8.4: HIGHER EMPLOYMENT RATES – FEMALE (15-64)

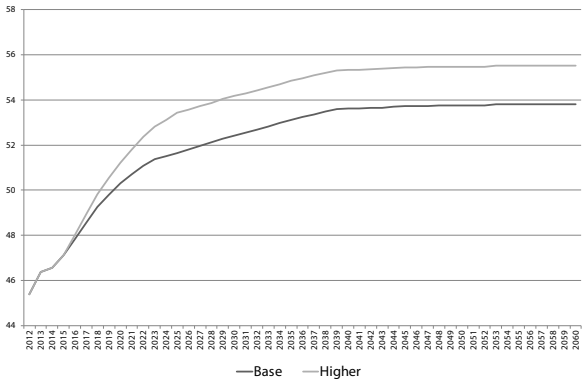


Figure 8.3 shows the higher employment rates of male workers. At the beginning of the period (2012-2014), due to the impact of the crisis, a strong contraction in employment rates for male workers has been registered, while after 2014 the employment rates resume in both the *Baseline* and the *High employment* scenarios. However, even in the *High employment* scenario the employment rate is not expected to reach the pre-crisis period levels over the projection horizon. Figure 8.4 instead shows the higher employment rates of female workers *vis-à-vis* the *Baseline*. For female workers, the projected path is rather different from the one of male workers. After a period in which their employment rate is projected to accelerate (2016-2039), starting from 2040 it becomes rather flat at values around the 55.3%-55.5%.

Figures 8.5 and 8.6 show the lower employment rates for male and female workers.

FIGURE 8.5: LOWER EMPLOYMENT RATES – MALE (15-64)

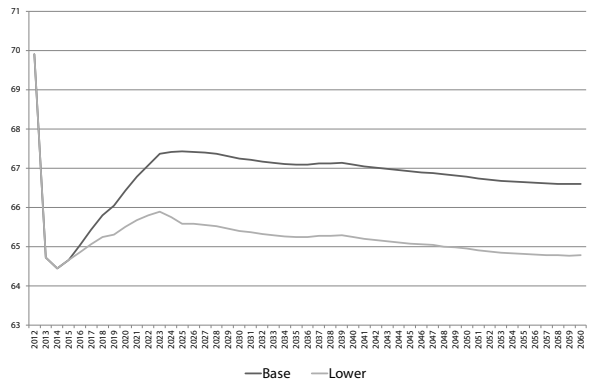
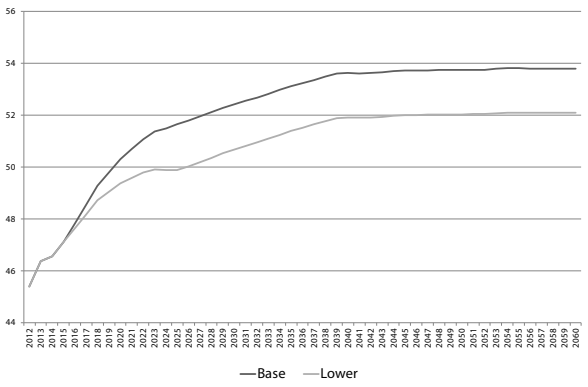


FIGURE 8.6: LOWER EMPLOYMENT RATES – FEMALE (15-64)



The alternative employment scenarios cause GDP growth rates to differ from the *Baseline*. On the basis of AWG 2015 dynamics, both a positive and a negative shock on employment rates produce a slightly higher/lower GDP growth *vis-à-vis* the *Baseline*.

FIGURE 8.7: HIGHER GDP GROWTH RATES

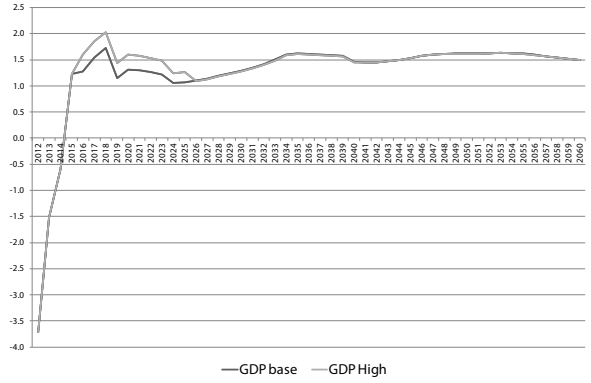
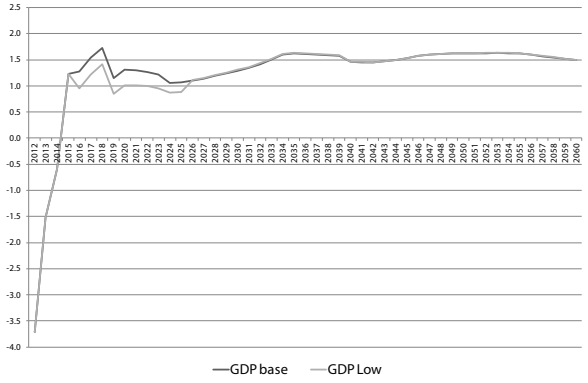


FIGURE 8.8: LOWER GDP GROWTH RATES



8.1.3 SHOCKS ON RATES OF RETURN OF PENSION FUNDS AND ON GDP GROWTH

In Chapter 5 (sub-paragraph 5.3.5.2), private pensions' rates of return have been defined for the *Baseline* scenario, differentiating between occupational and individual schemes. In this section, two new sensitivity tests are introduced, in which we assume:

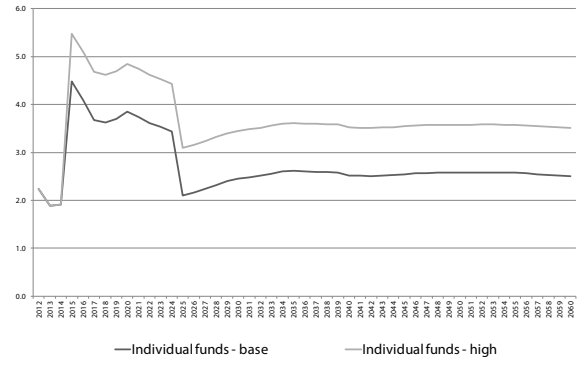
1. a positive shock on private pensions' rate of return combined with "higher GDP growth rate";
2. a negative shock on private pensions' rate of return combined with "lower GDP growth rate".

The positive/negative shock on private pensions' rates of return is combined with the consistent GDP growth rate scenario, adopting the alternative hypotheses on GDP described above in Paragraph 8.1.1. In the current section, a special focus is devoted only to the alternative scenarios on private pensions' rates of return.

Figures 8.9 and 8.10 show a positive shock on private pensions' *Baseline* rates of return of +1 percentage point. The rate of return for occupation funds in the *High return* scenario amounts to 4.5% on average from 2012 to 2020, and it decreases to 3.5% on average from 2021 until the end of the projection period. The rate of return for individual funds amounts to 3.9% on average from 2012 to 2020, and decreases to 3.6% in the remaining period. As mentioned earlier, the shock on private pensions' rates of return is combined with a coherent shock on GDP growth rate (See Figure 8.1).

FIGURE 8.9: HIGHER RATES OF RETURN – OCCUPATIONAL SCHEME

FIGURE 8.10: HIGHER RATES OF RETURN – INDIVIDUAL SCHEME



Figures 8.11 and 8.12 show a negative shock on private pensions' rates of return, symmetric to the *High return* scenario, in which a decrease of 1 percentage point was assumed.

FIGURE 8.11: LOWER RATES OF RETURN – OCCUPATIONAL SCHEME

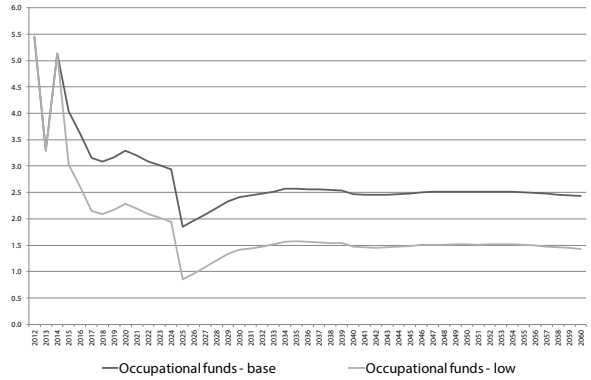
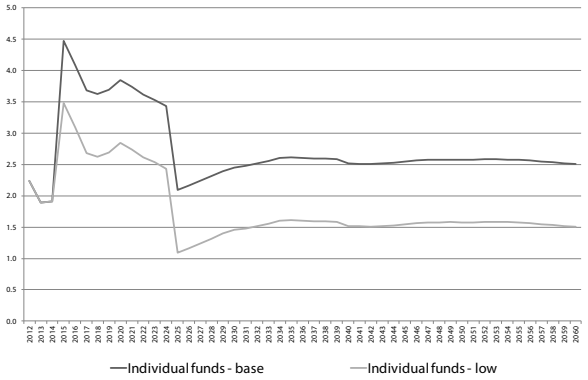


FIGURE 8.12: LOWER RATES OF RETURN – INDIVIDUAL SCHEME



8.1.4 SHOCK ON FERTILITY RATES

In the *Baseline* scenario, it is assumed that for each woman in fertile age (14-50 years old) the probabilities to give birth are aligned to those of AWG (2015) reference scenario, which in turn are based on Eurostat demographic projections with 2013 as base year. According to this assumption, the Total Fertility Rate (TFR) will converge to 1.61 in 2060. Against this backdrop, a shock on the TFR is assumed. Accordingly, from 2016 until 2023 the TFR is gradually increased up till 2.0, whereas from 2023 until the end of the projections (2060), it is assumed to remain constant at 2.0 (Figure 8.13). The new assumptions on fertility has been applied with no modification of the population weights for each age cohort.

FIGURE 8.13: POSITIVE SHOCK ON TFR

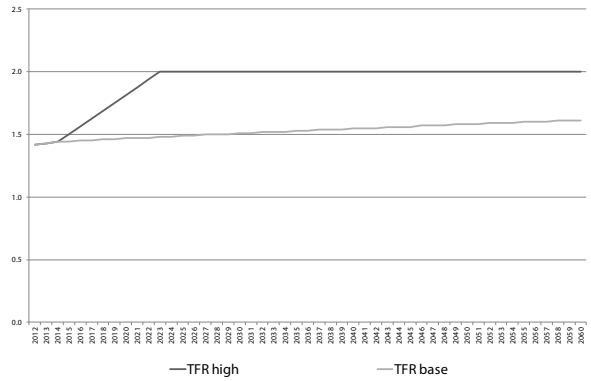
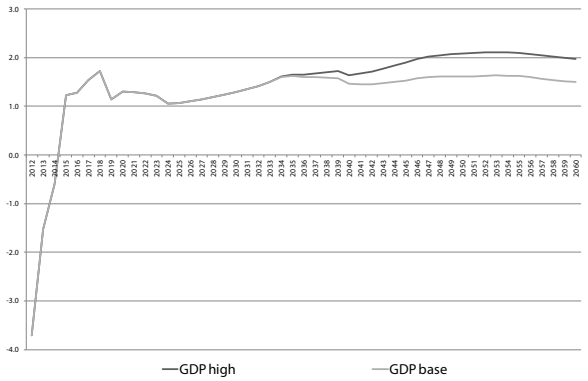


FIGURE 8.14: HIGH GDP GROWTH RATES IN THE HIGH FERTILITY SCENARIO



The higher TFR[144] has a second round effect on participation rates in the long run, which in turn produces a positive impact on GDP growth rates (Figure 8.14), leaving the other key assumptions unchanged (*ceteris paribus*).

144 European Commission (2015), Directorate-General for Economic and Financial Affairs, The 2015 Ageing Report: Underlying Assumption and Projection Methodologies.

Figure 8.14 shows the evolution of GDP growth rates for the *Baseline* and *High fertility* scenarios. Until 2036, both scenarios proceed on the same growth path, while afterwards GDP growth accelerates under the alternative assumption. At the end of the projection (2060) the GDP growth rate in the *High fertility* scenario is 0.3 percentage points higher with respect to the *Baseline*.

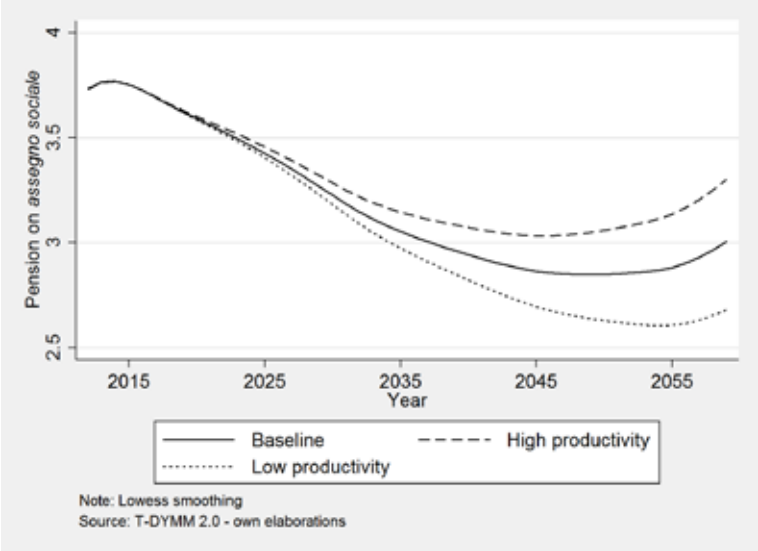
8.2 SENSITIVITY TESTS: RESULTS

8.2.1 SHOCKS ON PRODUCTIVITY

The sensitivity analyses is carried out by shocking productivity indicators (TFP or labour productivity, according to the correspondent AWG scenario).

When NDC computation rules are in place, a change in productivity does not only influence gross wage dynamics, but also the notional rates of return on contributions paid out to the public pension scheme. Figure 8.15 shows how the ratio between pension and *assegno sociale* at retirement is affected under alternative assumptions on labour and total factor productivity[145].

FIGURE 8.15: GROSS PENSION ON ASSEGNO SOCIALE RATIO, OVERALL AVERAGE. SHOCKS ON PRODUCTIVITY. 2012-2059

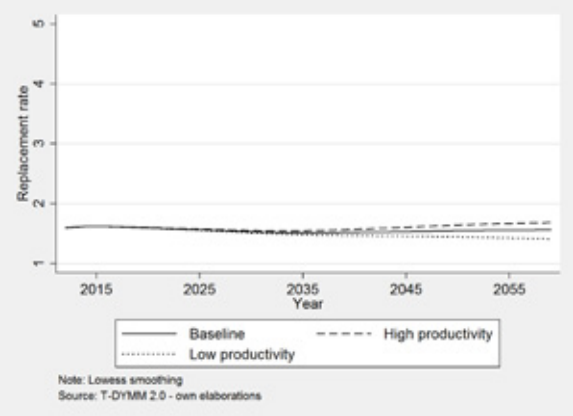


As highlighted by Figure 8.16, the lion's share of the change in absolute terms is observed for the higher quintiles of income distribution. However, given the different scale of the phenomenon, the variation for poorer pensioners is proportionally more relevant.

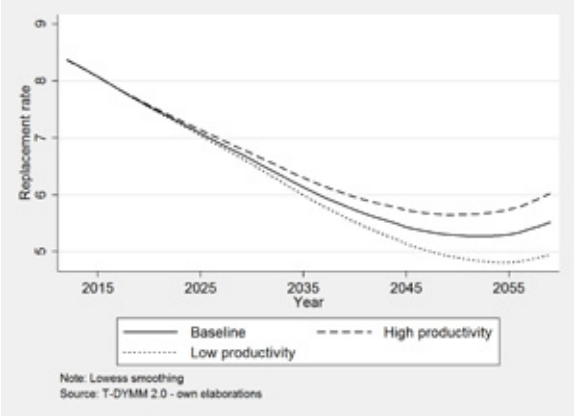
145 In order to allow for an easier comparison of the results, throughout this chapter – regardless of the scenario – the level of the *assegno sociale* we kept into consideration when designing indicators is the one pertaining to the *Baseline* scenario.

FIGURE 8.16: GROSS PENSION ON *ASSEGNO SOCIALE* RATIO BY INCOME CATEGORY. SHOCKS ON PRODUCTIVITY. 2012-2059

a. **First quintile of income distribution**



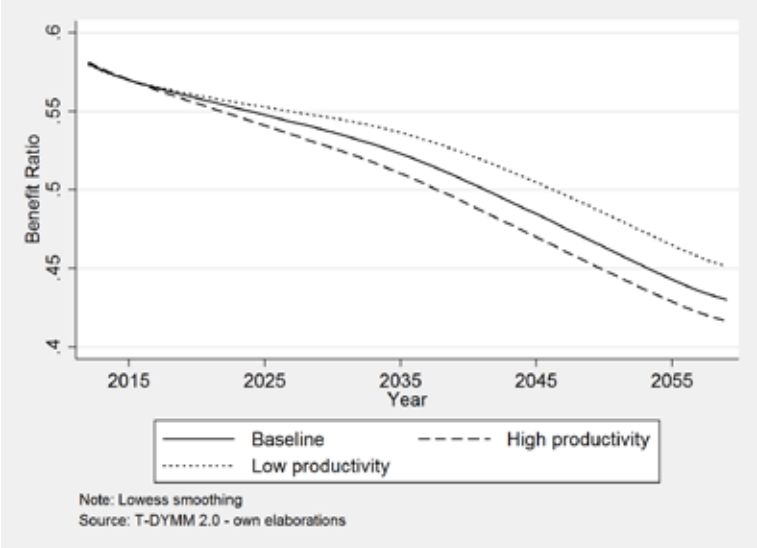
b. **Last quintile of income distribution**



Note: Only pensions greater than the assegno sociale are considered

As far as the benefit ratio is concerned (Figure 8.17), it is relevant to note how, under less favorable macroeconomic circumstances, the indicator improves, whereas it worsens under assumptions that are more favorable. Being computed as the average pension divided by the average salary in a given period, thus indicating the overall generosity of the pension system, the variation in the benefit ratio between scenarios shows that pensioners on average are less exposed to macroeconomic shocks than workers.

FIGURE 8.17: BENEFIT RATIO. SHOCKS ON PRODUCTIVITY. 2012-2059



Note: All gross public pension incomes are considered

Figure 8.18 shows the changes observed in the poverty rate when productivity is shocked. Because poverty indicators are computed on net values, results are only shown from 2015 onwards. Very small differences among the three scenarios are noticed. In the first years of the simulation, higher productivity growth rates impact salaries more than they affect pension benefits. Indeed, lower/higher productivity growth rates do not

impact benefits already being paid at all. Therefore, the position of pensioners worsens/improves compared to workers and the former will be relatively poorer. At the end of the simulation period, the effect produced by lower/higher GDP growth rates on pension entitlements makes the poverty rate higher in the *Lower productivity* scenario and lower in the *Higher productivity* scenario.

