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GENERATIONAL AND GENDER GAPS IN LABOUR AND PENSION LIFE-TIME INCOMES. THE EVOLUTION OF THE LABOUR MARKET AND RETIREMENT BENEFITS IN ITALY*

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1. Introduction

In order to analyse the welfare of the Italian population by generations and genders (i.e. considering the evolution of the so called gender gap) both from a theoretical and a policy perspective it is crucial to collect accurate information on wealth or lifetime incomes.[1] However, since these data (or estimates) are limited and not easily available, most of the literature investigates distributional and poverty issues only on the basis of current individual incomes. Obviously, this simplifies issues, but may lead to incomplete and distorted analyses, especially when we examine the potential effects of a given policy, as this paper will show.

In order to determine the best policies to avoid intensifying future inequalities and poverty trends, it is increasing critical to study the interactions between the distribution of human capital, earnings, wealth and the long run performances of redistributive institutions. Only in such a framework one can successfully examine the effects of alternative sustainable "welfare state" systems on inequality and poverty.[2] Focussing on sustainability, an important methodological tool has been provided by the intergeneration accounting model. We try to develop this tool, enhancing its potentials, while overcoming some of its limitations.[3] Differently from intergenerational accounting, our agent-based gender comparison between present and future generations doesn't assume neither the constancy of

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[1] For instance, focusing on policy, recent tests proposed for benefit eligibility are becoming, de facto, negative taxes on wealth (with notable exemptions, e.g. owner-occupied housing).

[2] In fact such systems may differ across countries with similar economic and political fundamentals, e.g. European and US-style. The rise in inequality has been attributed to factors such as changes in skills and wealth distribution, productive structure and institutions (e.g. the decline of unions and the erosion of the welfare state).

[3] The main contributions in this area are from Auerbach and Kotlikoff (1987), Kotlikoff (1993). For an application to the Italian case see Franco et al. (1994), Sartor (1997) and for the pension system see Boll, Raffelhuschen and Walliser (1994).

relative profiles (i.e. the ratio between net tax burdens) – including relative discrimination – nor the satisfaction of the intertemporal budget constraint. Namely, the use of an agent-based dynamic microsimulation model allows us to consider behavioural responses to revisions in pension rules, as they change along the transition path towards the new defined benefit regime. Accordingly, we are able to analyse the changing patterns of the distribution of life-time and current incomes in Italy, necessary to examine intragenerational and intergenerational issues, and to provide new evidence on the effects of policy options related to seniority pensions and the future social security system.

Different strands of economic literature tried to tackle some of these issues, mainly considering separately topics such as human capital, wealth distribution and gender gaps. However, rarely they attempted to consider the long run effects of a given institutional policy.[4]

The first contribution by the economic literature is related to empirical and theoretical studies of human capital, incomes and growth, which basically consider the attained level of formal education.[5] It is clear that the labour quality (human capital) may play an important role in determining future incomes and growth.[6] Accordingly, our work considers the decision about schooling and on-the-job training as a means of investing in human capital and accounts for some of the differences using the Mincerian regression model, at the basis of the "*Education, Work and Income*" module of our micro-simulation model. For Becker (1964) the two devices are based on different decision-making mechanisms, since firms invest mainly in specific training (increasing worker's productivity inside the firm). They also seem imperfect substitutes having different effects: (***i***) education provides more flexible skills, fruitful in innovating activities, (***ii***) training seems more suitable for exploiting existing technologies. In reality, this distinction is quite problematic and less clear-cut.[7] Accordingly, we simplify matters, considering a stochastic mechanism and disregarding, as a first approximation, the

[4] This type of theoretical research project has in part started in Bénabou (2002) who tries to identify political-economic mechanisms that allow sustainable alternative national social contracts (taxes and transfers, unemployment and health insurance, education finance, and labour regulation).

[5] As Aghion and Howitt (1998) stated, the "educational achievement of a society (is) usually referred to as the human capital stock" (p. 354). Schultz (1960, 1961) was one of the first to consider "human capital" embodied in workers as a factor of production (knowledge, skills, competence and other relevant attributes) different from other type of capital and the relevance of capital market imperfections for this type of investments; see also Aghion Bolton (1997) and Galor Zeira (1993). Other papers deals with human capital accumulation role in enhancing growth, taking into account mechanism of accumulating human capital (e.g. schooling, on-the-job training), cf. Zotteri (2002). Cf. also OECD (1998),

[6] As Barro and Sala-i-Martin (1995) say, human capital may relax "the constraint of diminishing returns to a broad concept of capital and can lead thereby to long-term per capita growth in the absence of exogenous technological progress" (p. 172).

[7] As Katz and Ziderman (1990) and Acemoglu and Pischke (1998) show, firms may have incentives to invest in general training, sharing costs with workers. Moreover, distinction between general and specific training is not exhaustive (Stevens, 1994a, 1994b, 1994c, 1996). When training is transferable, firms and workers have some incentives to invest in it.

effect on the next generation's human capital. This seems quite reasonable, especially focussing on pension policies, since most education or training investments are specific and unlikely to be inherited.

The second topic, that is the study of wealth distribution, has a long lasting research tradition in Italy, dating back at least to the attempt to estimate the private wealth by Pantaleoni (1890). One main difficulty in investigating the distribution of wealth and its evolution is still the quality of available data.[8] Micro-level data on family holdings of real and financial assets have been gathered since the late 60ies with the Bank of Italy's *Survey of Household Income and Wealth* (SHIW) and a complete balance sheet has been collected only from 1987.[9] Recently, Brandolini et al. (2004) examine household net wealth as the market value of dwellings, consumer durable goods and financial assets (net of debts).[10] However, the value of small unincorporated businesses, life insurance, private pension funds, and public pension rights are not included, not being recorded in the SHIW.[11] Moreover, wealth data may be quite independent from the evolution of incomes, due to changing behaviours and demography.[12] Because of the big differences between the evolution of net real wealth and income, due to accumulation and de-cumulation processes,[13] we decided to focus on gross life-time incomes from labour and pension in our exercise, to concentrate on the consequences of working and retirement choices. This does not only represent a better basis for evaluating changes in welfare, but also allows us to avoid the difficulties of considering future tax systems and possible interactions with changes in Italian household savings' behaviours.