FIGURE 8.18: POVERTY RATE. SHOCKS ON PRODUCTIVITY. 2012-2059

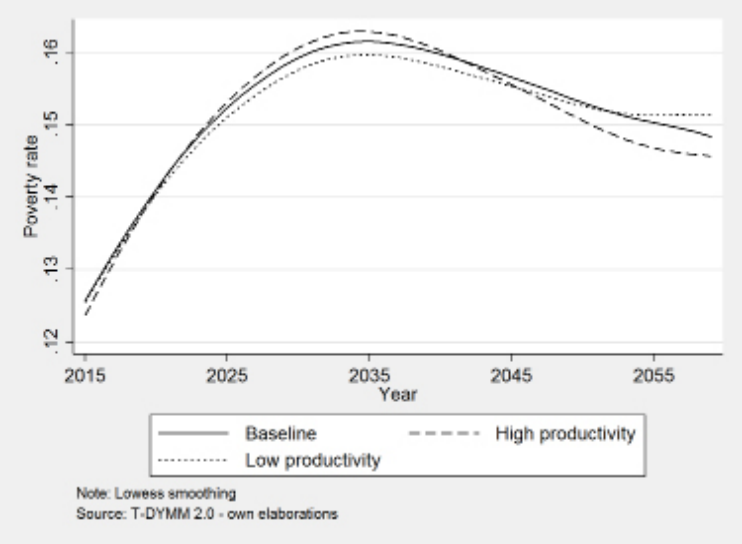
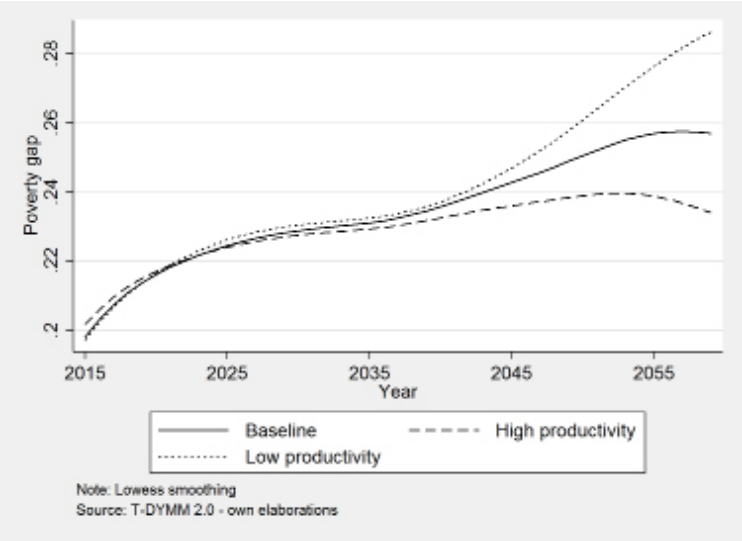


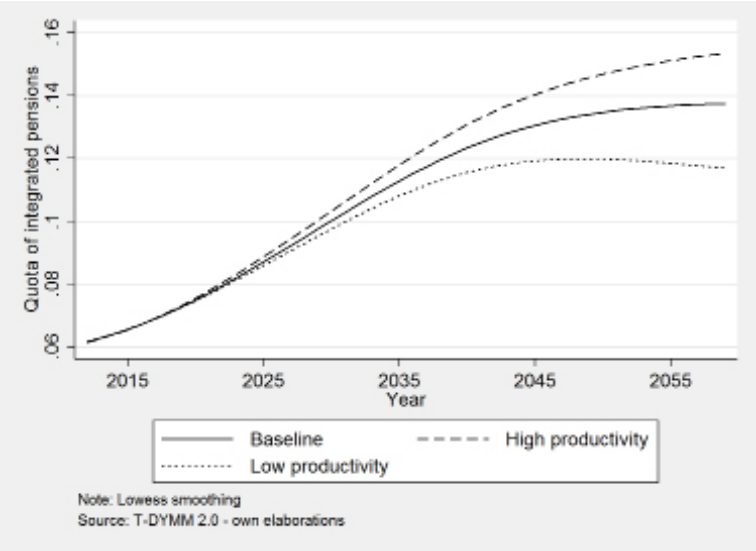
Figure 8.19 shows the evolution of the poverty gap indicator, already seen in Figure 7.28. Expectedly, the intensity of poverty is inversely correlated to productivity growth rates.

FIGURE 8.19: POVERTY GAP. SHOCKS ON PRODUCTIVITY. 2012-2059



Because the amounts of social assistance benefits are indexed to GDP growth and GDP growth is correlated with productivity growth, variations in productivity growth rates determine variations in the growth rates of social assistance benefits. Therefore, the quota of pensioners that receive integration on their pension benefits from social assistance increases in the *High productivity* scenario and it decreases in the *Low productivity* scenario (Figure 8.20).

FIGURE 8.20: QUOTA OF PENSIONERS RECEIVING (FULL OR PARTIAL) SOCIAL SECURITY INTEGRATION. SHOCKS ON PRODUCTIVITY. 2012-2059



8.2.2 SHOCKS ON EMPLOYMENT RATES

The sensitivity analyses is carried out by shocking employment rates and consistently assuming a different projection in terms of GDP growth rates.

Since under NDC computation rules pension benefits are the result of the amount of notional contributions accrued throughout individual working careers, shocks on employment rates highly influence the condition of future pensioners. The combined effect of more (less) stable careers and higher (lower) returns on notional contributions – due to variations in GDP growth – produces changes similar to the ones observed in Figure 8.15 in terms of the average ratio of gross pensions on the *assegno sociale* (Figure 8.21), albeit generally smaller.

FIGURE 8.21: GROSS PENSION ON *ASSEGNO SOCIALE* RATIO, OVERALL AVERAGE. SHOCKS ON EMPLOYMENT RATES. 2012-2059

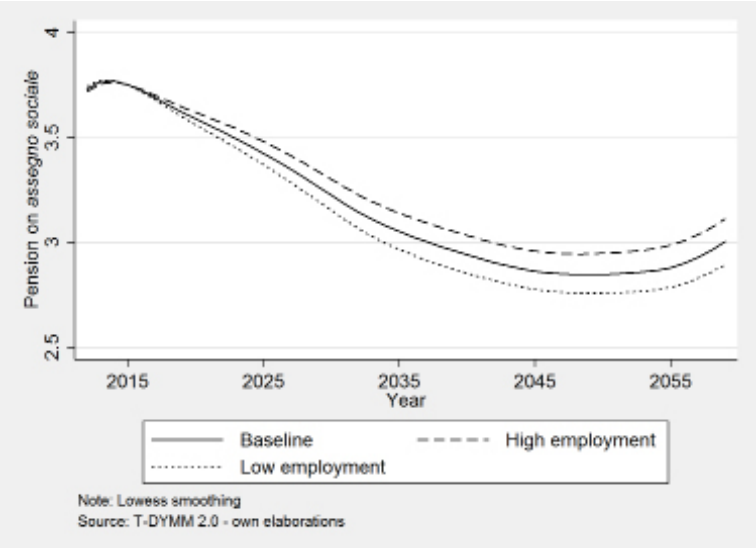
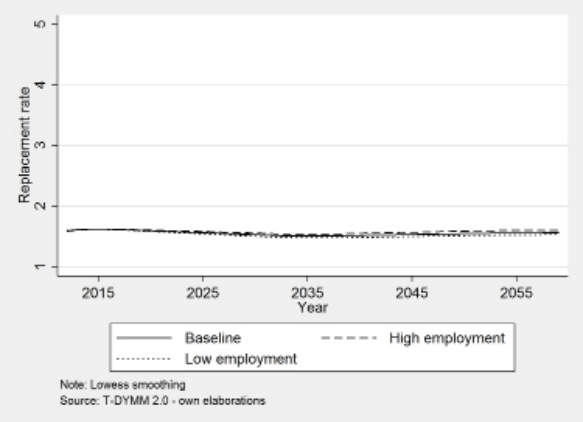


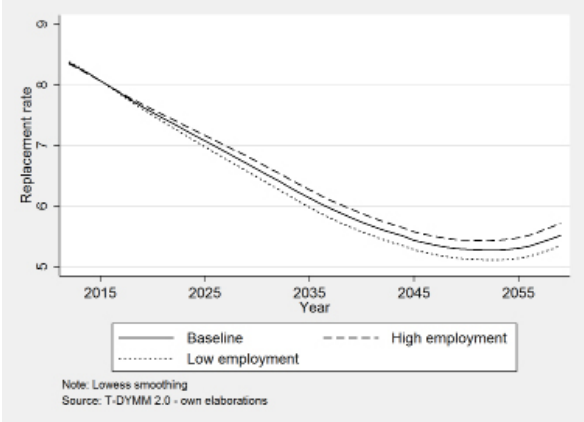
Figure 8.22 shows the impact on benefit levels by income level. Overall, higher growth in average employment rates favours richer workers more than it does with poorer workers, since the latter are generally less employable.

FIGURE 8.22: GROSS PENSION ON *ASSEGNO SOCIALE* RATIO BY INCOME CATEGORY. SHOCKS ON EMPLOYMENT RATES. 2012-2059

c. **First quintile of income distribution**



d. **Last quintile of income distribution**

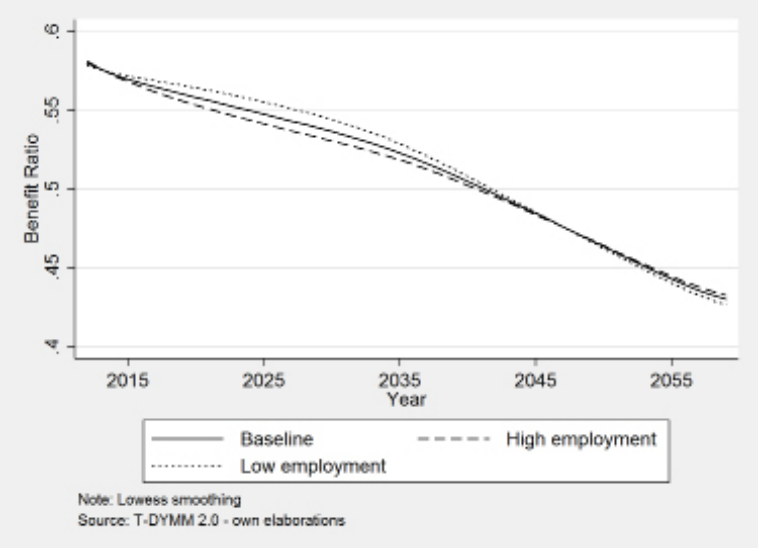


Note: Only pensions greater than the *assegno sociale* are considered

In terms of the benefit ratio (Figure 8.23), since higher/lower employment rates determine an increase/decrease in GDP growth and wages, the Low scenario provides more favorable results because, as noticed above, pensions are less exposed to macroeconomic shocks than wages.

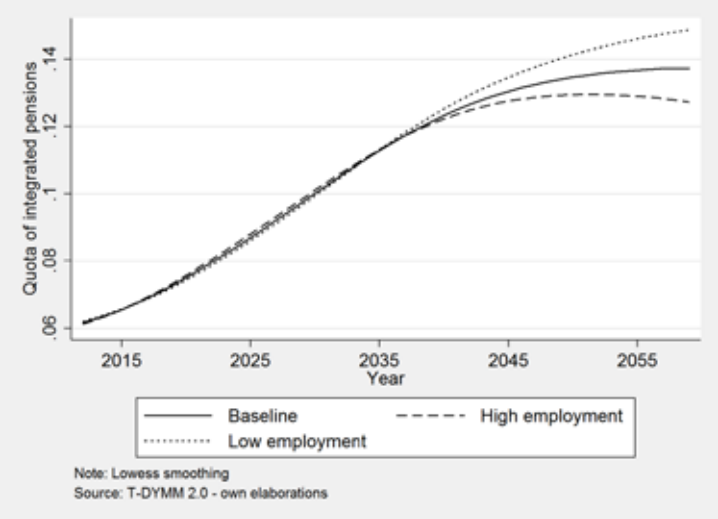
However, the distances from the Baseline scenario appear less visible and are concentrated in the first part of the simulation period, where the differences in the GDP growth rates series among scenarios are larger.

FIGURE 8.23: BENEFIT RATIO. SHOCKS ON EMPLOYMENT RATES. 2012-2059



The quota of pensioners receiving a (full or partial) social security integration to their benefits (Figure 8.24) is also influenced by the stability of workers' careers.

FIGURE 8.24: QUOTA OF PENSIONERS RECEIVING (FULL OR PARTIAL) SOCIAL SECURITY INTEGRATION. SHOCKS ON EMPLOYMENT RATES. 2012-2059

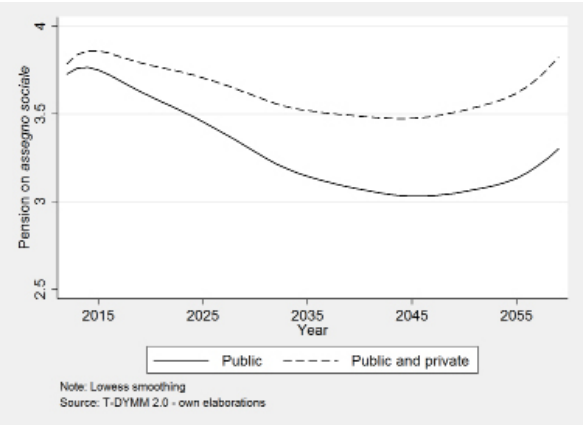


8.2.3 SHOCKS ON RATES OF RETURN OF PENSION FUNDS AND ON GDP GROWTH

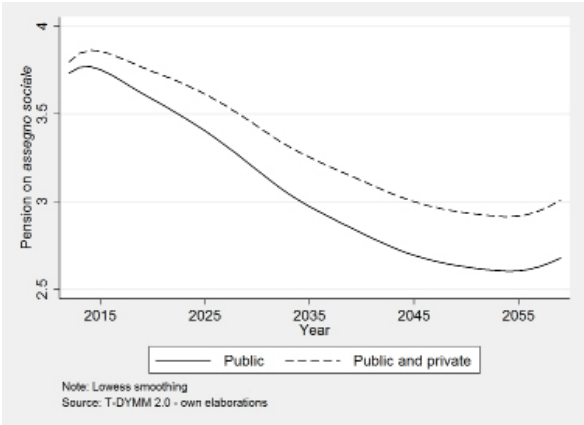
This set of sensitivity analyses has been carried out by shocking the rates of return on pension fund savings. GDP growth rates also vary accordingly, in line with the high/low productivity growth assumptions employed in Paragraph 8.2.2. The impact of such combined shocks on the ratio between gross pension and *assegno sociale* is presented in Figure 8.25, accounting for private pension integration to public pension benefits.

FIGURE 8.25: AVERAGE GROSS PENSION ON *ASSEGNO SOCIALE* RATIO, OVERALL AVERAGE. THE IMPACT OF PRIVATE PENSIONS. SHOCKS ON RATES OF RETURN AND GDP GROWTH. 2012-2059

a. ***High returns* scenario**



b. ***Low returns* scenario**



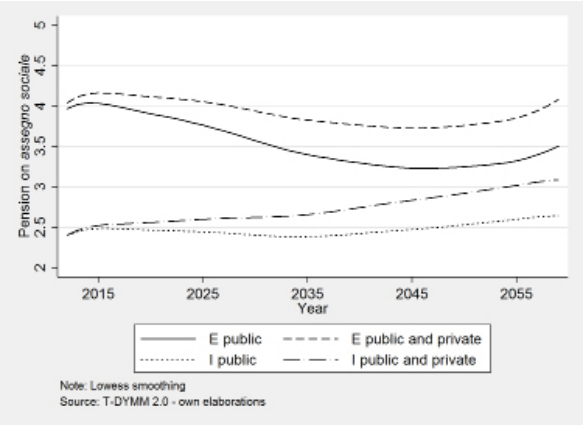
In the *Baseline* scenario, at the end of the simulation period average total pension benefits are higher than average public pension benefits alone by 14.1%, in the *High returns* scenario the increase is of 16.2% and in the

Low returns scenario the distance is reduced to 12.6%. Higher returns expectedly give a higher advantage to the workers who do invest in private pension funds, but different categories of workers are impacted differently.

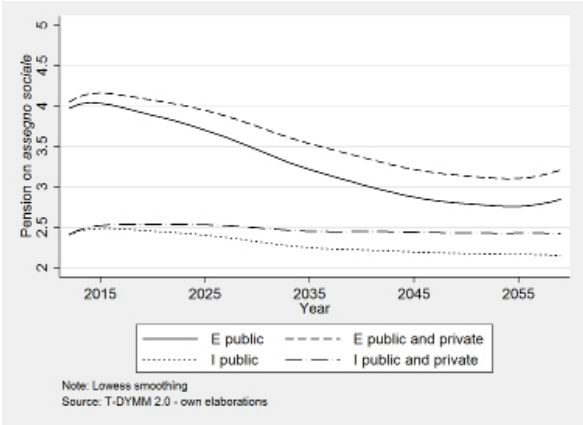
Figure 8.26 shows how variations in the rates of return to pension funds and in GDP growth rates affect independent workers *vis-à-vis* employees.

FIGURE 8.26: AVERAGE GROSS PENSION ON *ASSEGNO SOCIALE* RATIO BY EMPLOYMENT CATEGORY. THE IMPACT OF PRIVATE PENSIONS. SHOCKS ON RATES OF RETURN AND GDP GROWTH. 2012-2059

a. ***High returns* scenario**



b. ***Low returns* scenario**



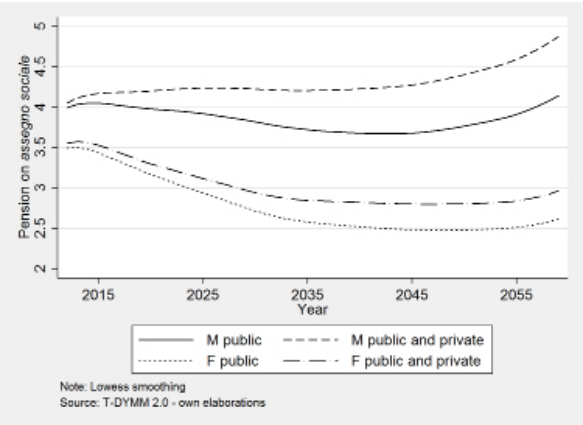
Note: Workers are assigned to either employment category if they have spent 80% or more of their career in one

When compared to the correspondent graph relative to the *Baseline* scenario (Figure 7.32), independent workers seem to be proportionally more affected by changes in the rates of return on pension funds, even if by a small margin. In the *Low returns* scenario, at the end of the simulation period, total pension benefits are 13.1% higher than public pension benefits for independent workers, 13% for employees. In the *Baseline* those variations amount respectively to 15% and 14.5%, and in the *High returns* scenario they rise to 17.4% and 16.6%.

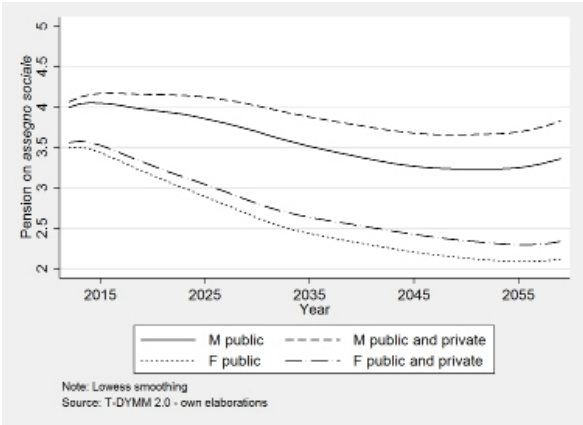
Figure 8.27 compares the impacts on the two genders. It seems that better macroeconomic conditions reinforce the position of male pensioners: the gap amongst genders widens in the *High returns* scenario *vis-à-vis* the *Low returns* and the *Baseline* scenarios (see Figure 7.33).

FIGURE 8.27: AVERAGE GROSS PENSION ON *ASSEGNO SOCIALE* RATIO BY GENDER. THE IMPACT OF PRIVATE PENSIONS. SHOCKS ON RATES OF RETURN AND GDP GROWTH. 2012-2059

a. ***High returns* scenario**



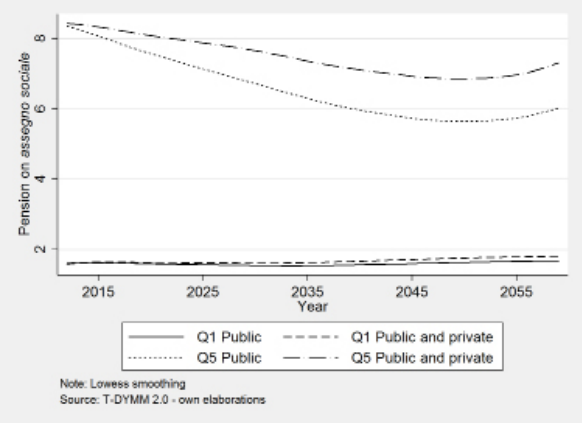
b. ***Low returns* scenario**



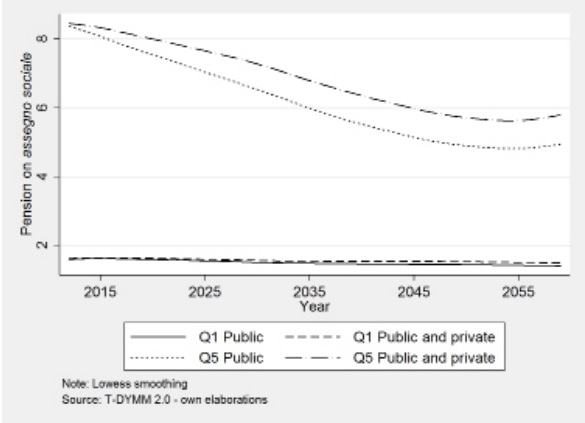
Taking into account income distribution, Figure 8.28 shows how all the change in the average values computed on all observations (Figure 8.25) is explained by the variation concerning the workers in the higher quintiles of income distribution, while nearly no change is discernible for the first quintile.

FIGURE 8.28: AVERAGE GROSS PENSION ON *ASSEGNO SOCIALE* RATIO BY INCOME CATEGORY. THE IMPACT OF PRIVATE PENSIONS. SHOCKS ON RATES OF RETURN AND GDP GROWTH. 2012-2059

a. ***High returns*** **scenario**



b. ***Low returns*** **scenario**



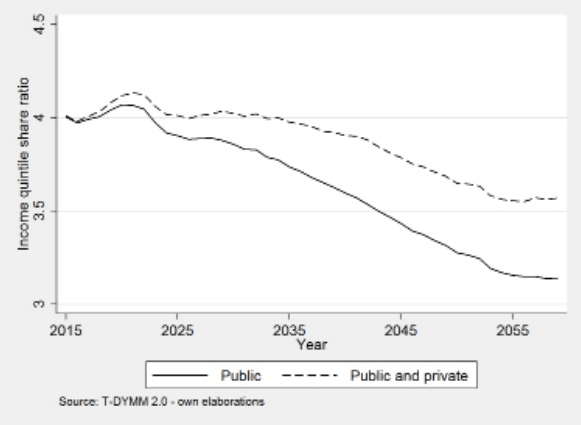
Note: Only pensions greater than the *assegno sociale* are considered

At the end of the simulation period, average total pension benefits for the top income quintile are higher than average public pension benefits by 17% in the *Low returns* scenario, 18.8% in the *Baseline* scenario and by 21.1% in the *High returns* scenario. On the other hand, the same variations amount to 5.5%, 6.2%, and 7.7% for the bottom income quintile.

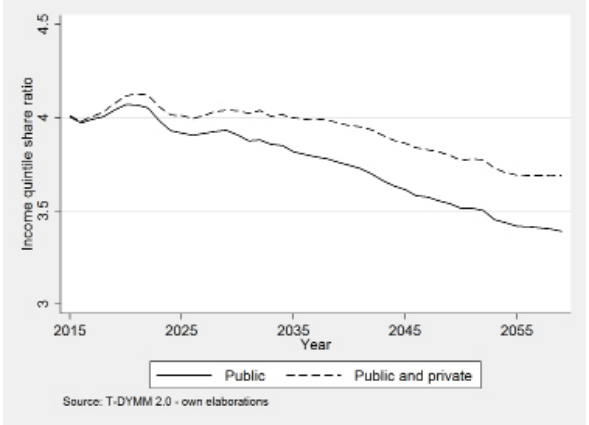
Coherently, the simulations also show that the inclusion of private pension benefits increases inequality indicators, because it is more likely that richer workers can have access to them. Figure 8.29 – to be compared with Figure 7.36 – illustrates how higher returns are actually associated with a higher margin in the income quintile share ratios calculated with and without consideration of private pension benefits. However, worse macroeconomic conditions generally lead to more inequality (Figure 8.29-b): the income quintile share ratio at the end of the simulation period registers 3.39 in the *Low returns* scenario, 3.25 in the *Baseline* and 3.14 in the *High returns*. The same indicator amounts to respectively 3.69, 3.6 and 3.57 if private pension incomes are also considered.

FIGURE 8.29: INCOME QUINTILE SHARE RATIO (P80/P20) FOR PENSIONERS. THE IMPACT OF PRIVATE PENSIONS. SHOCKS ON RATES OF RETURN AND GDP GROWTH. 2015-2059

a. ***High returns*** **scenario**



b. ***Low returns*** **scenario**

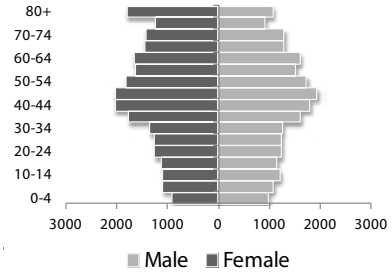


8.2.4 SHOCK ON FERTILITY RATES

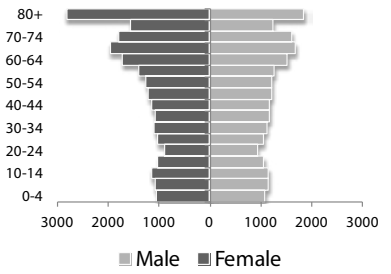
This section presents the results of a simulation scenario which assumes that the expectations on fertility rates for women are significantly higher than what projected in the *Baseline*. In Figure 8.30, we observe how the population pyramids shape at the beginning, in the middle and at the end of the simulation period. When confronting these graphs with those seen in Chapter 7 (Figure 7.2), we can verify how the broadening of the older cohort of the population (over 80 years of age) – especially for women – is not at all affected when switching from the *Baseline* to the *high fertility* scenario. That does not come as a surprise, since the assumptions on life expectations are left untouched in the *high fertility* scenario. However, the increase in fertility rates for women produces a notable increase in the overall population as in 2059, the *high fertility* scenario present a sample that is 15% larger than the *Baseline*.

FIGURE 8.30: POPULATION PYRAMIDS (UNITS). *HIGH FERTILITY* SCENARIO. 2011-2059

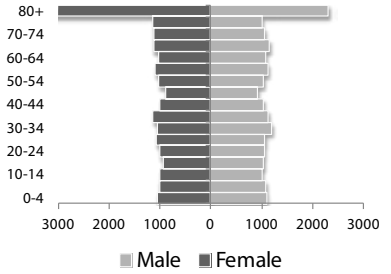
a. *2011*



b. *2035*

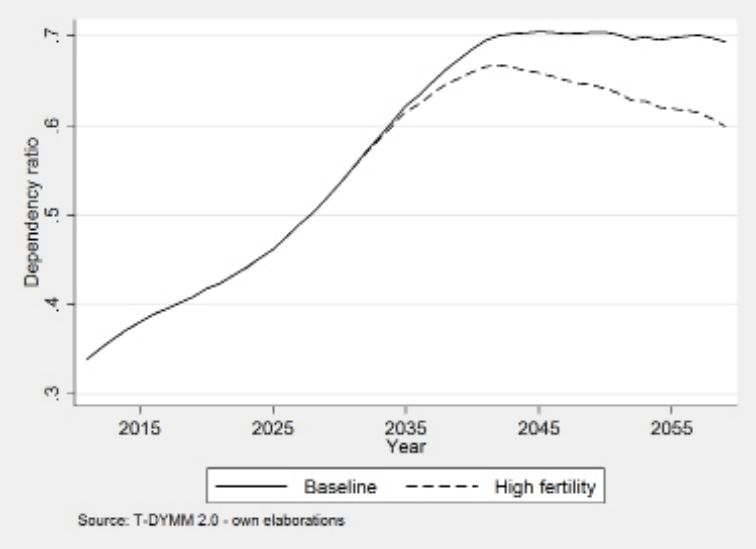


c. *2059*



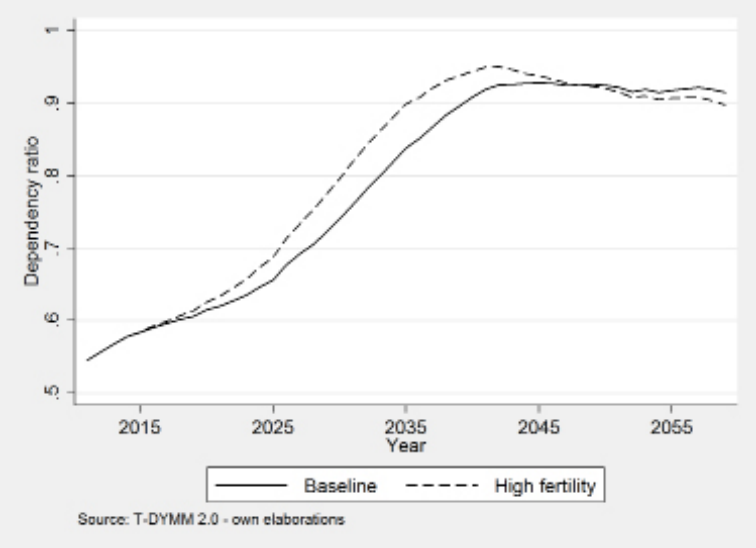
Under the high fertility scenario, the old age dependency ratio lowers by 10 percentage points by the end of the simulation period, although differences emerge only in the late 2030s (Figure 8.31).

FIGURE 8.31: OLD AGE DEPENDENCY RATIO (65+/15-64). SHOCKS ON FERTILITY. 2011-2059



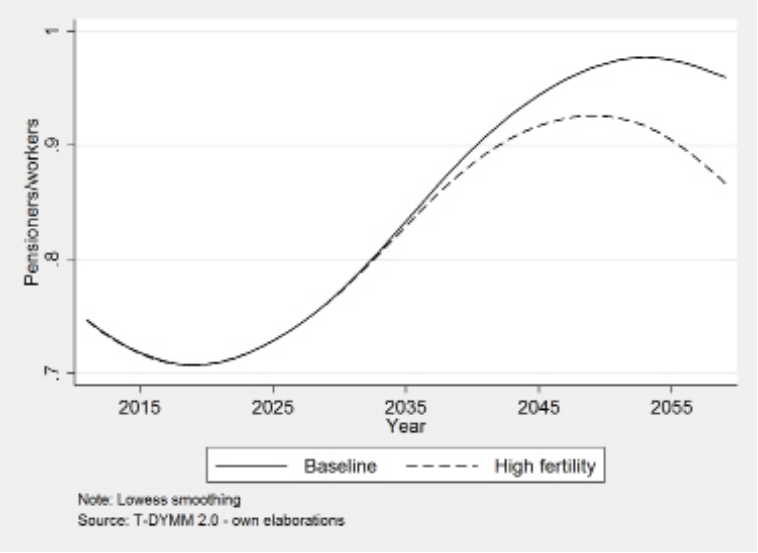
If the total dependency ratio – sum of people over 64 and people under 15 divided by the amount of individuals aged between 15 and 64 – is considered (Figure 8.32), it is clear how the indicator has higher values in the *high fertility* scenario compared to the *Baseline* scenario up until the late 2040s. In the short to medium term, dependency indicators would clearly benefit more from an increase in migration flows of working-age individuals than from an increase in fertility rates.

FIGURE 8.32: TOTAL DEPENDENCY RATIO. SHOCKS ON FERTILITY. 2011-2059



By the end of the simulation period, the pensioners on workers ratio is reduced by around 10 percentage points in the *High fertility* scenario (Figure 8.33), but a shift only emerges – and rapidly expands – from the late 2030s.

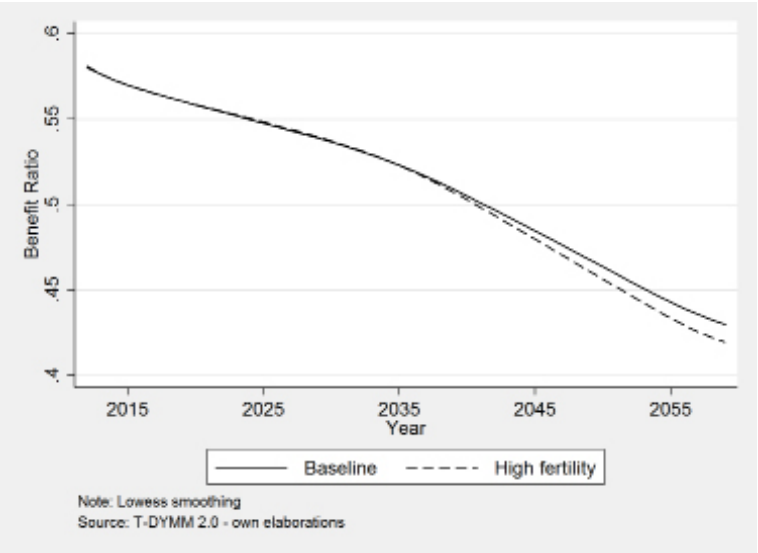
FIGURE 8.33: PENSIONERS ON WORKERS RATIO. SHOCKS ON FERTILITY. 2011-2059



Such an improvement in the pensioners on workers ratio would obviously improve sustainability indicators and therefore insure the pension system from adequacy risks as well.

According to the applied AWG logic, higher fertility rates translate into higher GDP growth, because of the enlargement in the labour force. The implications on pension adequacy indicators are therefore similar to those seen for the high productivity scenario. In both scenarios, what causes changes in pension amounts is the impact of the relative (macroeconomic or demographic) shock on GDP growth. Figure 8.34 shows how the benefit ratio would evolve overtime.

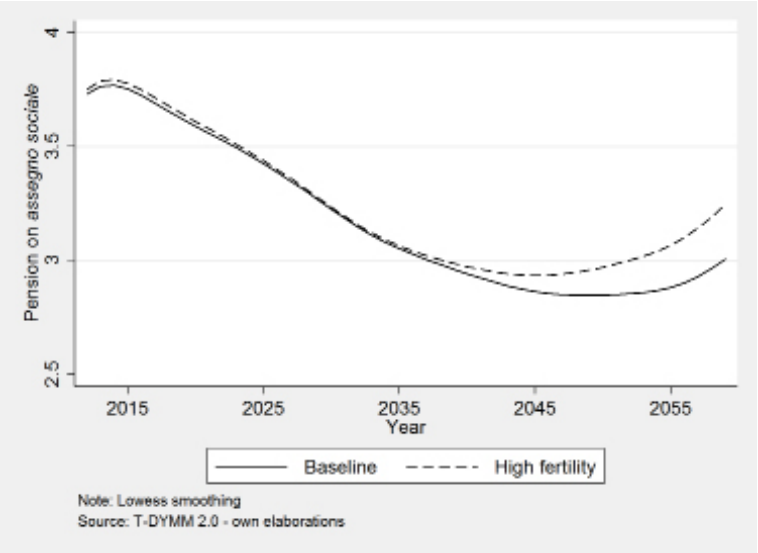
FIGURE 8.34: BENEFIT RATIO. SHOCK ON FERTILITY. 2012-2059



As noted above, shocks on macroeconomic indicators affect gross wages more than they do on pensions benefits. When GDP growth accelerates, the benefit ratio indicator is bound to reduce.

Figure 8.35 shows how variations in the average gross pension on *assegno sociale* ratio observed in the *High fertility* scenario are similar to the ones observed when accounting for higher productivity.

FIGURE 8.35: GROSS PENSION ON *ASSEGNO SOCIALE* RATIO, OVERALL AVERAGE. SHOCK ON FERTILITY RATES. 2012-2059



9. SIMULATION RESULTS: POLICY SCENARIOS AND POLICY SUGGESTIONS

When NDC computation rules are in place, pension benefits are positively correlated to the amount of notional contributions accrued and negatively correlated to life expectancy at retirement. The most distinctive feature of NDC computation rules is actuarial fairness: regardless the age of retirement, the average individual will receive – once retired – a total benefit amount correspondent to the contributions accrued during his/her career, gross of notional returns.

The "mirroring" features of NDC pension systems may prove problematic when working histories are interrupted by unemployment spells. Accordingly, the first section of this chapter deals with this issue within the Italian legislative framework, through the implementation of two alternative scenarios in T-DYMM.

In addition, since pension benefits are automatically reduced when workers choose to retire early, it is relevant to assess how the flexibility that NDC computation rules make available interacts with adequacy concerns. The second section tries to address this issue by implementing two additional scenarios in T-DYMM.

9.1 THE IMPACT OF UNEMPLOYMENT COMPENSATION LAWS

As anticipated earlier, in T-DYMM 2.0, three scenarios are implemented on unemployment benefit regulations: *Ante Fornero*, *Fornero* and *Jobs Act*, the latter being the *Baseline* scenario (see Paragraph 5.3.4.1).

Table 9.1 sums up the main features of the regulations underlying the scenarios implemented within the model.

TABLE 9.1: REGULATIONS ON UNEMPLOYMENT BENEFITS AS IMPLEMENTED IN T-DYMM

a. *Ante Fornero*

	Benefit under ordinary requirements (*indennità di disoccupazione non agricola ordinaria*) [3]	**Benefit under reduced requirements (*indennità di disoccupazione con requisiti ridotti*)**
Requirements	2-year seniority in unemployment insurance; 12 months in work within the previous 2 years	2-year seniority in unemployment insurance; 4 months in work in the previous year
Duration	Under 50 years of age: 8 months Over 49: 12 months	6 months
Amount	Computed as a share of the average income earned the previous year, decreasing overtime. Two ceiling amounts ("low" and "high") are in place, depending on previous income level[1]	Computed as a share of the average income earned the previous year, increasing overtime[2]. Two ceiling amounts ("low" and "high") are in place, depending on previous income level
Imputed contributions	Computed on the basis of the average income earned the previous year	Computed on the basis of the average income earned the previous year

[1] 1st to 6th month: 60% of the average income earned the previous year; 7th to 8th month: 50%; 9th to 12th month: 40%.

Low ceiling (2011): € 906.80; High ceiling amount (2011): € 1,089.89. Threshold amount (2011): € 1,961.80. All economic parameters and thresholds are indexed to real GDP growth.

[2] 1st to 3rd month: 35% of the average income earned the previous year; 4th to 6th month: 40%.

[3] Unemployment benefits granted to workers employed in sectors different from agriculture.

b. *Fornero*

	Benefit under ordinary requirements (*ASPI*)	**Benefit under reduced requirements (*MINI-ASPI*)**
Requirements	2-year seniority in unemployment insurance; 12 months in work within the previous 2 years	3 months in work in the previous year
Duration	2013 Under 50 years of age: 8 months Over 49: 12 months	Half the number of months in work in the previous year
	2014 Under 50 years of age: 8 months 50-54: 12 months Over 54: 14 months	
	2015 Under 50 years of age: 10 months 50-54: 12 months Over 54: 16 months	
	2016 Under 55 years of age: 12 months Over 54: 18 months	
Amount	Computed as a share of the average income earned the previous 2 years, decreasing overtime. Only one ceiling amount is in place[1]	Computed as for the benefit under ordinary requirements
Imputed contributions	Computed on the basis of the income relative to the previous 2 years	Computed on the basis of the income relative to the previous 2 years

[1] The amount is computed as 75% the average income earned the previous 2 years, up to a given threshold (2015: € 1,195.37); exceeding the threshold, an additional 25% of the average income earned the previous 2 years is added, up to a ceiling amount (2015: € 1,167.91). After the 6th month, the benefit is decreased by 15%. After the 12th month it is further decreased by an additional 15%. All economic parameters and thresholds are indexed to real GDP growth.

c. *Jobs Act (baseline)*

	Benefit under ordinary requirements (NASPI)[1]
Requirements	3 months in work within the previous 4 years; 1 month in work in the previous year
Duration	Half the number of months spent in work in the previous 4 years. From 2017 onwards, duration is limited to 18 months
Amount	Computed as a share of the average income earned the previous 4 years, decreasing overtime. Only one ceiling amount is in place[2]
Imputed contributions	Computed on the basis of the income relative to the previous 4 years, limited to 1.4 times the ceiling amount of the unemployment benefit

[1] The 2015 reform has simplified the regulations in place and has annulled the legislation on benefits under reduced requirements.