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[8] Financial accounts have been published by the Bank of Italy since the early 1960ies and tangible assets were only estimated in few occasional studies, cf. Tresoldi and Visco (1975), Banca d'Italia (1986), Marotta (1988), Pagliano and Rossi (1992).

[9] This has been the basis for studies of the economic behaviour of Italian households - Ando, Guiso and Visco (1994) - and of wealth distribution - Cannari and D'Alessio (1993), Jappelli and Pistaferri (2000), Brandolini et al. (2004).

[10] While disposable income is underestimated at around 30% (see Brandolini, 1999 and Cannari and Violi, 1995), wealth is less reliable. Under-reporting is lower for tangible assets 30-40% than financial assets 60-70%. Moreover, there is an under-representation issue, being wealth distributed with a highly asymmetric profile and extremely concentrated, while the probability of including the wealthiest households in the sample is quite low. In Canada and United States this issue is brought under control by over-sampling high-income households. Hence, in Italy the aggregate estimates of household net wealth and the SHIW ones are very different.

[11] In 1995, Jappelli and Pistaferri (2000) estimated life insurance (and private pension funds) to account for a 10% (and 4%) of household financial wealth (as defined in their paper). On pension issues see also Brugiavini, Maser, Sundén (2005).

[12] Smaller household size increases resources available for wealth accumulation during the life-cycle and causes a lower inheritance fragmentation.

[13] According to Brandolini et al. (2004) in the last decade we witnessed a strong wealth accumulation: wealth grew in real terms by 2.7% per year, while income remained unchanged, due to capital gains and the high propensity to save of Italian households.

Finally, theoretical and empirical studies documented the existence of the gender gap in wages and examined its evolution, based on surveys or census data-sets, observing a progressive shrink in many developed countries in recent decades, cf. Goldin, (1990), O'Neill and Polachek (1993) and Blau and Khan (1997). The factors that contribute to this trend are still debated and a number of possibilities (including worker characteristics, job characteristics, work experience and discrimination)[14] have been put forward. The determinants of earnings and gender wage differentials have been (and are still) studied using the Mincerian regression model and the Blinder-Oaxaca wage decomposition model.[15] Recently, O'Neill (2003) shows that there is still a 10% wage gap in the U.S. in 2000 unexplained by gender differences in schooling, actual experience and job characteristics.

While classical studies on gender inequality focus on gender discrimination factors and their decrease, others pointed instead at the decreasing weight of male's comparative advantage in the labour market.[16] Also in this case theoretical and empirical analyses have not found clear-cut results.[17]

Italy made a great progress over the past half century in removing gender gaps. However, it still displays significant disparities in the opportunities available in education and in the workplace.[18] Italy is just the 45th among the 58 countries considered by the World Economic Forum (2005) to assess the current size of the gender gap, considering five critical areas: economic participation (51), economic

[14] Usually women are likely to work in female dominated jobs, with below average wages and have lower experience due to breaks in their labour force participation for childbearing and other reasons. Among younger cohorts of women, delayed marriages and lower fertility rates contributed to rise women's labour force participation.

[15] An review of the empirical literature studying the gender wage gap in the post-war period and its evolution is provided in Altonji and Blank (1999), cf. also Goldin (2002). The Blinder-Oaxaca decomposition separates the portion of the gap resulting from differing characteristics of men and women from the unexplained one which may result from discrimination.

[16] The classical literature on gender inequality, starting with Becker (1957), mainly explained higher men's wage rate in equilibrium, assuming that employers prefer to hire men, due to gender discrimination factors. Hence, the narrowing gender gap may be explained as a decrease in gender discrimination. As Becker (1985) explains, this phenomenon differs from racial discrimination due to its feedback on the optimal intra-household division of labour which generates a larger impact on earnings. Galor and Weil (1996) argue instead that developed economies reward less attributes in which physical labour has a comparative advantage. In practice, capital accumulation reduces the gender gap, since capital is complementary to mental labour, and substitutable to physical one. Fan and Lui (2003) tested this model considering also structural changes towards a service-oriented economy analysing two census data sets (1981 and 1991) in Hong Kong, showing a larger gender gap in the occupations using more intensively physical labour.

[17] In fact, the discrimination issue may be reformulated in terms of private information and incentive problem in the labour market, where firms use gender as a screening device. Firms assuming women to be less attached to market work may offer contracts with lower earnings and hours, even in the absence of gender differences in productivity. Using 2000 Census data, Albanesi and Olivetti (2005) show that, in equilibria with female discrimination, gender earning gaps should be higher in industries with severe incentive problem, as this model predicted.

[18] In fact, we still fall far short of expectations, lagging behind not only in economic participation and economic opportunity, but also in educational attainment. Italian women have low levels of economic participation, but are also subject to a lack of opportunity for advancement in their careers.

opportunity (49), political empowerment (48), educational attainment (41), health and well-being (11). Accordingly, it seems relevant to carefully evaluate the effects of pension reforms in this respect.[19]

This paper tries to shed some light on the evolution of welfare by generations and genders using the Mincerian regression model to simulate the evolution of the Italian household employing dynamic ageing methods. We also provide a first assessment, in terms of life-time inequalities and poverty trends (in a family perspective using several measures), of the consequences of the relevant changes made to the Italian social security system in the '90ies. More specifically, we analyse the effects of the recent seniority pension reform on the distribution of life-time income from labour and pensions.