[2] The amount is computed as 75% the average income earned the previous 2 years, up to a given threshold (2015: € 1,195.37); exceeding the threshold, an additional 25% of the average income earned the previous 2 years is added, up to a ceiling amount (2015: € 1,300). The amount of the benefit is decreased by 3% each month starting from the 4th. All economic parameters and thresholds are indexed to real GDP growth.

As a general caveat, it is of some importance to underline that a few assumptions are in place in the estimation of unemployment benefits.

First, we only attribute unemployment benefits to former employees. While no unemployment safeguard has ever been implemented for independent workers, part of the legislation on the matter has aimed at extending the coverage of unemployment benefits to "parasubordinate" workers. However, these regulations require a level of detail that is not possible to reproduce in our simulation model.

Secondly, all non-working individuals are assumed to fulfil the requirements of the so called *stato di disoccupazione*[146]. It is obvious that not all individuals who are not in work are in fact looking for a job and/or comply with the administrative procedures that are required to obtain unemployment benefits. However, since it is not possible to discriminate amongst them in the model, a general extension seemed appropriate[147].

Third, in T-DYMM unemployment benefits are not compatible with labour earnings. Therefore, the impact of the 2012 and 2015 reforms cannot be assessed for what concerns the mentioned compatibility – which they have increasingly allowed for.

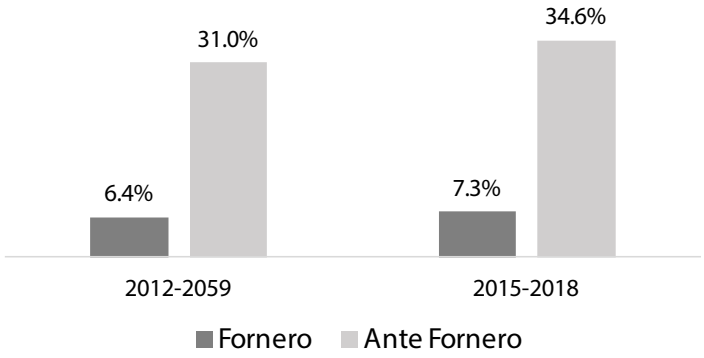
146 As of art. 19 of the Legislative Decree n. 150/2015, "A person is considered to be in *stato di disoccupazione* (lit.: 'status of unemployment') if he/she is not in work and is immediately available for working and for job searching, following the procedures defined by employment services".

147 The assumption alone that all non-working individuals are assumed to fulfil the requirements of the stato di disoccupazione does not entail that all non-working individuals in fact receive an unemployment benefit, as the requirements concerning individual working histories and the limitations in payment duration listed in Table 9.2 are kept into account

9.1.1 THE IMPACT OF UNEMPLOYMENT COMPENSATION LAWS ON ACTIVE INDIVIDUALS

Figure 9.1 shows the variations in coverage of unemployment benefits in the three scenarios implemented.

FIGURE 9.1: VARIATIONS IN COVERAGE OF UNEMPLOYMENT BENEFITS. *BASELINE* SCENARIO VS *FORNERO* AND *ANTE FORNERO* SCENARIOS



It is evident that a much larger variation is observed in the *Baseline* scenario when compared to the *Ante Fornero* scenario. Indeed, before the Fornero reform of 2012, the legislation on unemployment benefits was much more complex: other typologies of unemployment benefits were awarded to workers belonging to specific sectors and/or according to firm dimension. In our simulations, we have only accounted for universal benefits in all scenarios.

It is interesting to note in Figure 9.1 how the wider coverage granted by the *Jobs Act* legislation is above the long term average over the 2016-2018 triennium (an increase of 9.2% with respect to the previous legislation vis-à-vis the 2012-2059 average of 6.0%) , when the labour market is still recovering from the crisis and workers are expected to be more vulnerable than further on in the simulation period. The 2015 reform (so-called *Jobs Act* reform, accounted for in the *Baseline* scenario) explicitly set to guarantee better protection to individuals characterized by instable working patterns. On the same point, individuals pertaining to the 1st income decile, whose careers are generally instable, are granted much broader protection under the *baseline* scenario: 40% and 79% more benefits are granted to this category in the *Baseline* scenario, compared to the *Fornero* and *Ante Fornero* scenarios, respectively.

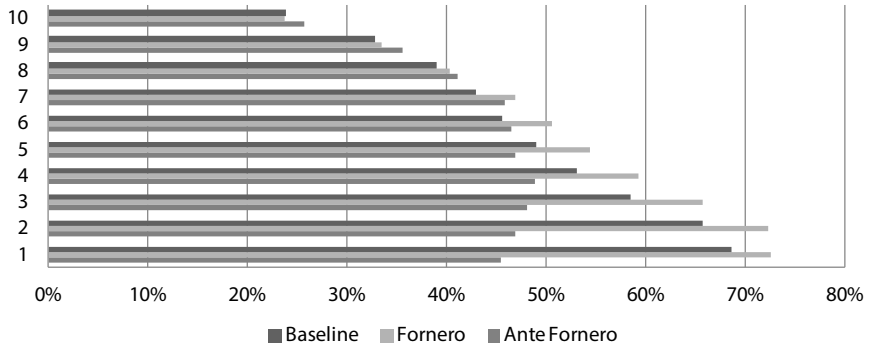
For what concerns income replacement, Figure 9.2 shows how replacement rates (computed as the ratio between the unemployment benefit paid out and the last wage) vary in the three scenarios dividing the population by the income decile they pertained to before losing their job.

FIGURE 9.2: GROSS REPLACEMENT RATES OF UNEMPLOYMENT BENEFITS. *BASELINE* SCENARIO VS *FORNERO* AND *ANTE FORNERO* SCENARIOS. 2012-2059

a. Overall averages

	Baseline	*Fornero*	*Ante-Fornero*
Replacement rate	54.8%	58.4%	45.4%

b. Averages by income decile

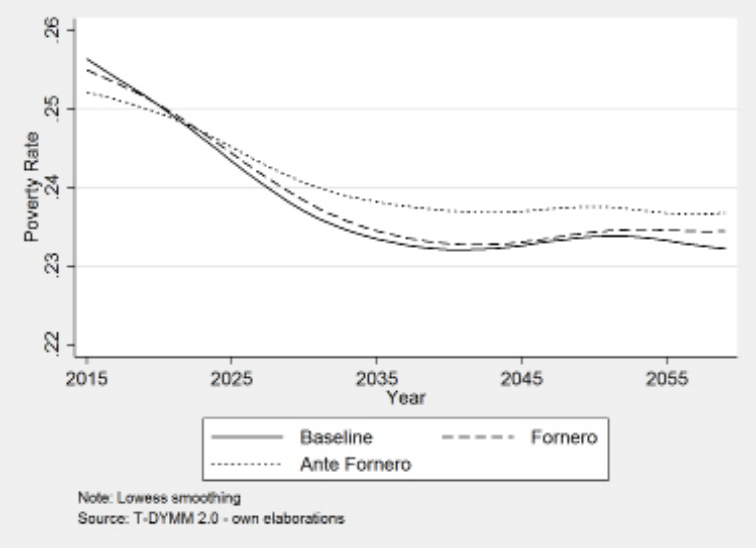


Expectedly, replacement rates are inversely related to previous income in the *Fornero* and in the *Baseline* scenario. In the *Ante-Fornero* scenario this relation only holds for the richer cohorts (above the 4th decile). The poorer cohorts, usually characterized by instable working histories, can generally only access unemployment benefits under reduced requirements, which before the 2012 Fornero reform entered into force granted a rather low income replacement. While granting better coverage (see Figure 9.1) the *Baseline* scenario allows for lower unemployment benefits on average compared to the *Fornero* reform. As specified in Table 9.1, under *Jobs Act* regulations unemployment benefits are computed on the basis of the income relative to the previous 4 years, whereas in the *Fornero* scenario only the last 2 years are kept into account.

Figure 9.3 shows the evolution throughout the simulation period of the poverty rate indicator – the share of individuals whose equivalised disposable income lies underneath the so-called poverty line[148] – in the three scenarios. Only individuals that are in work for less than 12 months – the most susceptible to variations in the legislation on the matter – are considered.

148 Set at 60 % of the national median equivalised disposable income after social transfers.

FIGURE 9.3: POVERTY RATE AMONG INDIVIDUALS WHO ARE IN WORK FOR LESS THAN 12 MONTHS A YEAR. *BASELINE*, *FORNERO* AND *ANTE FORNERO* SCENARIOS. 2015-2059



A very small difference is observed among the three scenarios. Since we are considering equivalised disposable incomes, this may be read as an indication that mutual assistance within households is more relevant than changes in the legislation on unemployment benefits, as far as poverty indicators are concerned.

9.1.2 THE IMPACT OF UNEMPLOYMENT COMPENSATION LAWS ON RETIRED INDIVIDUALS

While workers are on unemployment spells, the welfare system not only grants them a benefit to replace their labour incomes, it also pays out contributions that would normally be due by employers and employees. Periods covered by these imputed contributions concur in fulfilling the seniority requirements for retirement. Furthermore, under NDC computation rules, the payment of imputed contributions does not only affect seniority requirements, but also the amount of the eventual pension benefits.

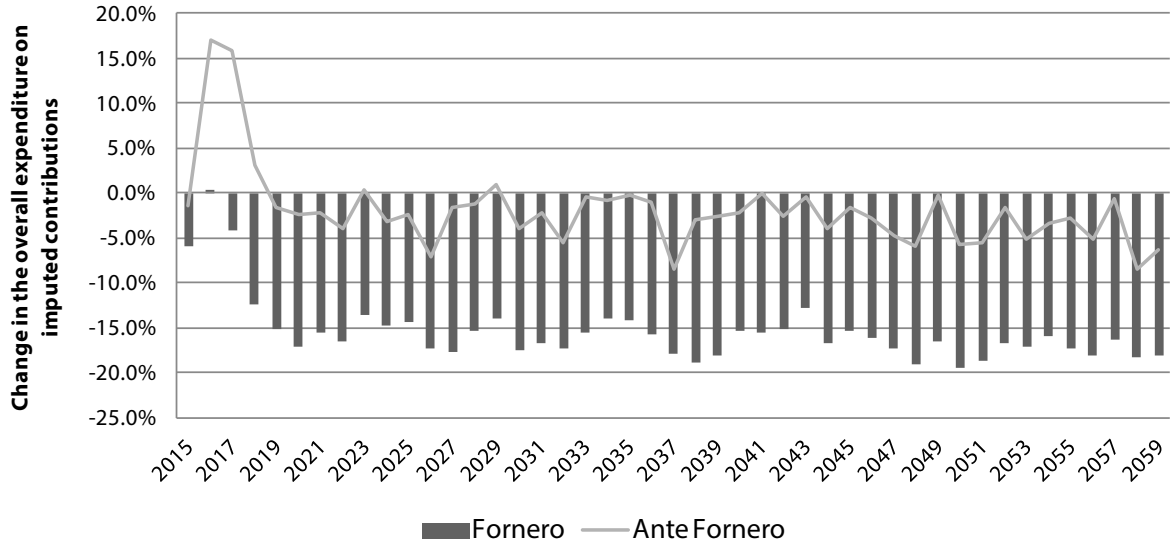
The amount of imputed contributions to be paid out is computed on the same "basis amount" a portion of which constitutes the unemployment benefit. As specified in Table 9.1, while previous legislations had not set a upper limit to the mentioned "basis amount", the *Jobs Act* reform states that imputed contributions are to be paid by the State on the basis of the income relative to the previous 4 years, but limited to 1.4 times the ceiling amount of the unemployment benefit.

Because of these provisions, during the simulation period around 38% of the recipients of unemployment benefits see their imputed contributions cut down. 65% of these workers are included between the 5th and 7th deciles of income distribution. As a result, in the Baseline scenario, the average monthly-imputed contributions are 16.8% and 18.4% lower than in the Fornero and Ante Fornero scenarios, respectively

When the overall expenditure on imputed contributions is considered – therefore the increased coverage granted under the Jobs Act regulations is considered –, payments in the Baseline scenario are lower by 14.7% compared to the Fornero scenario and by just 2% compared to the Ante Fornero scenario[149]. Figure 9.4 shows how in the first years of the simulation the change in the overall expenditure on imputed contributions is positive in the Baseline scenario, because of the increased coverage of unemployment benefits.

149 Because of its microeconomic focus, all results in T-DYMM that concern expenditure and/or general macroeconomic outcomes should be assessed in their direction and their general magnitude, since figures may deviate from official macro projections.

FIGURE 9.4: CHANGE IN THE OVERALL EXPENDITURE ON IMPUTED CONTRIBUTIONS COMPARED TO THE BASELINE SCENARIO, 2015-2059



While reductions in imputed contributions paid out by the system are bound to reduce single pension benefit amounts, T-DYMM 2.0 simulations show that, on average, the impact is barely visible when assessing adequacy indicators for vulnerable workers. Figure 9.5 shows how the variation in terms of replacement rate is only (barely) perceivable for workers with over 10 years of unemployment during their working histories. In the *Fornero* scenario, these workers have a 0.4% higher replacement rate compared to the *Baseline* scenario.

FIGURE 9.5: AVERAGE GROSS REPLACEMENT RATES FOR VULNERABLE WORKERS. *BASELINE*, *FORNERO* AND *ANTE FORNERO* SCENARIOS. 2015-2059

9.2 FLEXIBLE ACCESS TO RETIREMENT

When NDC rules are in place and access to retirement is flexible, individual retirement choices are crucial in determining considerable differences in benefit amounts.

The impact of the economic incentives to postpone retirement – inherent to all Defined Contribution pension schemes – is debated in the economic literature and has yet to be observed on Italian workers, since the long phasing-in process started by the 1995 "Dini Reform" will cause the NDC rules to be fully determinative of pension benefits only starting from the 2030s. In order to account for flexibility at retirement, theoretical assumptions on the impact of the incentives to prolong/shorten working lives seem appropriate.

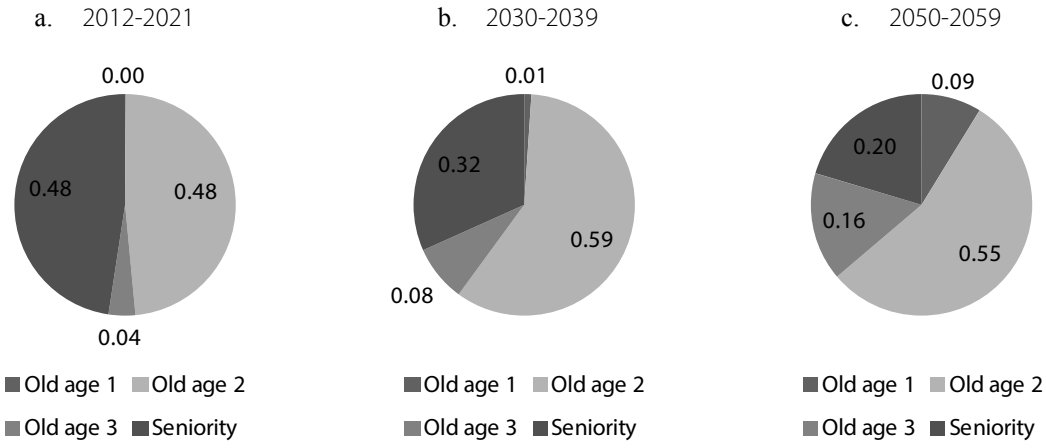
9.2.1 CHOICE SCENARIO

In the *Choice* scenario, we assume that, if workers fulfil the criteria for early retirement (Old Age 1 or Seniority, according to the classification seen in Table 4.2[150]) but have not reached the statutory age requirements for old-age retirement (Old Age 2), they will retire only if their potential replacement rate exceeds 70.8%[151] or if they lose their job.

The implementation of this choice function allows us to take into consideration the inherent incentives to postpone retirement typical of Defined Contribution pension schemes. We are considering the statutory age requirements for old-age retirement (Old Age 2) as the upper limit: no worker who has the chance to retire is allowed to keep working further within the model. Given that retirement age is expected to rise considerably according to demographic projections, this last assumption does not seem farfetched, but could prove restrictive for a few specific career typologies.

Figure 9.6 illustrates the evolution of retirement criteria for new pensioners over the course of the simulation period in the *Choice* scenario.

FIGURE 9.6: SAMPLE EVOLUTION BY RETIREMENT CRITERIA (%). NEW PENSIONERS. *CHOICE* SCENARIO



150 For simplicity's sake, a schematization of the retirement criteria seen in Chapter 4 is proposed here:
Old Age 1: 63 years of age, 20 years of contribution, 2.8xAssegno Sociale (AS);
Old Age 2: 66 years of age, 20 years of contribution, 1.5xAS;
Old Age 3: 70 years of age, 5 years of contribution;
Seniority: 41 years 1 month of contribution (F), 42 years 1 month of contribution (M).
These are the requirements in place as of 2012 (start of the simulation). All age requirements and the seniority requirement for Seniority retirement are indexed to periodical changes in life expectancy.

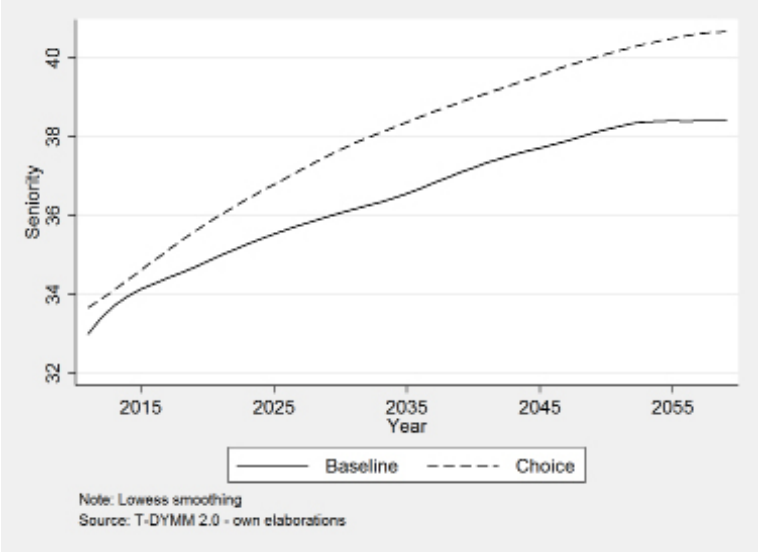
151 70.8% is the Theoretical Replacement Rate for workers with a 40-year career up to 65 years of age valid for Italy in 2013 according to the 2015 Adequacy Report (European Commission, 2015b).

When compared with Figure 7.19, relative to the *Baseline* scenario, it is noticeable how the smallest changes are observed on first graph on the left, elaborated on the 2012-2021 decade, where seniority retirement is only reduced by a little over 1 percentage point. No variation can be observed on Old Age 1, only accessible to workers enrolled in the NDC regime, who cannot access retirement at the beginning of the simulation period. In the second and third graph, in the *Choice* scenario much fewer workers access retirement via the Old Age 1 criteria, while the role of Old Age 2 and Seniority criteria is considerably expanded. Under the assumptions of the *Choice* scenario, workers are willing to work longer in order to increase the value of their pension benefits.