The main novelty of this paper is the attempt to explore distributional and gender issues on the basis of life-time incomes. Moving forward in this direction, we do not limit ourselves to the study of the different profiles, by sex and types of incomes (from labour and pensions), of ***expected*** individual life-time incomes (assuming individuals to reach the very same age, set equal to 74 years for men and 81 for women). In fact, we also simulate the ***actual*** equivalent family life-time incomes cumulated by the individuals during part of their lifetime (taking into account that individuals live in families) and study their distribution through the most used inequality and poverty indices.

This is the main difference with our previous works - Bianchi *et al*. (2003 and 2005) and Vagliasindi *et al.* (2004a, 2004b and 2004c) - where we dealt uniquely with ***current*** annual labour and pension incomes, sticking to the standard *cross-section approach* in determining income concentration and poverty trends each five years considering the equivalent family income of the individuals with at least a pensioner in their family. This analysis gives an instantaneous picture of the income inequality and poverty present in various periods, but poor hints on how lifetime incomes are distributed in each generation, since in each period incomes can be volatile and assume peculiar short-lived configurations that do not represent the real permanent situation of each individual. On the other hand, the *life-time approach* (proposed in this work) evaluates inequality and poverty considering life-time incomes, collecting all labour and pension incomes earned by each individual during her simulated life.[20] It

[19] Italy performs poorly on economic participation, economic opportunity and political empowerment and only slightly less so on the specific dimensions of educational attainment. We are very far from the Nordic countries, like outstanding Sweden (1) or followers like United Kingdom (8), Germany (9) and France (13) who have made considerable progress in recent decades in removing obstacles to the full participation of women in their respective societies. Like Greece (50) it performed very poorly, worse than most of the East European group, below Russia (31) and Latin American nations such as Costa Rica (18), Colombia (30) and Uruguay (32), or Asian and African countries such as Bangladesh (39) and Zimbabwe (42). Italy best performance was only on health and well-being (11), lower than Spain (5) but higher than France (17) and United Kingdom (28).

[20] In particular, we record the future value of equivalent family incomes from labour and pension each individual will accumulate starting from her 60ies, using a discount real interest rate equal to 2.5%.

allows to consider directly ***expected*** and ***actual*** lifetime incomes, for each generation. In this way, along with the expected life-time income, we can try to accurately compute the actual level of concentration over the distribution of simulated life-time incomes, providing more correct measures of inequality among the relevant agents and estimating long poverty trends related to life-time incomes, as well as their annual equivalent to arrive at a better welfare indicator, measuring effective annual individual command on economic resources. More specifically, the paper describes simulation results relative to the future evolution of pension treatments, distinguishing between the rules applied to (private and public) dependent employees and to self-employed workers and considers behavioural reactions (in accordance with the *OV* model by Stock and Wise, 1990) to changing incentives using the MIND dynamic microsimulation model, comparing (from 1995 to 2095) two alternative social security policy scenarios. In this way, considering life-time incomes, we analyse the long run distributional impact of the seniority pension reform recently enacted (following previous governmental proposals) among and across generations, under alternative behavioural rules (i.e. *individual* and *family bounded rationality*). Along these lines we refine and extend previous experiments discussed in Bianchi *et al*. (2003) and Vagliasindi *et al.* (2004a, 2004b, 2004c), where we validated the MIND model, assessing the micro foundations of agents' behaviour.

In what follows, in section 2 we review the most important concepts used in our analysis and the working of the MIND Model, discussing the most relevant methodological issues when dealing with life-time incomes and intergenerational comparisons, in an attempt to devise the most accurate and correct ways to measure inequality over the distribution of simulated life-time incomes. We then briefly describe the new defined benefit regime and the recent seniority pension reform currently endorsed by the government and the parliament (section 3).

Section 4 describes the evolution of expected life-time incomes from labour and pensions in 6 different generations determined aggregating over a 5 years period, taking into account several characteristics of the population, including sex, geographical dimension (North, Centre and South) and employment status (public and private employees, self employed workers).[21] To reduce the outcome variability, the results are obtained running 10 Monte Carlo simulations.

In section 5 we describe some of the main different features of inequality trends and consider intergenerational comparisons with life-time incomes, in an attempt to devise the most accurate and correct ways to measure actual inequality. In the subsequent section 6 we consider the evolution of

[21] We produce simulation-based estimation of past and future income flows for individuals born between 1935 (or 1950) and 1979, obtaining the gross life-time income from labour and pensions cumulated in their past working periods and future expected retirement periods.

relative poverty looking at the life-time incomes of the Italian population over 60. Section 7 concludes the paper with a sensitivity analysis and section 8 closes our study with some conclusive remarks.

2. Life-time incomes from wages and pensions

It is well known that the usual *cross-sectional approach* considers, for a given year, the individual or the equivalent family income of selected individuals belonging to different generations (e.g. older than 60 year).[22] In doing so it provides an instantaneous picture of the income distribution that can become unreliable whenever incomes assume specific configurations, as a result of temporary circumstances not representing the permanent situation of the considered individuals, due to stochastic components. In this respect, a *life time approach* is an improvement, since it evaluates poverty and inequality phenomena over individual life time.

Dynamic microsimulation allows us to build panel data for a relevant period of individual life of selected individuals, simulating labour and pension incomes collected by them.

2.1. The life time approach: methodological issues.

In particular, we may record the future value of individual or equivalent family incomes from labour y_{it} (and pensions p_{it}) each individual i will accumulate starting during a given working period, of a years before retiring at time R, that is $t= R\text{-}a \ldots R\text{-}1$ (and retirement period, before she dies at time D, that is $t = R \ldots D$), e.g. from her initial working period (or from a given date, e.g. her 60ies).[23] Accordingly, for individual i - belonging to generation θ_i - we define Y_i as the cumulated values of labour incomes y_{it}, capitalised in the contribution years a_i, before retirement R_i (determined by the individual behaviour in the labour market).[24]

$$[1] \qquad Y_i = \sum_{t=R-a}^{R-1} y_{it}(1+r)^{R-1-t}$$

On the other hand P_i the life-time income from pensions of individual i is the cumulated values of discounted pensions p_{it}, perceived before she dies at time D.

$$[2] \qquad P_i = \sum_{t=R}^{D} p_{it}(1+r)^{R-D-1}$$

In this way, the two component of lifetime income are the future values of labour incomes and the

[22] The incidence of each family is weighted by the number of members at least 60 years old.