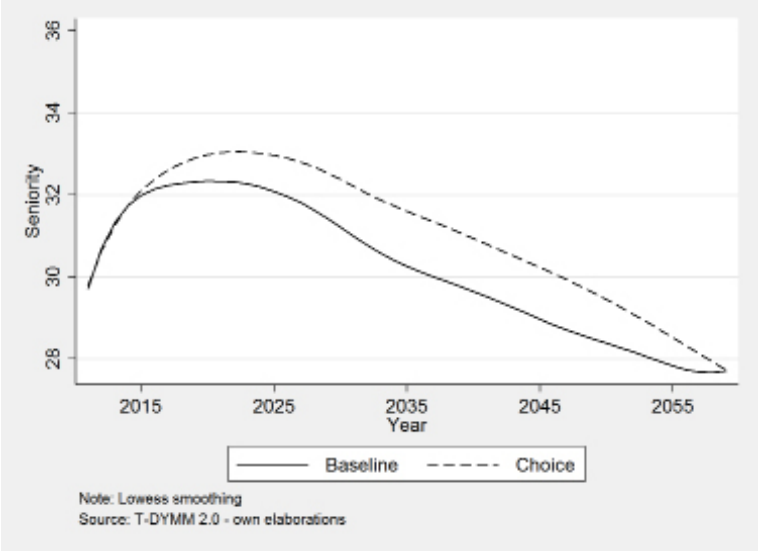
Figures 9.7-a and 9.7-b illustrate how the average seniority at retirement increases in the *Choice* scenario compared to the *Baseline* case by gender. While men can effectively take advantage of the opportunity to work longer and earn higher pension benefits, women struggle to satisfy the minimum eligibility requirements in the first place and their position does not significantly vary in the *Choice* scenario.

FIGURE 9.7: AVERAGE SENIORITY AT RETIREMENT. *BASELINE* AND *CHOICE* SCENARIOS. 2012-2059

a. Male workers



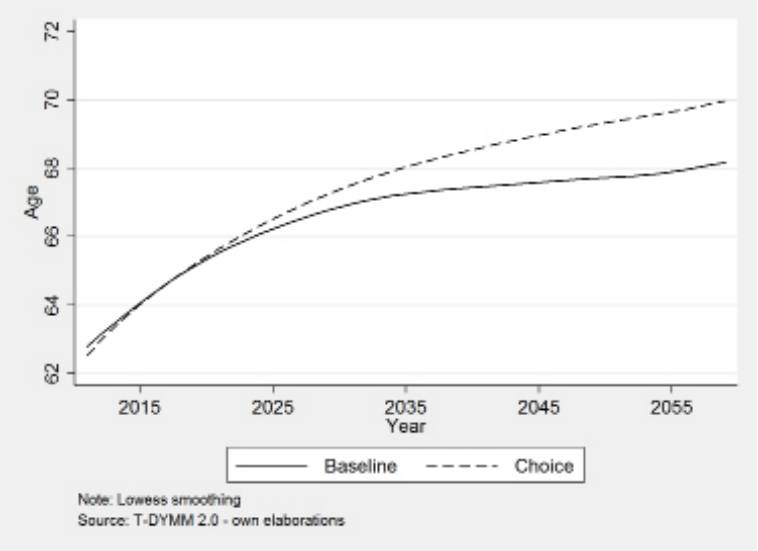
b. Female workers



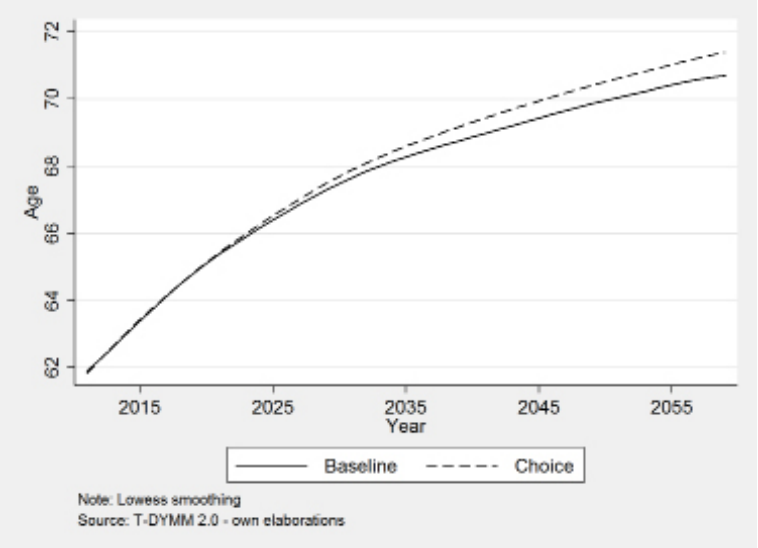
The observations proposed for Figures 9.7-a and 9.7-b can be extended to Figures 9.8-a and 9.8-b, which illustrate the evolution of the average effective retirement age comparatively in the *Baseline* and *Choice* scenario and separately for male and female workers. At the end of the simulation period, a two-year difference between scenarios is observed for male workers, a less-than-a-year difference is observed for female workers.

FIGURE 9.8: AVERAGE EFFECTIVE RETIREMENT AGE. *BASELINE* AND *CHOICE* SCENARIO. 2012-2059

a. Male workers



b. Female workers



Expectedly, when comparing Table 9.2 with Table 7.4 (relative to the *Baseline* scenario) the largest differences between *Baseline* and *Choice* scenarios are observed for workers belonging to the NDC regime. It is the workers who satisfy Old Age 1 eligibility requirements that are mainly impacted by the variations in retirement behaviours characterizing the *Choice* scenario, and those can only be enrolled in the NDC regime. For them, the average age at retirement increases by over a year and the gross replacement rate by 4 percentage points *vis-à-vis* the baseline.

TABLE 9.2: AVERAGE CONDITION AT RETIREMENT BY COMPUTATION RULE. *CHOICE* SCENARIO. 2012-2060

	Mixed 2011	*Mixed 1995*	*NDC*	*TOT*
Age	63.7	67.7	70.1	68.4
Seniority	40.4	37.0	31.0	34.7
Gross replacement rate	81%	60%	51%	58%
Gross pension on average career wage ratio	101%	87%	82%	86%
Gross pension on average wage ratio	93%	66%	54%	64%
Gross pension on *assegno sociale* ratio	4.7	3.5	3.0	3.4

The evolution of adequacy indicators by birth cohort similarly highlights differences with the *Baseline* scenario (Table 7.6) that are increasingly relevant for the younger birth cohorts (Table 9.3).

TABLE 9.3: AVERAGE CONDITION AT RETIREMENT BY BIRTH COHORT. *CHOICE* SCENARIO. 2012-2060

a. All pensions

	1950	*1960*	*1970*	*1980*
Age	66.0	67.9	69.3	70.1
Seniority	33.3	35.0	35.2	35.6
Gross replacement rate	64%	58%	55%	56%
Gross pension on average career wage ratio	86%	84%	87%	90%
Gross pension on average wage ratio	71%	63%	60%	62%
Gross pension on *assegno sociale* ratio	3.7	3.4	3.3	3.4

b. Pensions up to 3 times greater than the *assegno sociale*

	1950	*1960*	*1970*	*1980*
Age	67.3	68.7	70.0	70.7
Seniority	26.4	28.7	28.8	29.6
Gross replacement rate	52%	50%	51%	53%
Gross pension on average career wage ratio	74%	73%	79%	84%
Gross pension on average wage ratio	35%	35%	35%	37%
Gross pension on *assegno sociale* ratio	1.8	1.9	1.9	2.0

c.* Pensions more than 3 times greater than the *assegno sociale

	1950	*1960*	*1970*	*1980*
Age	64.8	66.9	68.5	69.4
Seniority	39.9	42.2	42.5	42.2
Gross replacement rate	73%	66%	60%	58%
Gross pension on average career wage ratio	98%	96%	95%	97%
Gross pension on average wage ratio	105%	94%	89%	88%
Gross pension on *assegno sociale* ratio	5.4	5.1	4.8	4.8

On overall average, in the *Choice* scenario workers born in the '80s would have to stay active a year and a half longer than in the *Baseline* scenario, but the gap in gross replacement rates between the youngest and the oldest cohort would be reduced from 13 to 8 percentage points. Richer pensioners (with pension incomes

over 3 times greater than the *assegno sociale*) would expectedly benefit more from the opportunity to keep working longer. Compared to the *Baseline* scenario, the average pension for workers born in the '80s would rise by 11.6%. On the other hand, they would have to retire 3 years later, on average. While in the *Baseline* scenario the percentage of new pensioners earning a benefit lower than 3 times the *assegno sociale* amount rises from 49.2% for the 1950-59 cohort to 63% for the 1980-89 cohort, in the *Choice* scenario it only goes from 48.6% to 52.2%. We may conclude that in the *Choice* scenario smaller differences appear among workers belonging to different income classes in terms of average effective retirement age, whereas the equalization path observed in pension amounts is reduced because of the opportunity that richer workers have (and poorer workers may not have) to work longer.

It is also relevant to point out how the conditions at retirement for poorer workers (with pension incomes up to 3 times the *assegno sociale*) slightly worsen in the *Choice* scenario (Table 9.3-b) compared to the *Baseline* (Table 7.6-b). The average seniority at retirement for workers belonging to the 1980-1989 birth cohort decreases by more than a year and a half, while pension incomes decrease by 9%. Indeed, poverty indicators also indicate that in the *Choice* scenario the number of poor pensioners increases, both in terms of the number of pensioners whose equivalised disposable income lies underneath the poverty line (Figure 9.9) and in terms of the number of pensioners whose equivalised disposable income lies underneath 1.5 times the *assegno sociale* (Figure 9.10).

FIGURE 9.9: POVERTY RATE. *BASELINE* AND *CHOICE* SCENARIOS. 2015-2059

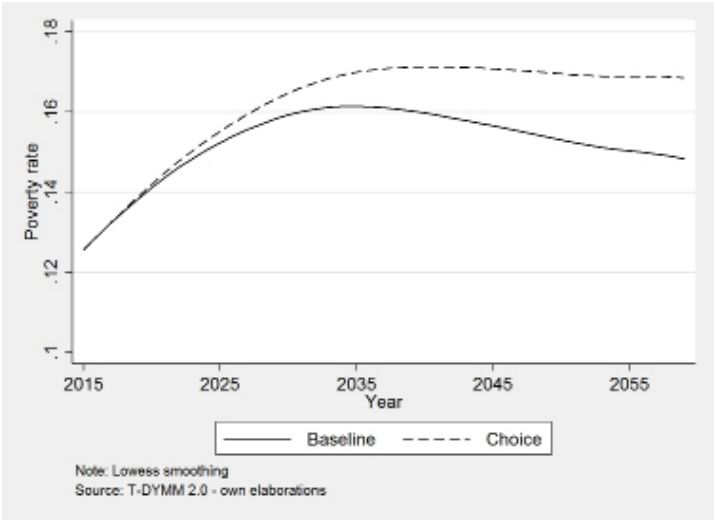
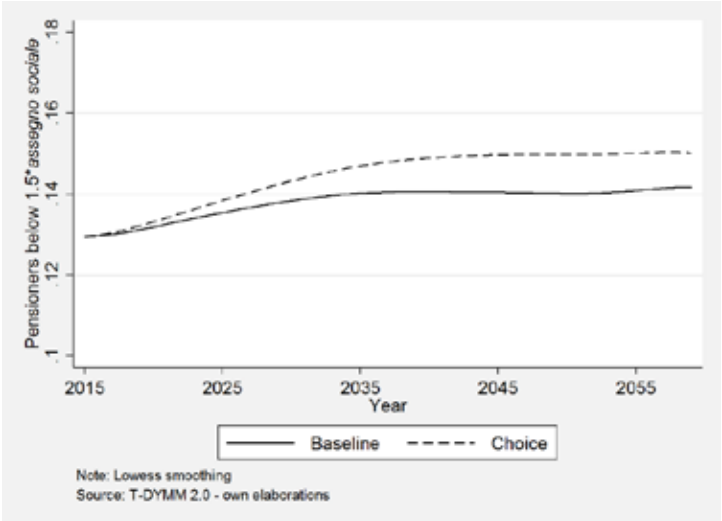


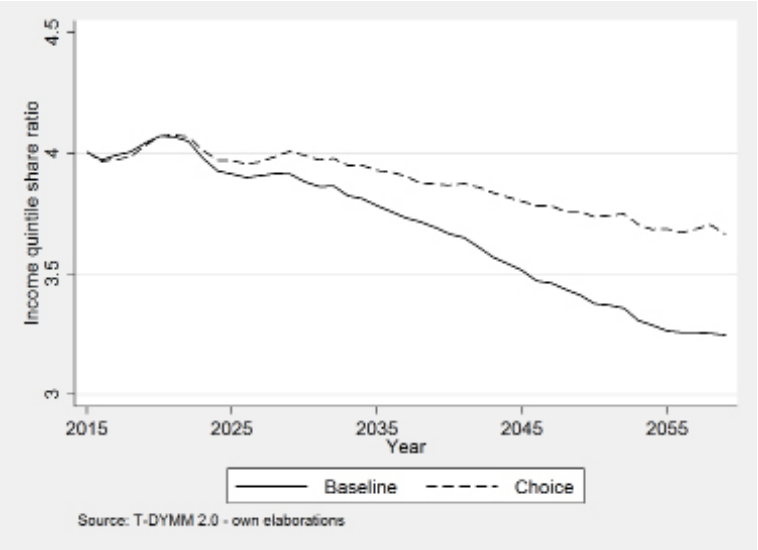
FIGURE 9.10: QUOTA OF PENSIONERS BENEATH 1.5 TIMES THE *ASSEGNO SOCIALE*. *BASELINE* AND *CHOICE* SCENARIOS. 2015-2059



These results in the *Choice* scenario can be explained as the consequence of the increased persistence in the labour market of senior workers who do meet the eligibility requirements for early retirement, but keep on working in order to increase their pension benefits. These workers are generally richer, more educated, more experienced, and their persistence makes it harder for less qualified workers in the same age cohort to find jobs. In T-DYMM, employment alignments are employed by gender for each age, following AWG (2015) projections. When workers are selected to be in work every year during the simulation period by means of our microeconometric estimations on the AD-SILC dataset, they are *de facto* only competing within their gender and their age category. While our results may be explained by the inherent rigidity of T-DYMM, it is interesting to observe how the possibility to keep working longer in order to increase individual pension benefit amounts – opportunity that would factually be only available to richer workers – would increase the competition in the labour market, which in case of rigidity of labour demand would disadvantage less qualified (and generally poorer) workers.

In a scenario where poor pensioners become poorer and the rich richer, inequality indicators are expected to score higher figures than in the Baseline scenario. Figure 9.11 compares the evolution of the income quintile share indicator, computed as the ratio between the average pension income of the top quintile and the average pension income of the bottom quintile.

FIGURE 9.11: INCOME QUINTILE SHARE RATIO (P80/P20) FOR PENSIONERS. *BASELINE* AND *CHOICE* SCENARIOS. 2015-2059



9.2.2 FLEXIBLE SCENARIO

The rapid tightening up of retirement eligibility requirements that the Italian pension system is undergoing has fed the debate on flexible access to retirement[152].

Following the theoretical model of NDC pension systems, the Italian scheme does provide flexibility for workers belonging to the NDC regime, even though the accessibility to early retirement has been limited by income requirements (see Chapter 4, Table 4.2), but such possibility is not available for workers belonging to the Mixed regime[153].

152 See INPS (2015).

153 As reminded above, individuals who have started working before 1996 are enrolled in the Mixed regime. For them, pension benefits are computed *pro quota* by employing both Defined Benefit rules and Notional Defined Contribution rules.

In this regard, T-DYMM 2.0 has developed a *Flexible* scenario, where an additional opportunity for early retirement is given to workers belonging to the Mixed regime in exchange for an actuarially-neutral penalization on pension amounts. The assumptions are:

1. The Old Age 1 criteria are extended to workers enrolled in the Mixed regime. Starting from 2016, they are allowed to retire up to 3 years earlier than the statutory old-age requirements, having also accrued at least 20 years of contributions. The income requirement is elevated from 2.8 times the *assegno sociale* to 3 times a new threshold amount, set to 400 € in 2016-2017 and to 500 € from 2018 onwards[154]. The new income requirement is also extended to workers enrolled in the NDC regime, for whom the income requirement for Old Age 2 criteria is also changed to 1.5 times the new threshold amount;

2. The penalizations introduced by the 2011 Fornero reform (see Chapter 4, Paragraph 4.3) on workers belonging to the Mixed regime who access retirement before turning 62 are abrogated. The amount of pension income computed with Defined Benefit rules is instead discounted by multiplying it with a ratio between the conversion coefficient corresponding to the statutory retirement age (Old Age 2 requirement) at the given period and the conversion coefficient corresponding to the actual age of retirement, thus ensuring that differences in life expectancy are taken into account when computing benefits[155]. Obviously, the quota of benefit computed with NDC rules is automatically discounted by applying the appropriate conversion coefficient to the amount of contributions accrued;

3. In order to allow for an easier comparison with *Baseline* results, in the *Flexible* scenario we have kept the assumption that workers retire as soon as they become eligible.

Table 9.4 shows the percentage discount that would be applied on the quota of benefits computed with Defined Benefit rules for workers belonging to the Mixed regime that may choose to retire earlier, computed as the aforementioned ratio between the correspondent conversion coefficients in force as of 2016.

TABLE 9.4: DISCOUNTS ON QUOTAS OF BENEFITS COMPUTED WITH DEFINED BENEFIT RULES. *FLEXIBLE* SCENARIO

Age at retirement	**Discount**
Statutory retirement age (2016: 66 years, 7 months)	-
1 year earlier	3.3%
2 years earlier	6.4%
3 years earlier	9.3%

Source: GU n.154, 6/7/2015. Triennial revision of conversion coefficients – Own elaborations

Overall reductions on pension incomes for workers belonging to the Mixed regime that chose to retire earlier under the extended Old Age 1 criteria, however, would also be determined by the shorter working histories they would live, which would translate into lower accrual of contributions. Microsimulation can help in assessing the overall variation.

Figures 9.12 and 9.13 show how the retirement criteria change for new pensioners in the two scenarios. Opposite variations between the beginning and the end of the simulation period are observed.

154 Like all other welfare parameters, these threshold incomes are indexed to real GDP growth.

155 Said discount is not computed on individuals who have started working before turning 18 years of age.

FIGURE 9.12: NEW PENSIONERS BY RETIREMENT CRITERIA (%). 2016-2020

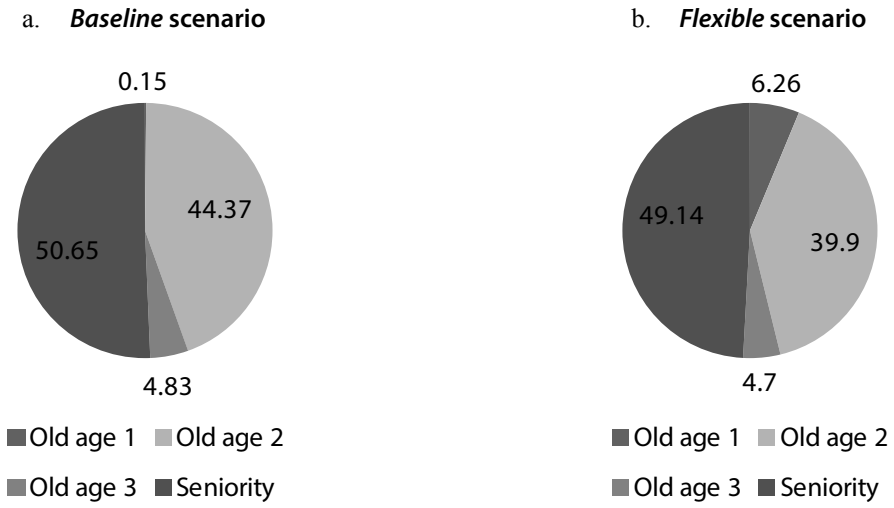
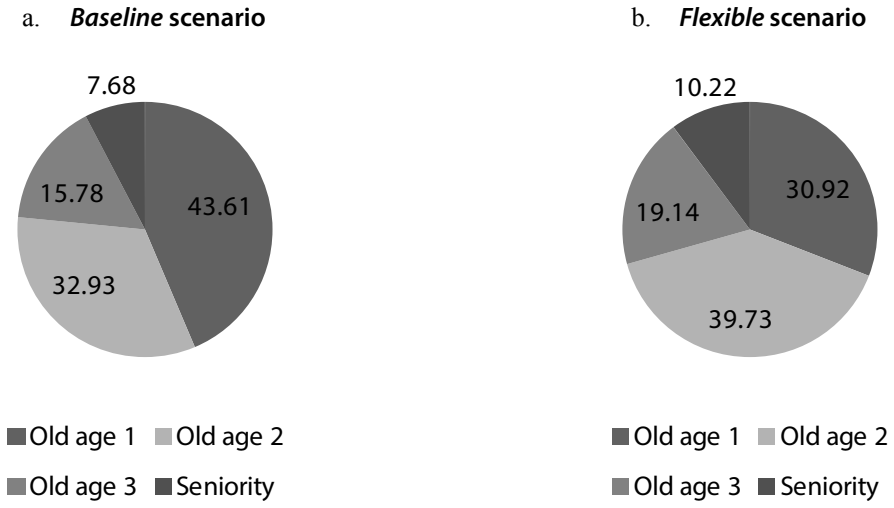


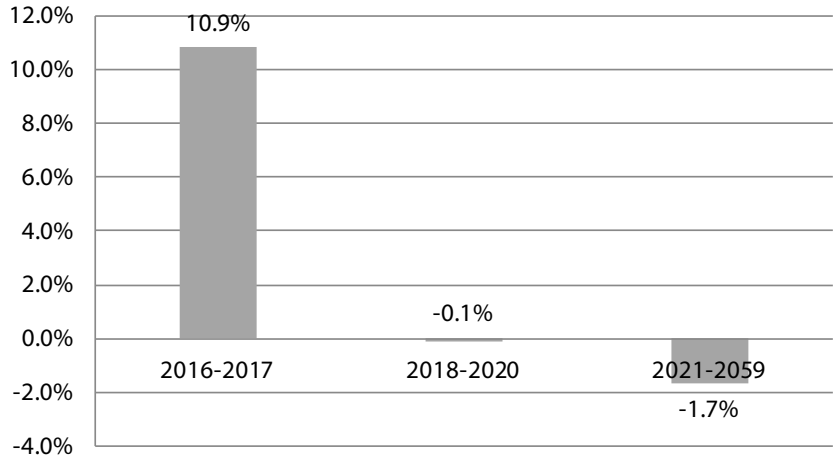
FIGURE 9.13 NEW PENSIONERS BY RETIREMENT CRITERIA (%). 2055-2059



In the 2016-2020 period, access to early retirement is expanded by the extension of the (tightened) Old Age 1 criteria to workers belonging to the Mixed regime. At the end of the simulation period, however, the tightening up of eligibility requirements for what concerns pension incomes – for both Old Age 1 and Old Age 2 criteria –, determines an increase in the rigidity of the system. About 10% less workers are able to retire before reaching either Old Age 2 or Old Age 3 criteria, compared to the *Baseline* scenario. It is particularly relevant to note that a higher quota of workers would not be able to reach eligibility requirements other than Old Age 3, thus retiring 4 years later the statutory retirement age.

Figure 9.14 illustrates the variations in the flows of new pensioners during the simulation period. An initial growth in the outflow is followed by a reduction at the end of the simulation period, correspondent to the access to retirement of the cohorts of workers enrolled in the NDC regime, that would have to satisfy tougher eligibility requirements concerning pension incomes.

FIGURE 9.14: VARIATIONS IN THE OUTFLOW OF NEW PENSIONERS. *FLEXIBLE* SCENARIO VS *BASELINE* SCENARIO. 2016-2059



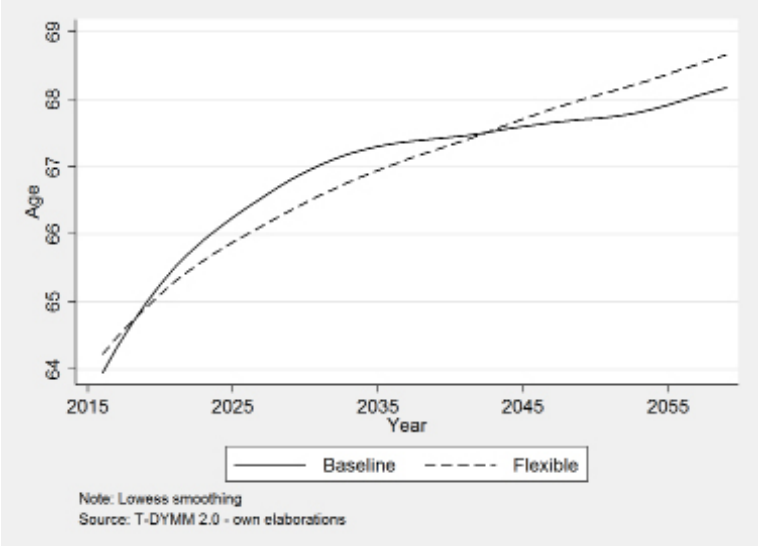
The biggest change is observed in the 2016-2017 biennium. The elevation of the income threshold from 400 € to 500 €, together with the reduction in the number of "pensionable workers", produces a sudden decrease of the variation in the 2018-2020 triennium. Overall, in the 2016-2059 period the number of new pensioners is reduced by 1.7% in the *Flexible* scenario compared to the *Baseline* scenario. Access to retirement would overall become more rigid if the legislation was to be modified according to the assumptions of the *Flexible* scenario.

Just like in the *Baseline* scenario, in the *Flexibile* scenario women struggle more than men to reach eligibility requirements. As a consequence, in the 2016-2020 period, the number of male new pensioners increases by 3.4% in the *Flexible* scenario compared to the *Baseline* scenario and only 1.8% for females.

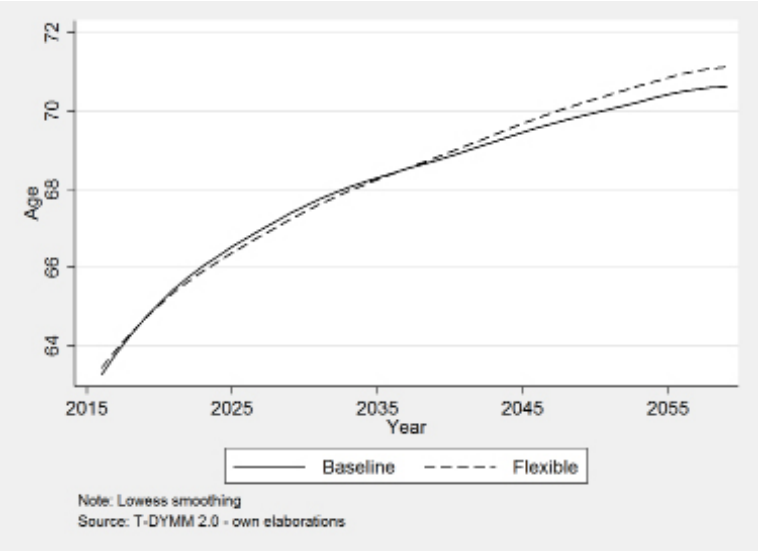
Figure 9.15-a and 9.15-b illustrate the variation in average effective retirement ages for male and female workers, comparatively in the *Flexible* and in the *Baseline* scenarios.

FIGURE 9.15: AVERAGE EFFECTIVE RETIREMENT AGE. *BASELINE* AND *FLEXIBLE* SCENARIOS. 2016-2059

a. Male workers



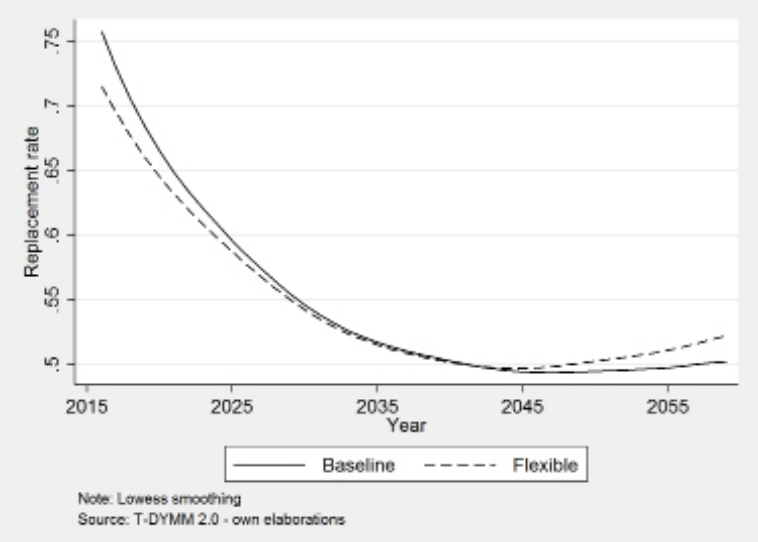
b. Female workers



While a much bigger variation between scenarios is observed for male workers, a similar pattern is observed. The increase in average effective retirement age becomes more linear in the flexible scenario, where a less steep increase in the first years of the simulation is followed by a bigger increase in the second part of the simulation.

Figure 9.16 shows that the variation in terms of average gross replacement rates would be rather small, but would overall produce a smoother transition over the simulation period. However, it has to be noticed that while lower replacement rates at the start of the simulation period are attributable to the choice to retire earlier (theoretically assumed to be valid for everyone within T-DYMM), higher replacement rates at the end of the simulation are attributable to the fact that workers would be obliged to keep working in order to satisfy tighter eligibility requirements.

FIGURE 9.16: AVERAGE GROSS REPLACEMENT RATE. *BASELINE* AND *FLEXIBLE* SCENARIOS. 2016-2059



Because the new eligibility requirements would overall render the access to retirement more rigid, despite the increased flexibility of the first few years, poverty indicators are bound to increase as previously foreseen in the *Choice* scenario. Overall, more rigidity in the access to retirement produces higher competition among senior workers, and because labour demand is rigid by assumption, this translates in less labour available for poorer workers, who are generally less desirable.

Figure 9.17 shows the evolution of the poverty rate, Figure 9.18 the evolution of the quota of pensioners whose equivalised disposable income lies beneath 1.5 times the *assegno sociale*.

FIGURE 9.17: POVERTY RATE. *BASELINE* AND *FLEXIBLE* SCENARIOS. 2016-2059

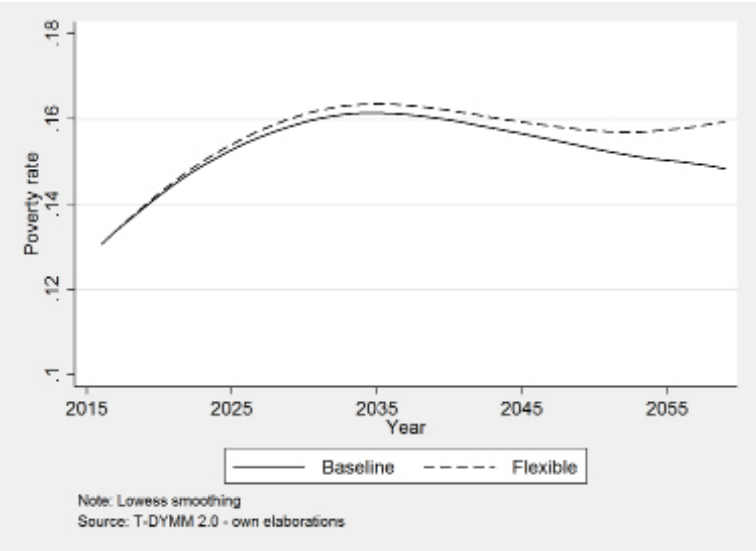
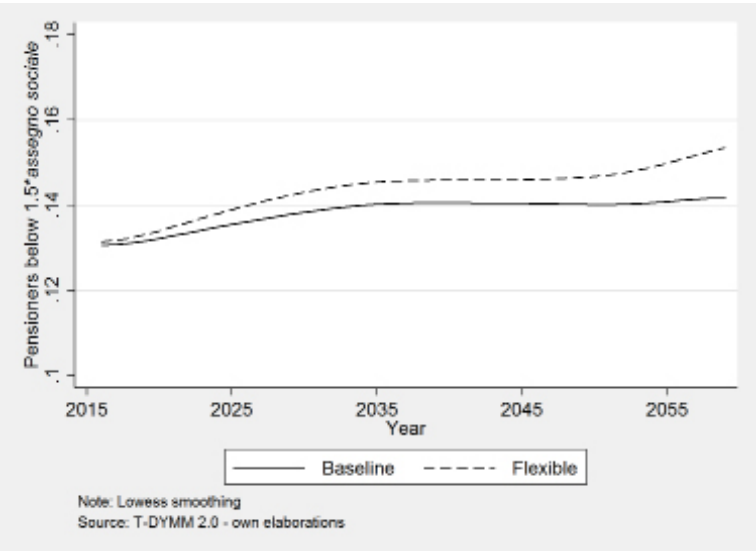


FIGURE 9.18: QUOTA OF PENSIONERS BENEATH 1.5 TIMES THE *ASSEGNO SOCIALE*. *BASELINE* AND *FLEXIBLE* SCENARIOS. 2016-2059



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10. MACRO ANALYSIS ON THE EFFECTS OF INCREASING THE RETIREMENT AGE ON GDP AND ON EMPLOYMENT, ESPECIALLY OF OLDER WORKERS

Since the inception of the financial and sovereign bond crisis, many European Union Member States undertook extensive attempts to reform their national pension systems mostly in view of securing the long term sustainability of public finances and dealing with the challenges posed by the ageing of active population. In most of the cases, enacted pension reforms increased retirement age and reduced pension benefits.

Against this backdrop, this chapter aims at describing the existing European pension schemes and at analysing the main effects of raising the retirement age in terms of GDP growth and labour market dynamics, especially over the long run. In particular, the analysis will highlight hypotheses, findings and challenges of some methodologies and outcomes distinguishing between the deterministic approach adopted by the European Commission Ageing Report and more sophisticated general equilibrium models. The study is centred on Europe but underlining that differences across European countries can be very large both in terms of legislation and in terms of demography and initial macroeconomic conditions.

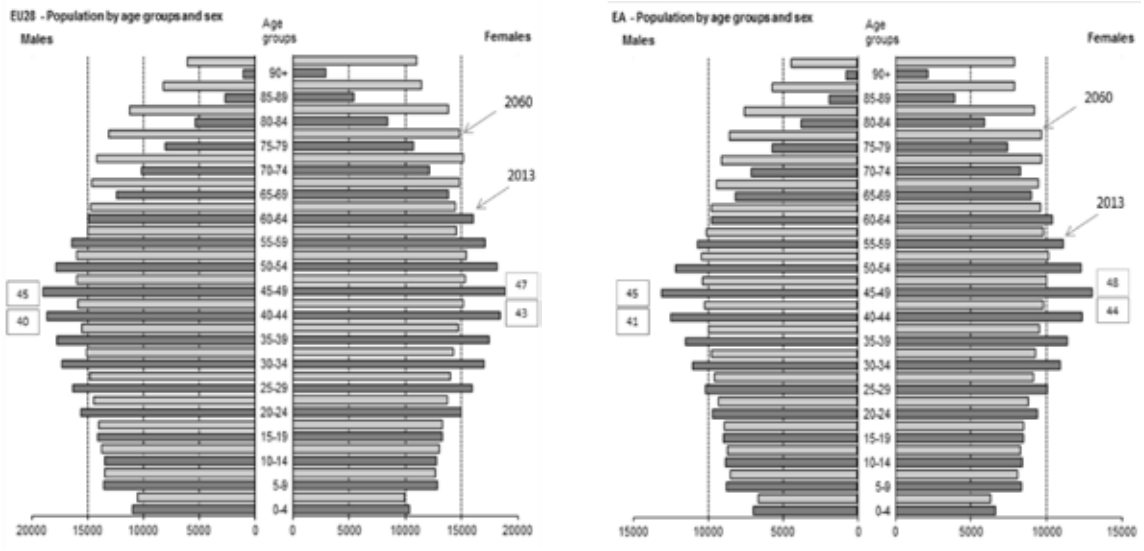
The following section presents the demographic development over the medium and long run as projected by Eurostat and subsequently a description of the pension systems in force in Europe according to the taxonomy adopted by the 2015 Ageing Report. Furthermore, a section is dedicated to labour force and participation rate projections of the 2015 Ageing Report. The following sections present a survey of analytical studies which have investigated the link between the increase in retirement age and the overall performance of national economies and/or labour markets. The studies will be presented according to the adopted estimation methodology: on one side, those which rely on the deterministic approach of the 2015 Ageing Report; on the other side, those which are based on dynamic stochastic general equilibrium models (DSGE).

10.1 DEMOGRAPHIC DEVELOPMENTS IN EUROPE

The recent long-term demographic projections carried out by Eurostat in 2013, which underlie the European Commission 2015 Ageing Report, show that, on the basis of a convergence approach on fertility rate, mortality rate and level of net migration, the shape of the overall population pyramid is going to change significantly in the next 50 years. The population in 2060 is going to be slightly larger but much older than the present one as a result of low fertility rate and higher life expectancy (Figure 10.1). In fact, looking at the changes in the structure of the EU population by main age groups (Figure 10.2), it is evident that old age cohorts are growing faster than other groups up to 2060. As a result of the change in the age pyramid, the old-age dependency ratio (people aged 65 or above relative to those aged 15-64) is projected to increase from 27.8% to 50.1% in the EU as a whole over the period 2013-20160. This implies that the EU would move from having four working-age people for every person aged over 65 years to only two working-age persons. As a consequence, the working-age population is projected to shrink starting from 2013 by around 13% during the projection period.

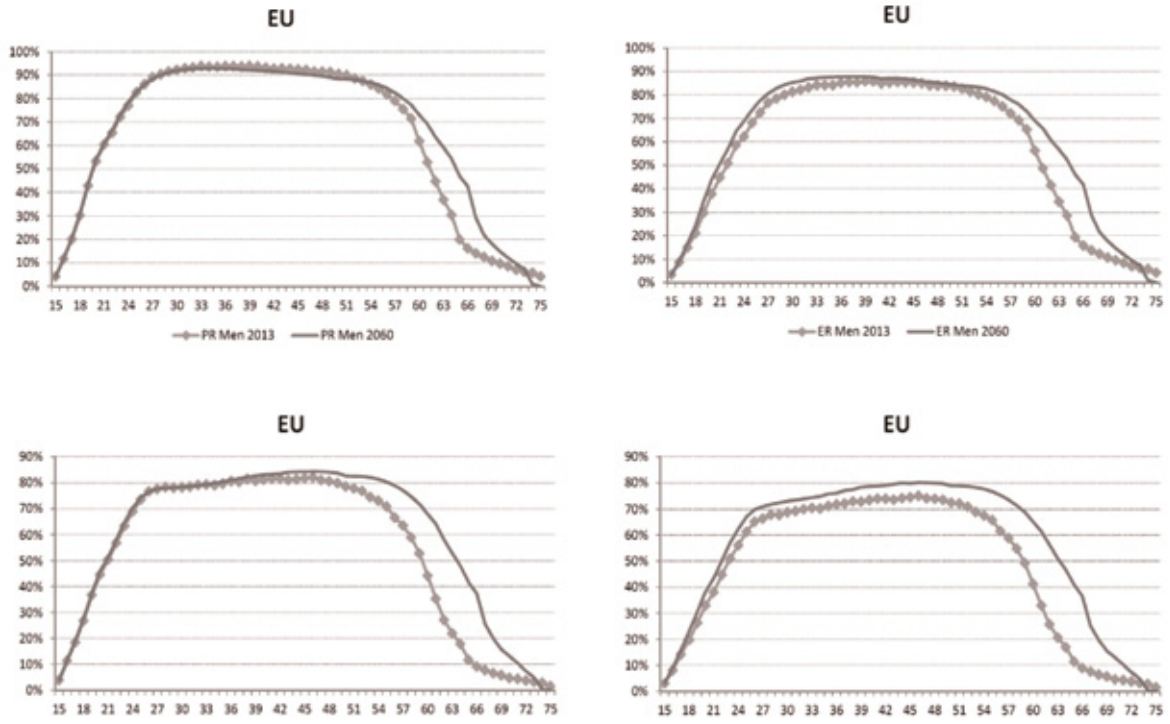
Such demographic changes are going to pose relevant challenges on EU countries public finances and pension systems.