[23] The real interest rate used is equal to 2.5%.

[24] The real rate of interest are those on the Ordinary Treasure Bill BOT until 1994 (until 1979 see Homer and Sylla, 1991); then it equals 2.5% see note 13.

present values of pension incomes calculated discounting incomes flow with the same real interest rate r at individual i retirement time R_i, taken as her individual reference year.

In order to obtain comparable values we must normalise values, choosing the very same reference year for all gross life-time incomes from labour and pensions (cumulated during each individual's working and retirement periods). This is obtained by setting $T = T^\circ$ as the reference year and by discounting data with the same real interest rate r. Moreover, we set generation $\theta = \theta^\circ$ as the reference point and, as in intergenerational accounting, we adjust incomes with per capita GDP growth rate at the entry in the labour market g.

[3] $$Y_i^* = Y_i\,(1+g)^{\theta^\circ-\theta}\,(1+r)^{-T^\circ+R_i}$$

[4] $$P_i^* = P_i\,(1+g)^{\theta^\circ-\theta}\,(1+r)^{-T^\circ+R_i}$$

In this way we can compare the distribution of individual (or family equivalent) lifetime incomes considering periods of five years (e.g. individual born from 1950 to 1954), which allows us to compare the selected individuals even if belonging to different generations.

Finally, to derive the average lifetime-income from labour WY_θ and pension WP_θ we simply take the arithmetic average of all the adjusted life-time incomes (Y_i^* and P_I^*) of the NY_θ individuals collecting income from labour and the NP_θ individuals collecting income from pensions, belonging to the very same generation θ as follows.[25]

[5] $$WY_\theta = \sum_{i=1}^{NY_\theta} Y_i^*/NY_\theta$$

[6] $$WP_\theta = \sum_{i=1}^{NP_\theta} P_i^*/NP_\theta$$

We use this method to derive expected lifetime-incomes setting $NY_\theta = NP_\theta$ equal to the workers who decide to retire, and setting their life expectation equal to 74 years for men and 81 for women.[26] Moreover, the previous values (WY_θ and WP_θ) are aggregated in periods of 5 years (1950-54, 1955-59,

[25] Differently from intergenerational accounting, cf. Auerbach, Gokhale, Kotlikoff (1991), our comparison between present and future generations doesn't imply the constancy of relative profiles, the satisfaction of the intertemporal budget constraint, an equal general tax burden and a constancy of the relative discriminations among groups for future generations (i.e. ratio between net tax burdens). In fact, we have directly considered that behaviours change (in accordance with the OV hypothesis) as fiscal and contributive rules are modified and that current deficit of the pensions system could not be postponed and paid by future generations.

[26] In our simulation the length of the individual life is determined by chance, due to the dynamic ageing process. Hence, two agents perfectly identical, apart from the length of life, have different life-time incomes only because of the difference in the extent of time over which they collect their incomes.

1960-64, 1965-69, 1970-74, 1975-79), considered as belonging to the same generation. We can also compute the whole lifetime income summing up ($W_\theta = WY_\theta + WP_\theta$) or analyse sub sample of each generation, considering separately males and females.

Before proceeding to explain how the MIND model calculates gross incomes, let us consider the evaluation of the actual lifetime incomes. When we consider actual values, instead of expected ones, we have to properly consider another important issue: the length of the individual life. Let us start from the normalised values that allow us to consider at the same time individuals who belong to different generations. Two agents (*n* and *m*) who are perfectly identical (i.e. they earn each year the very same real income *y*) apart from the length of life, will have different life-time incomes, just because of the different horizon of time over which they collect their incomes. If the period is equal to Z and *k*Z respectively for *n* and *m*, it follows that their life-time incomes are different:

$$Y_n = \sum_{t=1}^{Z} y(1+r)^{Z-1-t} = y\frac{(1+r)^Z - 1}{r(1+r)} < Y_m = \sum_{t=1}^{kZ} y(1+r)^{kZ-1-t} = y\frac{(1+r)^{kZ} - 1}{r(1+r)}$$

Hence, we may also want to standardize all individuals' life-time incomes with respect to this factor, taking into account the annual average value of the human capital (that is, the average annual life-time income for each individual). This value cannot be calculated by dividing the life-time income by the number of years over which they are collected, since the income flows of future period need to be discounted to obtain their actual value. We can easily illustrate this point, considering again the previous case with $Y_n < Y_m$. The latter holds if we consider the life-time incomes that the two individuals enjoy per year, i.e. $Y_n/Z = \sum_{t=1}^{Z} y(1+r)^{Z-1-t}/Z < Y_m/kZ = \sum_{t=1}^{kZ} y(1+r)^{kZ-1-t}/kZ$.[27]

In contrast, we get the correct result (that is, the same annual life-time income) if we allow each period to have a weight lower than the previous one, following a geometric series with common ratio equal to 1/(1+*r*), where *r* is the real interest rate that we use to discount income's flows.[28]

Accordingly we proceed considering total life-time income $W_i = Y_i + P_i$ as the sum of incomes flows from labour and pensions and define the annual life-time income as follows:

[7] $$y_i^\circ = (1+g)^{\theta^\circ-\theta}(1+r)^{-T^\circ+R_i}\left(\sum_{t=R_i-a_i}^{R_i-1} y_{it}(1+r)^{R_i-1-t} \Big/ \sum_{t=R_i-a_i}^{R_i-1}(1+r)^{R_i-1-t}\right)$$

[8] $$p_i^\circ = (1+g)^{\theta^\circ-\theta}(1+r)^{-T^\circ+R_i}\left(\sum_{t=R_i}^{D_i} p_{it}(1+r)^{R_i-D_i-1-t} \Big/ \sum_{t=R_i}^{D_i}(1+r)^{R_i-D_i-1-t}\right)$$

[27] For example, assuming $y = 1$, $r = 25\%$ and Z = 20, this would be the case if $k > 1$. Being $Y_n = 26.183$ and $Y_m = 69.088$, with k=2, (or $Y_m = 45.00$ with k=1.5) and hence $Y_n/Z = 1.309$, while $Y_m/Z = 1.727$ with k=2, (or $Y_m/Z = 1.500$ with k=1.5).