FIGURE 10.1: AGE STRUCTURE OF THE POPULATION IN 2013 AND 2060, EU28 AND EA (PERSONS)



Source: EC Ageing Report (2015)

FIGURE 10.2: AGE PROFILES OF PARTICIPATION AND EMPLOYMENT RATES BY GENDER IN 2013 AND 2060 - EU



Source: EC Ageing Report (2015)

10.2 SHORT DESCRIPTION OF PENSION SCHEMES IN EU

As shown by the European Commission 2015 Ageing Report, due to projected ageing of EU societies, the sustainability of pension systems will be under strain. In order to face the liabilities stemming from ageing, many countries undertook significant pension reforms with the aim of securing national pension schemes.

Nowadays, large differences exist among the pension systems in the European Union for both public and private pension schemes. Table 10.1 summarizes the main characteristics and a few facts can be highlighted: the dominance of earning related old-age pensions, although some countries have also a flat rate pension; the existence of mandatory or quasi mandatory occupational or private individual pension schemes in some countries, vis-à-vis others where second and third pillar do not exist.

In spite of the large differentiation in national retirement schemes, some features which are common to all systems can be identified, such as the implementation of automatic or semi-automatic mechanisms to guarantee their sustainability in front of the liabilities stemming from the fast ageing of population, the trend to equalization of retirement ages across genders and, finally, the reduction of the share of life spent in retirement.

In this regard, Table 10.2 presents the countries where some specific mechanisms aimed at enhancing the sustainability of the pension system have been implemented. According to the taxonomy proposed by the European Commission, the first mechanism, the so called automatic balancing mechanism is generally country-specific and it is designed to ensure the financial stability of the system, by operating on pension indexation or contributions. By contrast, the second mechanism, the so called sustainability factor, by linking the amount of pension benefits to life expectancy at the time of retirement has the objective to contributing to the actuarial fairness of the system. Finally, the third mechanism recently introduced by many European countries establishes an automatic or semi-automatic link between eligibility requirements for being entitled to a pension (age and/or years of contributions) and life expectancy, sterilizing in this way the impact of demographic changes.

TABLE 10.1: PENSION SCHEMES IN EU MEMBER STATES AND PROJECTION COVERAGE

	Public pensions [1]					Private pension scheme		
Country	Minimum Pension[2]	Old-age pensions	Early retirement pensions	Disability pensions	Survivors' pensions	Occupational pension scheme	Mandatory private individual	Voluntary private individual
BE	MT - SA	ER	ER	ER priv FR self-emp	ER	M* priv V* self-emp	X	Yes*
BG	MT - SA	ER	ER	ER	ER	V*	Yes*	Yes*
CZ	FR	ER	ER	ER	ER	X	X	Yes*
DK	FR & MT suppl.	FR & MT suppl.	V	FR	FR	Quasi M	X	Yes*
DE	MT - SA	ER	ER	ER	ER	V*	X	Yes*
EE	MT - SA	ER	ER	ER	ER	M*	Yes*	Yes*
IE	MT - FR & SA	FR - ER	FR - ER/MT	FR - ER/MT	FR - ER/MT	M pub V* priv	X	Yes*
EL	MT - FR	FR & ER	FR & ER	FR & ER	FR & ER	X	X	Yes*
ES	MT	ER	ER	ER	ER	V	X	Yes
FR	MT - SA	ER	ER	ER	ER - MT	V*	X	Yes*
HR	ER	ER	ER	ER	ER	V*	M*	Yes*
IT	MT - SA	ER	ER	ER	ER	V*	X	Yes*
CY	MT & ER	ER	ER	ER	ER	M* - pub V* - priv	X	X
LV	FR - SA	ER	ER	ER	ER	X	Yes*	Yes*
LT	SA	ER	ER	ER	ER	X	quasi M	Yes*
LU	MT - SA	ER	ER	ER	ER	V*	X	Yes*
HU	MT - SA	ER	ER	ER	ER	V*	X	Yes*
MT	MT - SA	FR & ER	X	FR & ER	FR & ER	M*	X	Yes*
NL	SA	FR	X	ER	FR	M	X	Yes*
AT	MT - SA	ER	ER	ER	ER	M*	X	Yes*
PL	ER	ER	ER	ER	ER	V*	Yes*	Yes*
PT	MT - SA	ER	ER	ER	ER	M & V	X	Yes*
RO	SA	ER	ER	ER	ER	X	Yes	Yes
SI	X	ER	ER	ER	ER	V*	X	Yes*
SK	MT - SA	ER	ER	ER	ER	X	Yes*	Yes*
FI	MT	ER	ER	ER	ER	V*	X	Yes*
SE	MT	ER	ER	ER	ER	quasi-M	Yes	Yes
UK	FR & MT - SA	FR -ER, V	X	ER	ER	V*	X	Yes*
NO	FR	ER	X	ER	ER	M*	X	Yes*

(1) Public pension expenditure include all public expenditure on pension and equivalent cash benefits granted for a long period, see Annex 2 for details on the coverage of the projections of public pension expenditure.
(2) Minimum pension corresponds to Minimum pension and other social allowances for older people not included elsewhere.
MT - Mean-tested
FR - Flat rate
ER - Earnings related
SA - Social allowance/assistance
V - Voluntary
M - Mandatory
X - Does not exist
* Not covered in the projection

Source: EC Ageing Report (2015)

TABLE 10.2: AUTOMATIC BALANCING MECHANISM, SUSTAINABILITY FACTOR AND LINK OF RETIREMENT AGE TO LIFE EXPECTANCY

Country	Automatic balancing mechanism	Sustainability factor (benefit link to life expectancy)	Retirement age linked to life expectancy
Germany	X		
Finland		X	
Spain	X	X	
Italy		X	X
France*		X	
Latvia		X	
Poland		X	
Portugal		X	X
Sweden	X	X	
Norway		X	
Cyprus			X
Denmark**			X
Greece			X
Netherlands			X
Slovak Republic			X

Source: EC Ageing Report (2015)

TABLE 10.3: STATUTORY RETIREMENT AGES, EARLY RETIREMENT (IN BRACKETS) AND INCENTIVES TO POSTPONE RETIREMENT

	MALE				FEMALE				Incentives	
	2013	2020	2040	2060	2013	2020	2040	2060	Penalty	Bonus
BE	65 (60.5)	65 (62)	65 (62)	65 (62)	65 (60.5)	65 (62)	65 (62)	65 (62)		X
BG	63.7 (63.7)	65 (65)	65 (65)	65 (65)	60.7 (60.7)	62.7 (62.7)	63 (63)	63 (63)		X
CZ*	62.7 (59.7)	63.7 (60)	66.5 (61.5)	69.3 (64.3)	59.7 (56.7)	61.7 (58.7)	66.5 (61.5)	69.3 (64.3)	X	X
DK*	65 (60)	66 (63)	70 (67)	72.5 (69.5)	65 (60)	66 (63)	70 (67)	72.5 (69.5)		
DE	65.3 (63)	65.8 (63)	67 (63)	67 (63)	65.3 (63)	65.8 (63)	67 (63)	67 (63)	X	X
EE	63 (60)	63.8 (60.8)	65 (62)	65 (62)	62 (59)	63.8 (60.8)	65 (62)	65 (62)	X	X
IE	65 (65)	66 (66)	68 (68)	68 (68)	65 (65)	66 (66)	68 (68)	68 (68)		
EL*	67 (62)	67 (62)	69.9 (64.9)	71.9 (66.9)	67 (62)	67 (62)	69.9 (64.9)	71.9 (66.9)	X	
ES	65 (63)	65.8 (63)	67 (63)	67 (63)	65 (63)	65.8 (63)	67 (63)	67 (63)	X	X
FR	65.8 (60.8)	67 (62)	67 (62)	67 (62)	65.8 (60.8)	67 (62)	67 (62)	67 (62)	X	X
HR	65 (60)	65 (60)	67 (62)	67 (62)	60.8 (55.8)	62.5 (57.5)	67 (62)	67 (62)	X	X
IT*	66.3	66.8	68.4 (65.4)	70 (67)	62.3	66.8	68.4 (65.4)	70 (67)		
CY*	65 (63)	65 (63)	67 (65)	69 (67)	65 (63)	65 (63)	67 (65)	69 (67)	X	
LV	62 (60)	63.8 (61.8)	65 (63)	65 (63)	62 (60)	63.8 (61.8)	65 (63)	65 (63)		
LT	62.8 (57.8)	64 (59)	65 (60)	65 (60)	60.7 (55.7)	63 (58)	65 (60)	65 (60)	X	X
LU	65 (57)	65 (57)	65 (57)	65 (57)	65 (57)	65 (57)	65 (57)	65 (57)		
HU	62 (62)	64.5 (64.5)	65 (65)	65 (65)	62 (62)	64.5 (64.5)	65 (65)	65 (65)		X
MT	62 (61)	63 (61)	65 (61)	65 (61)	62 (61)	63 (61)	65 (61)	65 (61)		
NL*	65.1 (65.1)	66.3 (66.3)	69.3 (69.3)	71.5 (71.5)	65.1 (65.1)	66.3 (66.3)	69.3 (69.3)	71.5 (71.5)		
AT	65 (62)	65 (62)	65 (62)	65 (62)	60 (58.8)	60 (60)	65 (62)	65 (62)	X	X
PL	65.3 (65.3)	67 (67)	67 (67)	67 (67)	60.3 (60.3)	62 (62)	67 (67)	67 (67)		
PT*	65 (55)	66.4 (55)	67.7 (55)	68.8 (55)	65 (55)	66.4 (55)	67.7 (55)	68.8 (55)	X	X
RO	64.7 (59.7)	65 (60)	65 (60)	65 (60)	59.7 (54.7)	61.4 (56.4)	63 (58)	63 (58)		
SI	65 (58.3)	65 (60)	65 (60)	65 (60)	63.5 (58)	65 (60)	65 (60)	65 (60)	X	X
SK*	62 (60)	62.8 (60.8)	65.4 (63.4)	67.8 (65.8)	58.3 (56.3)	62.8 (60.8)	65.4 (63.4)	67.8 (65.8)	X	X
FI	66 (62)	66 (63)	66 (63)	66 (63)	66 (62)	66 (63)	66 (63)	66 (63)	X	X
SE	67 (61)	67 (61)	67 (61)	67 (61)	67 (61)	67 (61)	67 (61)	67 (61)		
UK	65 (65)	66 (66)	66.7 (66.7)	68 (68)	61 (61)	66 (66)	66.7 (66.7)	68 (68)		X
NO	67 (62)	67 (62)	67 (62)	67 (62)	67 (62)	67 (62)	67 (62)	67 (62)		

(1) An in-depth peer review was carried out by the AWG and the Commission at four meetings during September-December 2014. The projections incorporate pension legislation in place at that time. No further reform measures has been legislated in EU Member States by 1 April 2015 (except Portugal).Statutory retirement ages and early retirement ages as reported in the country fiche. Age requirement for early retirement is not necessarily the only eligibility criteria and it is often associated to contribution requirement (or other equivalent parameters) significantly higher than those foreseen for the statutory retirement age.

CZ - Statutory retirement age depending on the number of children. Values for women with 2 children are reported.

IT - In 2013, female SRA refers to private sector employees (the self-employed 63.8, public employees 66.3). In bracket the minimum age for early retirement under the NDC system (a minimum amount of pension of 2.8 times the old age allowance is also required). Early retirement is also allowed regardless of age, with a contribution requirement of 42.5 years (41.5 for female) in 2014, indexed to changes in life expectancy.

PT - Early retirement suspended for employees in the social security scheme in 2013. Since January 2015 retirement age is reduced by 4 months a year exceeding the 40th for workers with insurance careers longer than 40 years (applied to worker aged more than 60 in 2015). Reform not considered in the pension projections.

SE - Retirement age flexible from age of 61 without an upper limit. Under the Employment Protection Act, an employee is entitled to stay in employment until his / her 67th birthday.

*Countries where statutory retirement age is legislated to increase in line with increase in life expectancy. Reported retirement ages calculated according to life expectancy increases as from EUROPOP 2013 demographic projections.

Actuarial equivalence is not considered as a penalty/bonus.

Source: EC Ageing Report (2015)

Table 10.3 reports the statutory retirement age, early retirement age and the existence of incentives to postpone retirement, hence three key parameters that influence retirement decisions across individuals. According to the data reported for 2013 still there are large differences both in the statutory and effective retirement across gender in many countries. However, thanks to the implementation of recent structural reforms, retirement ages across gender are going to be aligned in the next decades. Table 10.4 shows the percentage of adult life spent at retirement by gender. Except for some countries (such as Italy and Greece), there is a general increase in this percentage. Only in some few cases, in the same country, such as Poland and Slovakia, over the period 2014-2060, men are going to experience an increase in their percentage while women are going to experience a decrease.

TABLE 10.4: PERCENTAGE OF ADULT LIFE SPENT AT RETIREMENT BY GENDER

	MALE					FEMALE				
	2014	2020	2040	2060	Change 2014 -2060	2014	2020	2040	2060	Change 2014 -2060
BE	31.3	31.9	34.2	36.1	4.8	34.9	35.5	37.3	38.9	4.0
BG	24.4	24.3	27.4	30.2	5.8	31.2	30.9	33.7	36.1	5.0
CZ*	27.6	28.4	28.8	29.7	2.1	34.7	35.1	33.3	32.8	-1.9
DK*	26.2	26.6	27.5	28.3	2.1	32.7	30.8	31.8	31.2	-1.4
DE	27.8	28.3	29.5	31.4	3.6	32.1	31.8	33.4	35.1	3.0
EE	25.2	25.4	28.1	30.7	5.5	31.2	31.0	32.9	34.8	3.6
IE	28.0	28.4	29.3	31.1	3.2	31.1	31.5	32.4	34.1	3.1
EL*	28.9	28.6	28.2	28.9	-0.1	31.9	31.5	31.9	32.5	0.5
ES	31.1	29.2	29.7	31.3	0.2	33.8	31.7	32.0	33.5	-0.3
FR	34.0	33.1	33.8	35.5	1.4	38.2	37.1	37.3	38.6	0.4
HR	27.9	28.0	29.4	32.0	4.1	33.9	33.6	33.3	35.4	1.5
IT*	32.1	27.7	29.3	29.8	-2.3	35.9	32.2	32.7	32.0	-3.9
CY*	28.2	27.2	28.0	28.6	0.4	33.6	30.1	31.7	32.1	-1.5
LV	23.0	24.0	27.2	30.1	7.1	29.6	29.3	31.6	33.8	4.3
LT	25.7	25.8	28.9	31.7	6.0	33.1	32.6	33.7	35.8	2.7
LU	34.9	35.6	37.6	39.3	4.4	37.4	37.9	39.6	41.0	3.6
HU	26.0	24.9	27.8	30.5	4.5	30.6	30.0	31.6	34.0	3.4
MT	32.0	31.1	31.9	33.6	1.6	36.6	36.0	36.6	38.2	1.6
NL*	27.6	26.0	26.8	28.3	0.7	32.4	31.8	32.4	33.8	1.4
AT	31.3	29.6	31.6	33.5	2.2	36.5	35.6	36.2	37.8	1.3
PL	26.1	24.7	27.5	29.9	3.8	36.0	34.2	31.4	33.4	-2.6
PT*	28.6	27.9	28.7	29.7	1.2	32.6	31.7	32.3	33.9	1.3
RO	24.9	26.0	29.1	31.9	6.9	31.3	32.2	34.0	36.5	5.1
SI	29.6	28.8	31.2	33.2	3.6	37.6	33.0	34.9	36.6	-1.0
SK*	27.8	28.7	29.5	29.3	1.5	35.2	33.4	34.2	32.7	-2.5
FI	29.0	29.5	31.6	33.5	4.5	34.0	33.4	35.2	36.7	2.7
SE	27.2	27.9	29.8	31.4	4.2	32.2	32.8	34.7	36.3	4.1
UK	28.3	28.9	29.7	31.3	3.0	32.3	32.8	32.3	34.0	1.6
NO	27.1	27.7	29.6	31.3	4.2	31.2	31.8	33.8	35.4	4.2
EU	28.3	28.1	29.7	31.5	3.1	33.6	32.8	33.7	35.1	1.5
EA	29.3	28.8	30.3	31.9	2.6	34.1	33.0	34.1	35.4	1.3

(1) Adult life spent at retirement is defined as the ratio between the life expectancy at average effective exit age and the estimated age of death (coherent with life expectancy at effective retirement age) minus 18.
* Countries where the statutory retirement age is legislated to increase in line with increase in life expectancy.