[28] Assuming (as before) $y = 1$, $r = 25\%$ and Z = 20, we have $Y_n/Z = Y_m/Z = y = 1$, cf. equation [7].

Only in this way we assign the same annual life-time income $y_n^\circ = y_m^\circ$ to the two perfectly identical agents (*n* and *m*), signalling that they enjoy the same amount of resources per year. Accordingly, this variable seems a better welfare indicator to measure individual command to economic resources and hence a better indicator of inequality and poverty.

Our analysis of inequality and poverty will be done using the Gini and Atkinson indices, which are extensively used in this area, because of their ease of interpretation. The Gini index has a natural interpretation as the normalised area between the Lorenz curve and the 45° line.[29] However, the same Gini coefficient can result from different income distributions, since the Lorenz curves can intersect for low and high income individuals, and as a consequence it would not capture the different inequality levels. The Atkinson index allows us to compare the level of inequality for different parts of the income distribution, considering different values of the degree of *inequality aversion*. The parameter ε indicating the quota of income that the society would be willing to sacrifice to achieve an equal distribution.[30] This analysis is also supplemented by investigating poverty trends that deserves a particular attention.

If in the present one-dimensional setting the evaluation of inequality does not seem to cause any particular methodological concern, the same is not true for the poverty issue. Notably, we need to determine for each individual her poverty thresholds (the absolute and relative ones). This is the preliminary step necessary to compute all poverty indices, included the values of the Sen index, as modified by Shorrocks (1995) in the *cross-sectional* and the *life time* approaches.[31] Its main advantage

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[29] The Gini index is a function of the cumulated fractions of population pi and of the equivalent family incomes q_i and represents the average difference of all equivalent family incomes y_i.

$$G(y) = \frac{\sum_{i=1}^{N-1}(p_i - q_i)}{\sum_{i=1}^{N-1} p_i} = \frac{1}{2N(N-1)m}\sum_{i=1}^{N}\sum_{j=1}^{N}|y_i - y_j|$$

Moreover, it satisfies the four important principles of anonymity, scale independence, population independence, and transfer principles (see, Cowell, 2000).

[30] The Atkinson index is defined as follows:

$$A(\varepsilon) = \begin{cases} 1 - \left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} & \text{if } \varepsilon > 0 \text{ and } \varepsilon \neq 1 \\ 1 - \exp\left[\frac{1}{N}\sum_{i=1}^{N}\ln\left(\frac{y_i}{\bar{y}}\right)\right] & \text{if } \varepsilon = 1 \end{cases}$$

[31] In the formula proposed Shorroks (1995) we have $P(y,z) = (2-H)HI + H^2(1-I)G_p$ where *H* is the *head count ratio H*, *I* the *income gap ratio* and G_p the *Gini index for the poor*. It can be interpreted in terms of "the area under the inverse generelized Lorenz curve for poverty gaps", cf. Chakravarty (1997).

is that it summarises several dimensions –such as poverty diffusion,[32] intensity[33] and concentration[34] - that we will also consider separately in appendix 2.

Specifically, when we investigate the relative poverty, the threshold assumed for families with 2 components, adopting the ISTAT equivalence scale, is the following:

[9] $TR_{99} = 17{,}732$ € *(in 1999 prices) anchored to incomes;*

In the *life time* approach we need to determine for each individual her equivalent life time poverty threshold ETR_i. The solution that we propose here is simply to assume that her equivalent life time poverty threshold is the amount that she would reach if for all her life she collected an income equal to the "cross-sectional" poverty threshold. Given the threshold ETR_i in the year T_0 and referring all the incomes to the year X, for each individual j born in θ and dead in D, if the incomes have been collected starting from her Vth year of age, we have the following:

$$[10] \quad ETR_i = TR_{T_0}(1+g)^{\theta^0-\theta}\sum_{t=V+\theta}^{D}(1+g)^{t-T_0}(1+r)^{X-t} \qquad (\textit{relative poverty})$$

We then need to consider the length of life of the individual. So, as we have done for all the incomes collected during the life, we need to discount the thresholds following the same procedure.

$$[11] \quad \text{etr}_i^{\circ} = ETR_i \;/\; \sum_{t=V}^{D_i}(1+r)^{D_i-1-t}$$

2.2. The life time approach*: hypotheses and measurements*

The problem is now to estimate the previous formulas in order to meaningfully examine the evolution of the Italian Pay as you go (PAYG) system and to consider the effects of alternative reform paths and their redistributive effects on life-time incomes' distribution and poverty in the long run. The MIND model, when properly validated and calibrated as shown in previous works, can provide accurate future scenarios and acceptable estimates of life-time incomes from labour and pensions of the

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[32] As poverty diffusion index we consider the usual *head count ratio*, $H=q/N$ indicating the quota of population under the poverty threshold, *i.e.* with an equivalent family income y_i below z.

[33] Poverty intensity is measured using the *income gap ratio* equal to the ratio between the average *poverty gap* and the poverty threshold (where the *poverty gap*, $g_i = z - y_i$, is the difference between the poverty threshold and the family income). It has several practical advantages: it has a straightforward interpretation and can be easily computed starting from common poverty measures, cf. Kuan and Osberg (2002).

$$I = \frac{\sum_{i=1}^{q} g_i / q}{z} = \frac{\sum_{i=1}^{q} g_i}{qz}$$

[34] This is measured using the *Gini index for the poor*.

Italian population. These estimates are crucial for undertaking a welfare analysis, both by generations and genders. Using a cross section approach Bianchi *et al* (2003) analysed the impact of the social security reform path on inequality and poverty in different scenarios and Vagliasindi *et al* (2004c) examined the short run impact of the proposed Maroni's seniority pension reform in the short-medium run under similar scenarios. They showed the relevance of (i) a correct specification of the socio-economic and demographic structures, considering different geographical areas, since structural changes modify the framework within which retirement security programs operate and (ii) a behavioural retirement function, to examine reactions to changes in eligibility rules and economic treatments. In what follows, we will provide a few details on the mechanics of the simulation model and retirement behaviours to make the reader familiar with these issues.

MIND is a modular dynamic ageing model that considers the socio-demographic dynamics of the Italian main geographical areas (North, Centre, South and Islands). Its demographic and socio-economic data are based on the "Survey of Households Income and Wealth (SHIW) in 1995" of the Bank of Italy (Banca d'Italia, 1997) and are adjusted along the simulation period. In particular, dynamic ageing allows us to derive future scenarios by modifying demographic and socio-economic characteristics through individual transition probabilities and decisional processes.

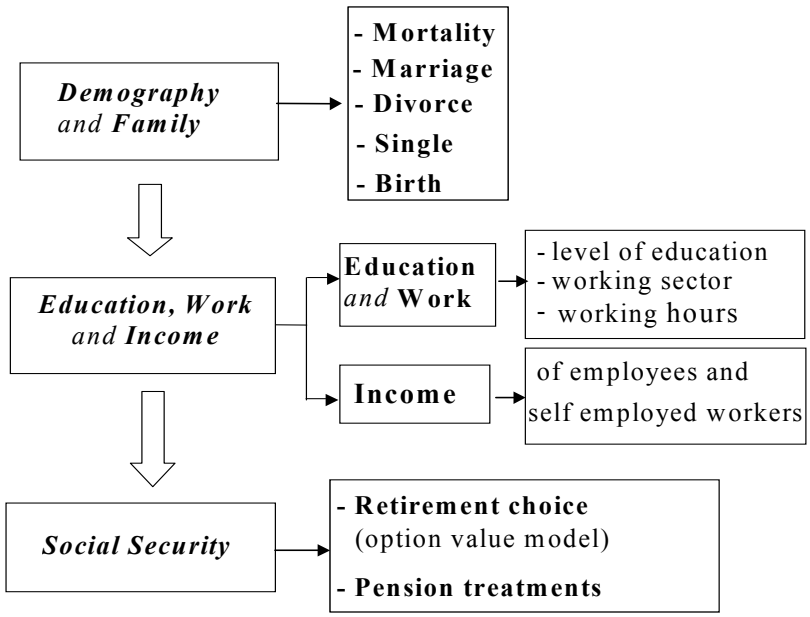

Fig. 1 The modular structure of the MIND model

As shown in fig. 1, its structure is organised in modules, which simulate the evolution of: (a) demographic and family structures, (b) socio-economic phenomena related to education, work incomes

and (c) optimal retirement choice and pension incomes (where individuals modify behaviours according to pension system changes).

In Vagliasindi et al (2004a and 2004b) we validated the evolution of demographic (marriages, births, etc.), economic (incomes) and fiscal (income tax revenue) variables and the retirement choice. In practice, the MIND model considers overlapping generation agents, where families differ with respect to the number of components and related characteristics (age, sex, education, income generation, etc.).

They are generated by the $MIND_3$ database (the best aligned with respect to elders) and the *demography and family* module, that modifies demographic and socio-economic structures starting from the evolution of individuals (birth, education, death, ...) and families (creation and dissolution of family unity: marriages, procreations, separations, divorces, …), using transition probabilities derived from ISTAT data and the SHIW sample, as illustrated in detail in Vagliasindi et al (2004a).

Let us instead focus on how MIND models individual education and working processes, by means of Monte Carlo methods. The *education, work and income* module simulates education levels and the entry in the labour market, finding new occupations and estimates initial incomes on the basis of education achievements (of unemployed, aged between 25 and 45 years) and updates them during individuals working careers. In practice, given the characteristics of occupational sector S_{it} (dependent, self-employed, public)[35] and geographical area G_{it} (North, Centre, South), at a given age age_{it}, each individual has her own ability or skill level a_{it} and earns her labour incomes, using her own human capital $k_{it} = (\varepsilon_{it}, \tau_{it})$ (where ε_{it} and τ_{it} are its specific components, respectively education and experience at time t)[36] and time-effort λ_{it}.[37] Specifically, we adopted a Mincerian regression model where income estimation is based on cross-section data[38] and has a log-normal specification (cf.

[35] The choice between the three different categories of work is stochastic, depending on the probabilities to be dependent workers (private or public) or self-employed.

[36] We consider three basic education degrees (elementary, high school, university) and the associated number of years ε_{ij} are stochastically attributed simulating the probability of achieving a certain degree, for all the individual older than 24.

[37] The time-effort λ_{ij} is the number of hours worked and is estimated on the basis of the average number of hours worked h and of the respective standard error se, depending on the sector and the geographical area and estracting rd a random number with normal standard distribution which introduces a stochastic element. $\lambda = h(age, S, G) + se(age, S, G) \times rd$

[38] Also Cannari and Nicoletti Altimari (1999) chose a similar cross-section approach in estimating wage profiles. Since the panel has a very limited number of families with older workers to produce reliable estimates (differentiated by gender, geographical area, kind of workers), we stick to their approach. Recent attempts with INPS panel have not improved results. If personal ability a_{it} is a linear function of education (edu) $a_{it} = \delta_0 + \delta_2 edu + e_t$, where the random term e_t is uncorrelated with the other covariates in the wage equation, the coefficients can be consistently estimated by GLS regression that omits ability, even if the return to education is overestimated, when $\delta_2 > 0$. On the evolution of the labour market and wages in Italy see Contini (2002).