Source: EC Ageing Report (2015)

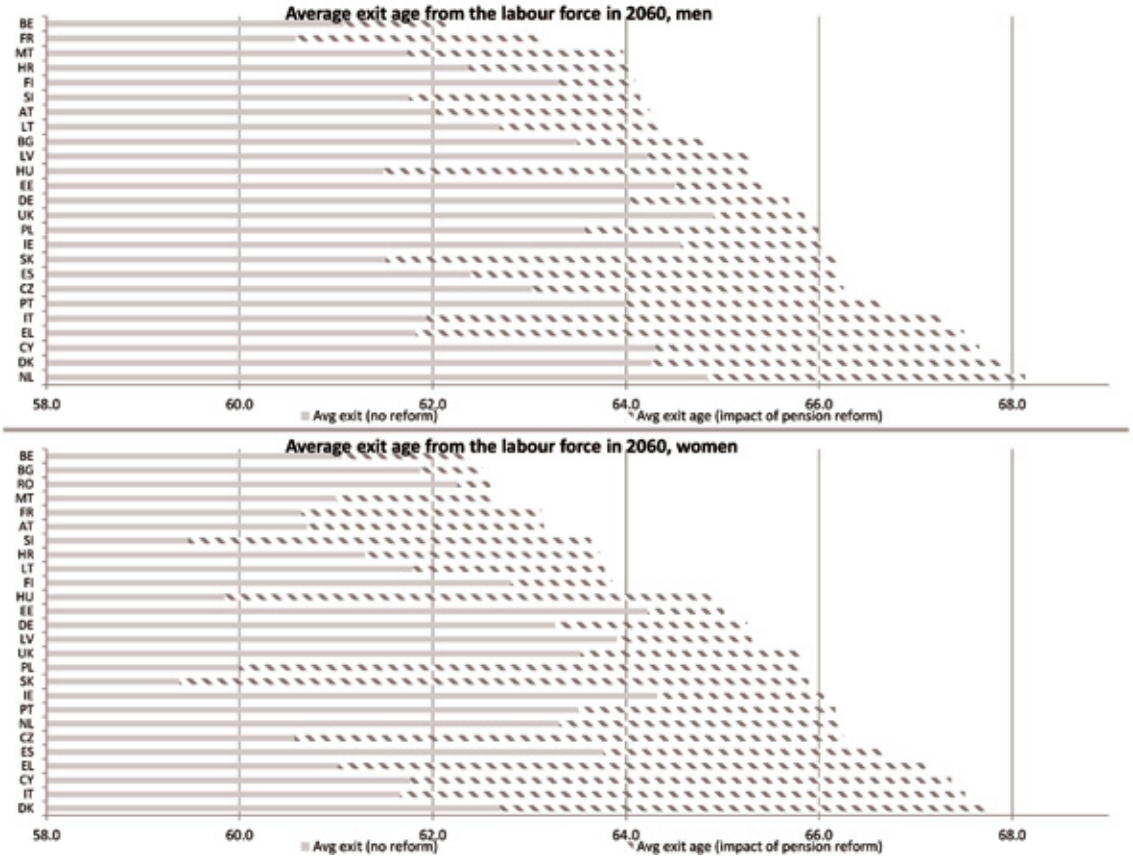
10.3 LABOUR FORCE PROJECTIONS AND PARTICIPATION RATE: THE DETERMINISTIC APPROACH OF THE 2015 AGEING REPORT

According to the European Commission, the increasing ageing of population coupled with the enacted rise in the effective retirement age will have an impact also on labour supply and participation to the labour force in Europe. The European Commission in the 2015 Ageing Report projects participation rates by gender and single age according to the so-called Cohort Simulation Model. Such a method is based on the calculation of the average probabilities of entry and exit for labour force over the historical period 2004-2013. These probabilities are then extrapolated in the future according to the change in age cohorts as projected by the Eurostat demographic long term scenario. Such a method produces estimates of average exit age from labour force under a no-policy change assumption, i.e. in the absence of implemented pension reforms. However, the Cohort Simulation method is flexible enough to allow to design suitable policy-scenarios in which it is possible to take into account the labour market effect of enacted pension reforms. The main characteristics of pension reforms are applied by single cohort by modifying and increasing average exit rates for different age groups and gender according to the main features of national pension systems. The re-estimation of average exit age from the labour force for single cohorts and for different gender has a non-trivial increasing impact on participation rates and, in turn, on GPD projections.

Based on the age group 50-70, the change in average exit rates by gender due to the impact of pension reforms in 2060, as projected in the 2015 Ageing Report, are reported in Figure 10.3. On average, enacted pension reforms will increase the effective retirement age by almost 5 years in 2060 exerting a large impact on labour force participation of older cohorts.

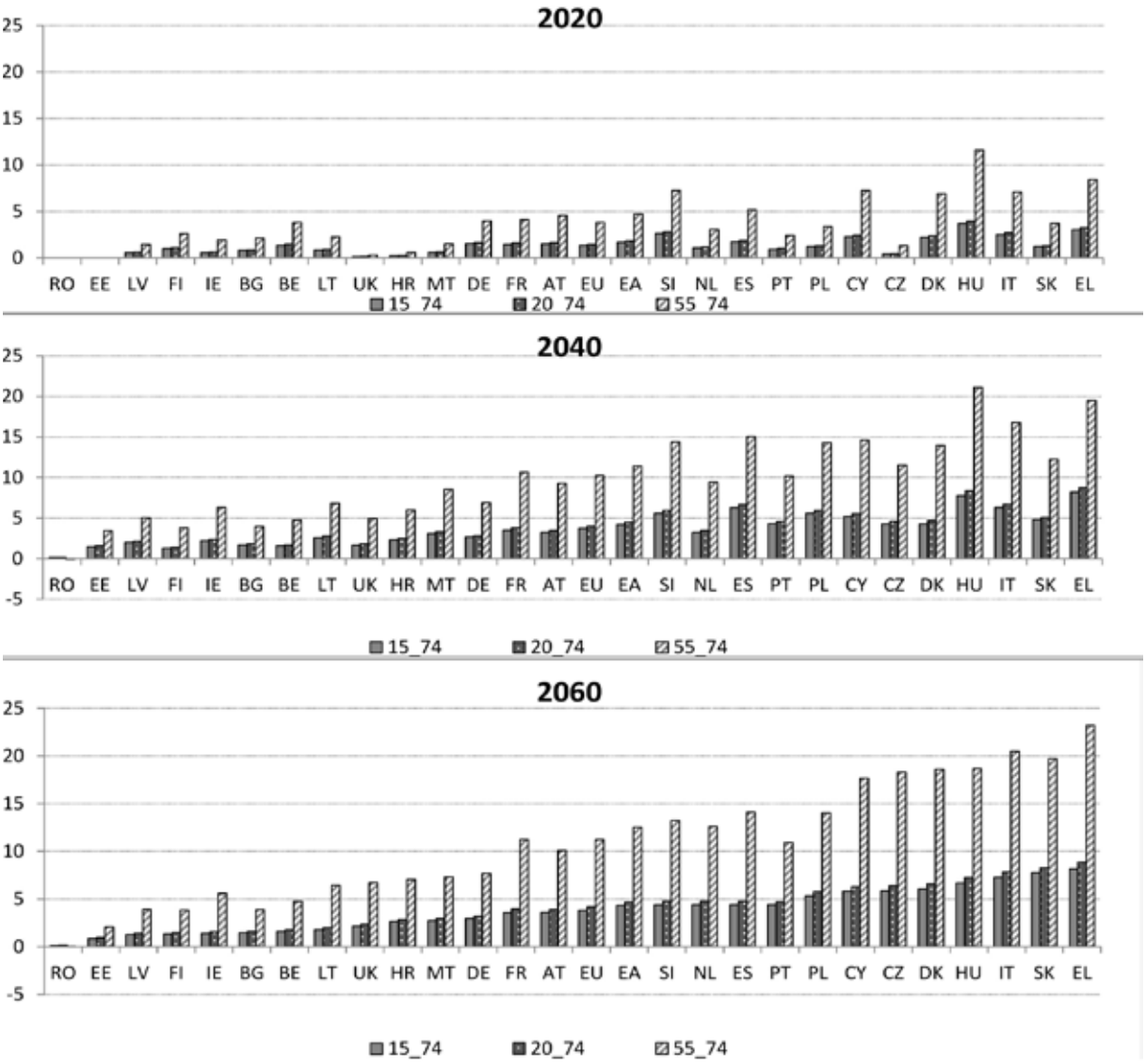
Such a pattern is even more evident in Figure 10.4 which reports the change in participation rates at three points in time: 2020, 2040 and 2060 for different age cohorts. The comparison is made with a scenario where pension reforms had not been implemented. Thanks to pension reforms, the participation rate of older workers (55-74) in the EU is projected to increase by 4 p.p. in 2020, 10 p.p. in 2040 and 11 p.p. in 2060. Overall, the higher participation rate of older workers induced by the postponement of retirement age due to the implementation of pension reforms will have an increasing impact of about 3,5 p.p. by 2060 on the total participation rate (15-74) in EU.

FIGURE 10.3: IMPACT OF PENSION REFORMS ON THE AVERAGE EFFECTIVE RETIREMENT AGE FROM THE LABOUR FORCE



Source: EC Ageing Report (2015)

FIGURE 10.4: PROJECTED IMPACT OF PENSION REFORMS ON PARTICIPATION RATES (2020, 2040, 2060) IN PERCENTAGE POINTS - COMPARISON OF PROJECTIONS WITH AND WITHOUT PENSION REFORMS



Source: EC Ageing Report (2015)

10.4 PENSION REFORMS AND PARTICIPATION RATE: DETERMINISTIC PROJECTIONS

In order to preserve growth, spur labour participation rates and deal with public finance liabilities linked to ageing, a paper by Schwan and Sail (2013) based on the European Commission deterministic methodology has suggested guidelines and recommendations for reforming pension systems. According to this study, two ways to reform pension systems may help to improve fiscal sustainability: eligibility-restricting reforms and generosity-reducing reforms. Even though the two categories are strictly interlinked, it is also true that each policy mix can have different impacts on labour market participation.

Pension reforms aiming at restricting eligibility requirements normally reduce the coverage rate of pension systems, that is the number of pensioners as a share of population aged above 65. Usually, this kind of reform has the objective of abolishing or restricting early retirement schemes, increasing statutory retirement ages or harmonizing retirement ages between men and women. When analysing the eligibility of a pension system, two specific indicators are investigated: coverage ratios and effective exit age projections, and the gap between effective labour market exit age and statutory retirement age. In almost all countries, average effective ages of exit from labour market are lower than the respective statutory retirement ages. Such an issue could be addressed by restricting the early retirement and other exit pathways.

Four specific reform instruments are, indeed, suggested concerning the eligibility of a pension system: the increase in statutory and early retirement ages; the link of eligibility requirements to life expectancy; the levelling of the gender gap in pension eligibility requirements; the definition of penalties (and bonuses) for early (late) retirement so that statutory and effective retirement age converge over time. These tools can be used to improve sustainability by adjusting the retirement age. As retirement age is postponed, they creates incentives to stay longer on the labour market.

The generosity-reducing reforms are usually designed so as to decrease the pension benefit ratio and hence the generosity of pension entitlements, thus having a substantial decreasing or at least stabilizing impact on public pension expenditure. Schwan and Sail (2013) point out that this kind of solution could be necessary especially in countries where benefit ratios are supposed to stay at a relatively high level over the coming decades. When analysing the generosity of a pension system, two specific indicators are investigated: public pension benefit ratios and average replacement rates. When considering these aspects, it should not be forgotten that the projections always rely on unchanged legislation and there exist the risk that, if pensions are perceived as "too low", this could create liabilities on public finances to guarantee benefit adequacy.

According to Schwan and Sail (2013), five specific reform instruments may be used in order to intervene on the generosity of a pension system: *i*) the reference pensionable earnings which should be increased in the direction of full career contribution or from final pay to average pay schemes; *ii*) the accrual rates which should be linked to the actual performance of national economies (as for instance GDP growth); *iii*) the full or partial indexation of pension benefits; *iv*) the existing of automatic or semi-automatic balancing mechanisms capping the amount of pension benefits; and, finally, *v*) the introduction of a sustainability factors which link the amount of pension benefits to the probability of mortality so as maintaining their actuarial fairness.

Given all the possible combinations between eligibility-restricting reform tools and generosity-reducing measures, Schwan and Sail (2013) have identified the policy mix that provides the best incentives to participate longer in the labour market, guaranteeing fiscal sustainability and reducing the risk of social inadequacy of pension systems.

According to their analysis, incentives to spur labour market participation especially of older workers are optimized when an automatic link between age/contribution eligibility requirements and life expectancy is put in place. In case of long working career, such a mechanism would assure that workers would accrue enough pension contributions to guarantee adequate pension benefits. However, in order to maintain actuarial fair pension entitlements and reduce the generosity of the system, it is also necessary to introduce an automatic balancing mechanism or a sustainability factor. In fact, a rule that links the amount of pension benefits to longevity gains, without adapting statutory retirement ages, would necessary result in lower pension benefits as they will be reduced in proportion to the decreased probability of death.

In a specific policy-change scenario, Schwan and Sail (2013) have simulated the savings in public finances and the gain in participation rates that each EU member state would obtain in case a reform linking retirement ages to gains in life expectancy is introduced. In such a scenario, exit probabilities from the labour market are shifted towards older age cohorts in line with gains in life expectancy and legislated pension reforms.

Participation rates of older workers aged 55-74 are projected to increase substantially in the EU by almost 6 p.p. up till 2060. The highest increase of more than 10 p.p. is observable for 11 countries (Bulgaria, Estonia, Ireland, Cyprus, Latvia, Lithuania, Luxembourg, Portugal, Romania, Finland and Sweden) which are supposed to keep their retirement age under current legislation rather constant in the future.

Dieppe and Guarda (2015), in a recent paper published by the European Central Bank, propose an extension of standard growth accounting that can be used to analyse how changes in the composition of the working population can affect the aggregate participation rate and therefore long-term growth. This model was used to quantify the impact of demographic changes, as immigration, and increases in participation rates that could be related to structural reforms. In particular, the standard growth accounting exercise was extended by disaggregating labour input along several dimensions, i.e. sex, age and citizenship, in order to assess the impact of a shifting population structure on potential growth. The idea is that since population projections differ across groups, the overall population structure will be transformed, and changes in population composition will affect aggregate participation rates and therefore labour force projections.

The data used in the paper refer to the Italian population, but the method is easily applicable to most European countries. The model analyses different scenarios according to different hypotheses. In one of them, potential output is computed assuming higher participation rates for the elderly following an increase of the retirement age. Results suggest that an increase in elderly participation rates as envisaged in the 2011 Italian pension reform may raise annual potential growth by nearly 0.1 p.p. on average over the next 20 years. In particular, the model shows that recent reforms aimed at raising elderly participation rates should increase the retirement age by three years. In conclusion, results suggest that a changing population structure will significantly affect average participation rates. By quantifying the impact of different policies, the analysis shows that the policies aimed at increasing participation rates will have the desired positive impact on potential output, but that this will be insufficient to offset the effect of ageing. The increase of three years in the retirement age only makes a little improvement, while the immigration would represent the larger contribution.

10.5 A DSGE MODEL FOR ITALY: THE FGB-MDL-MKIII

The projections of the 2015 Ageing report are based on deterministic assumptions which do not allow to take into account the inter-relations existing among macroeconomic variables as well as the behaviour of agents at microeconomic level who have to decide whether to participate to labour market or actually retire.

Against this backdrop, Beqiraj and Tancioni (2014), using a dynamic stochastic and new-Keynesian general equilibrium model (NK-DSGE) produced by the Fondazione Giacomo Brodolini for simulating the Italian labour market and characterized by a search and matching module[156], tried to evaluate the effects of the recent Italian pension reforms, in particular the increase in the retirement age on labour supply. The results of this simulation, which cover the period until 2018, show that changes in pensions regulation have an impact on individual decision to participate in labour market which is as large as that produced by changes in labour market regulation.

156 The most recent simulation are obtained by using the third version of the model, which is based on the previous structure distinguishing two blocks (Beqiraj, Tancioni, 2013). The first block, defined core, implements the relationships between the main macroeconomic variables. The second block, defined satellite, contains the relations for the breakdown of the aggregate quantities (region, sector, profession, education level, age). The second version of the model (Giuli, Tancioni, 2009) updated the original structure of the core module, defined by a system of simultaneous equations, by replacing it with a dynamic stochastic and new-Keynesian general equilibrium model (NK-DSGE), characterized by a labor market type of search and matching (Mortensen, Pissarides, 1994; Gertler, Trigari, 2009; Giuli, Tancioni, 2009; Blanchard, Gali, 2010; Riggi, Tancioni, 2010), and estimated using the Generalized Method of Moments (GMM).

The most recent version of the model maintains the previous definition of NK-DSGE for the estimation of core macroeconomic variables, but it updates significantly the theoretical basis as well as the domain of the variables underpinning the previous version of the model. More specifically, the changes were aimed at: *i*) improving the full theoretical specification of relations with the external sector, defined by exchanges of goods and services and movements of capital; *ii*) including the credit sector; *iii*) the full specification of a pattern of wage bargaining (Nash); *iv*) the specification of detail of the levers of fiscal policy, which also considers fiscal tools oriented to the labour market. Another innovation concerned the estimation method, for which it was decided to adopt a Bayesian perspective, centred on a Markov chain method.

Differently from the results of the 2015 Ageing Report, Beqiraj and Tancioni (2014) found that the Italian pension reform aimed at increasing the retirement age is projected to reduce GDP growth of about 0.02% in the first years of the simulation and then return to the benchmark values on the horizon of simulation (2018). The unemployment rate is expected to persistently rise to a value close to 1% on the horizon of simulation mostly as a result of the increase in unemployment among old age workers.

The model does not detect a direct relationship between the increase in the employment rate of the elderly and the crowding out of youth employment rate in the medium-term, as often claimed by specific strand of the literature.

10.6 OTHER RESULTS BASED ON DSGE MODELS

In a recent contribution, Dieppe and Guarda (2015) present the results of three General Equilibrium Models that analyse population ageing and alternative pension reforms for Portugal, Luxembourg and Finland. These models aim to compare alternative policies that should stabilize the debt-to-GDP ratio over the medium run. The common conclusion of the three models is that to stabilize debt following a realistic demographic shock, labour taxes should have to rise to unacceptable levels, which in turn would reduce labour supply and medium-term growth. If this policy is combined with a two-year increase in the retirement age, total pension expenditure is reduced and social contributions are increased by longer working lives, requiring a smaller increase in labour taxes to stabilize debt and by increasing labour supply with the increase in the retirement age. If in addition the pension replacement ratio was cut by 15 p.p., the labour supply would be stimulated, and the drop in the medium-term growth would be much more contained. If, furthermore, consumption taxes were increased, both the required increase in social contributions and its negative impact on labour supply would be reduced.

Overall, the scenario with only the two-year increase in the retirement age is outperformed, in terms of outcome for employment, growth and GDP per capita, by both the scenario with the cut in pension replacement ratio and the scenario with the increase in consumption taxes. In absence of policies, ageing dynamics would have a strong a negative impact on medium-term growth and on debt-to-GDP ratios. The results show that to face this challenge, a combination of policy instruments is most suitable in order to mitigate the negative effects of ageing on growth. Moreover, the country specific response to ageing largely depends on the current level of social contributions, income taxes and pension benefits. A further increase in taxes in countries where the level is already high would be counterproductive, while it is important at the same time to design a redistribution between current and future generations.

Other studies, based on General Equilibrium models, investigated the impact of ageing on pay-as-you-go social security systems in Europe and in US. According to Huang, Imrohoroglu and Sargent (1997), Nishiyama and Smetters (2007), Fehr, Habermann and Kindermann (2008), the fact of moving from pay-as-you-go to funded system can carry long-term benefits and, in particular, preparing for the transition by temporarily raising labour taxes to build up a fund to finance future pensions would be more efficient than compensating pensioners by increasing debt, mostly because the government provides insurance against two risks: higher labour income taxes reduce labour income risk, while social security benefits insure against longevity risk. Fuster, Imrohoroglu and Imrohoroglu (2007), on the contrary, argue that decreasing contributions but compensating pensioners by issuing debt financed by higher consumption taxes would be a virtuous policy: in such

a setting, welfare increases for 58% of agents, who would then support the reform. A flexible labour market would be crucial for this result. Finally, according to Ludwig, Schelkle and Vogel, (2012), the fact of raising the retirement age would be a good alternative to cutting pensions.

A second interesting strand of literature concerns the impact of pension systems in an endogenous growth framework. In particular, it has been found that higher life expectancy will increase growth by raising incentives to invest in human capital. This literature relies on the framework developed by Blanchard (1985) and Yaari (1965). Some interesting findings can be summarized: if the population grows too old, the growth rate falls, as an increasing share of the workforce is less productive (Boucekkine, De la Croix and Licandro, 2002; De la Croix and Licandro, 1999). However, a more generous social security system might encourage investment in human capital, although it should also require higher contribution rates, hence discourage labour supply and, ultimately, the investment in human capital (Echevarria and Iza, 2006).

In conclusion, there is a consensus on the fact that an older population will raise the capital/output ratio, cut the marginal product of capital and increase wages. According to Dieppe and Guarda (2012), in order to finance pay-as-you-go pensions in an ageing scenario, governments must raise contributions or cut benefits, while new debt might be only a short-run solution. The current pension levels will discourage capital accumulation by limiting incentives to save, while increasing contributions might discourage labour supply. A compromise is suggested: keep pensions constant but increase the retirement age. On the other side, public pensions provide insurance against longevity and income risk, hence adequacy issues must not be forgotten.

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