Andreassen, Fredriksen and Ljones, 1996).[39] Obviously, this Monte Carlo approach has its shortcomings, mainly because education and working choices are stochastic, and not policy dependent choices. This may be overcome by introducing new behavioural functions for education, training and labour. Nevertheless, in the context of the present policy experiment, this simplification seems quite acceptable, since for most individuals the main choices, that determine the level of incomes from labour that we are going to simulate, were taken before reforms and results do not rely on questionable causal relationships.

Accordingly, our main objective is to determine the main trend of intergeneration and gender inequalities due to the reform path, assuming: (***i***) a 10% increase of education levels attained, (***ii***) the convergence of the labour market in the South towards Centre and (***iii***) more uninterrupted careers for males and females and the key consequences of last year's seniority pensions reform.

Let us now examine how MIND models individual retirement decisions and the two possible behavioural proposed alternatives and their meaning. In order to determine individual retirement age, MIND incorporates individual choices as the Stock and Wise (1990) "option-value" model. Each individual compares the expected utility from an immediate retirement at age R, $V_t(R)$, with a delayed year at age R+1, $V_t(R+1)$. Differently from Stock and Wise our agents do not determine R*, the age that maximizes the value $V_t(.)$, but they retire immediately (at time t) if $V_t(R)$ is the maximum value compared to $V_t(R+1)$.[40] Otherwise, they postpone retirement and the previous calculation is repeated the next simulation period (time t+1), and so on. Our indirect utility specification of labour and pension incomes is $V_i(y_{it}, p_{it}) = \alpha y_{it} + p_{it} + \nu_{it}$, with $0 \leq \alpha \leq 1$ a comparative utility parameter of labour income and ν_{it} a zero mean random variables. Differently from Stock and Wise (1990), we have risk neutral individuals and linear utility specification.[41] The α parameter, reflecting the loss of leisure explicitly

[39] For the individual i, the forecast value ($\hat{y}_{it}$) at time t is obtained replacing the simulated values assumed by the exogenous variables in the vector $\boldsymbol{x}_{it}$ of the equation $\hat{y}_{it} = e^{(\boldsymbol{x}_{it}\hat{\beta} + \hat{u}_i)}$ where, to avoid biases induced by the non-linear transformations, the estimated errors $\hat{u}_i$ also included. Almost all the coefficient are of the right sign and statistically significant at the 99% confidence level. For further details, see Bianchi et al (2003). Real income at period t is derived from: $\hat{y}_{it} = \hat{y}_{it}\,(1+g)^{t-t_o}$, where g, the real growth rate of incomes, is assumed to be to 1% after 2004 and t_o is the initial simulation period.

[40] In their model, the individual decides her retirement year comparing all the expected utilities $V_t(R)$, calculated for each possible future age R of retirement. Thus the R* age that maximizes the value $V_t(R)$ is determine.

[41] In reality Vagliasindi *et al* (2004b) do not presume utility to be linear but simply indirectly estimate the relative benefit of income from labour, with respect to pension. In general low values of α (from 0 to 0.25) provide the best fitting. What we are really interested in, is future retirement behaviours and workers' reactions to policy changes. Obviously results depend on the functional form for the period specific utility function V_i (originally with constant relative risk aversion, coefficient γ), the difference between the utility derived from wages and from benefits (a leisure control constant k that reveals how much less individual values a euro from work income y than a euro from pension benefits p) and the assumptions on the

taking into account the average disutility of labour experienced by older workers, has been validated and calibrated in Vagliasindi et al (2004b).[42]

In our experiment we consider two limiting "retirement behavioural rules", useful as boundary cases in the context of retirement choice, since they encompass a number of intermediate behaviours. Under *individual rationality* ***IR***, α is set equal to 0.25 and retirement depends only on a rational comparison (using the market discount rate r equal to 2.5%) between (i) the present value of the expected utility of the flow of the pension benefits obtained with an immediate retirement and (ii) the one obtained postponing retirement to the next period. Under *family bounded rationality* ***FBR***, workers are eager to retire (valuing less the benefit from labour income, $\alpha = 0.125$), more myopic (using a higher discount rate r equal to 8% for actualising benefits streams) and females' retirement decision is influenced by her partner (she anticipates retirement with a 10% probability if the husband is already retired).[43]

In practice, according to *individual rationality* workers' α is 0.25 and the discount factor r is equal to 2.5%. They calculate their option-value, i.e. the differential benefit $OV_t(R+1)$ of postponing retirement next year, according to formula [12] and decide to retire only if $OV_t(R+1) \leq 0$.

[12] $$OV_t(R+1) = E_t\, V_t\,(R+1) - E_t\, V_t\,(R) = \alpha y_{it} - p_{it}(t) + \sum_{j=t+1}^{D}(1+r)^{j-D}(B_j(j+1)-B_j(j))$$

This provides the first insights on the underlying economic forces responsible for the simulation results under a given scenario. With *individual rationality*, there is a tendency for workers to postpone the exit from labour market, since delaying retirement allows to enjoy higher wage incomes for a longer period, compensating for the relatively lower pension benefits granted by the new pension rules. The presence and effect of *family bounded rationality* is instead an early retirement, given the lower evaluation of labour income ($\alpha = 0.125$) and the higher discount rate r equal to 8%. Moreover - with a probability $\pi = 10\%$ ($\pi = 20\%$ for public workers) - female workers decide to anticipate retirement if their husbands have already retired, independently from the economic losses they will experience on an individual basis. Hence, while under *individual rationality* retirement decisions are deterministic they are also stochastic for females under *family bounded rationality*.

Before starting the simulation, to gain a greater knowledge of the institutional arrangements and the economic incentives operating in the simulation, we need to gain a better understanding of the

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discount factor and the maximum life length D. $OV_t = \sum_{j=t}^{R-1}(1+r)^{R-t}\, y_{ij}^{\gamma} + \sum_{j=t}^{D}(1+r)^{D-j}(kp_{ij}(R))^{\gamma}$

[42] This can also allow to correct eventual biases in the shape of the wage profiles in the last part of the working career. This choice can be questioned on several grounds, but can also be justified, cf. Vagliasindi et al (2004b).

[43] Specifically, a public dependent wife will anticipate retirement with a probability of 20% if the husband is already retired.

problems of the Italian pension system and the changes brought by the seniority pension reform that will be summarised in section 3 below.

3. Recent reforms in the Italian Social Security System

Given the serious problems of deficit and public debt in Italy, the recent reforms of the social security system has been mainly targeted to reduce public expenditures in the short and in the long run. This concern over the public budget, together with pressures from strong interest groups, have overshadowed the need to design a coherent and satisfactory transition path between old and new regime and adequate redistribution schemes for pension treatments, to avoid an increase in poverty and inequality among pensioners.[44]

In particular, the Dini's reform eliminated the minimum pension treatment (terminating the so-called "integrazione al minimo" and leaving only social allowances) for new workers, mitigating concerns of vertical equity and redistribution in the pension system. This opened opportunities for a new and wider role for income support allowances and welfare state policies, but it did not lead to the design of any specific solutions. Notably, the indexation of pensions to prices and not to wages has perhaps been chosen as a source of savings to the budget. However, it has also: **(i)** transformed the lowest pensions from a social minimum into a biological one, **(ii)** recreated the "vintage pensions", with likely conflicts in the future and **(iii)** placed the premises for further manoeuvres to eliminate such problems, on an equity basis. In this way the lowest pensions, notwithstanding subsequent discretionary adjustments, are still insufficient to guarantee an adequate standard of living.

The implications of the elimination of the minimum pension treatment and of the indexation of pensions only to prices (and not to wages) - also for the lowest pension annuities - need to be considered separately. However, both are expected to increase inequalities and poverty in the medium term (as seen in points **i** and **ii** above). In this framework, at least in the short run, policies against poverty among pensioners, as the one recently adopted under the Berlusconi government (L.448/01), who increased social allowances for disadvantaged elders,[45] may represent a first step to reduce the impact on poverty and inequality. However, they do not remove the long run adverse consequences of indexing lowest pensions only to prices.

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[44] Interesting analysis of the transition to the new regime are contained in Brugiavini, Fornero (2001), Fornero (2003), Bianchi et al. (2003) and Sartor, Franco (2005). For the literature on early retirement see also Vagliasindi et al (2004b).

[45] The 2002 social relief intervention, which provides an increase in the lowest pensions in order to guarantee an individual monthly income of up to 516.46 euro, in favour of poor subjects who are 65 or older, has reduced poverty and limited the growth of inequalities. Further improvements could be made by redesigning benefit allowances and making structural provisions, e.g. indexing social pensions to incomes, as discussed in Bianchi et al. (2003).

The reforms of the '90s does not seem to have adequately removed the problems caused by the impending retirement of the baby-boomers which will determine substantial increases in the tax system and pension expenditures. The working generation will likely face an increased fiscal burden that could risk breaking the implicit inter-generational agreement if the conditions of working generations are worsen instead of being adequately adjusted. Two possible solutions to this problem can be considered. First, the retirement age can be increased. In this respect, increasing the working period seems to be a logical step if life expectancy continues to rise. Otherwise, it will be necessary to reduce pension benefits, unless economic growth (productivity) increases fast enough. The current transition rules to the new regime, which were strongly conditioned by the desire for consensus in a complex socio-economic situation, need to be revised in order to accelerate the transition; e.g. in relation to seniority pensions with equitable (dis)incentives to postpone (or take early) retirement, eliminating the privileges of the most mature generations.

The recent seniority pension reform (L.243/2004) seems to prefer the first solution. In particular, it is articulated into two phases. In the first phase, up to 2008, it introduces an incentive for employees in the private sector who have already matured the minimum requirement for the seniority pension and decide to postpone retirement. They may either opt to cash the value of the annual social security contribution (amounting to 32.7% of the net wage representing around 43% of workers' gross wages) or to pay it, increasing the years of contributions and hence future pension benefits. As of 2008, the second phase introduces a structural reform, raising the minimum requirements for entering the seniority pensions: together with a minimum number of contributions (equivalent to 35 "working years") paid to the system, the candidate has to be at least 60 (61 if self-employed)[46] instead of 57. The reform also provides an exception for women, who can retire under the old requisites (age of 57 plus 35 years of contribution) but only if they switch to the new defined contribution regime.

The draft of the reform that we discussed herewith represents some serious revisions with respect to what was proposed in October 2003, especially for the second phase. These changes partially reduce the innovative impact of the manoeuvre and its likely positive effects on budget savings. Notably, the original reform was expected to eliminate seniority pensions, raising also the minimum age requirements to benefit from the old age pension system. The exception, now provided only for women, was expected to be open to all interested workers, increasing the flexibility of the system. However, switching from the defined benefit system to the defined contribution regime in order to

[46] From 2010, the minimum age requirement would be raised by one year, with the possibility of a further increase in 2013.

enjoy early retirement could represent a sufficiently strong disincentive for early retirement.[47] The following section will try to evaluate changes in the expected life-time income of 6 generations due to the previous pension system and the impact of the seniority pension reform under different behaviours.

4. Expected life-time incomes from wages and pensions and gender inequalities

Under the two retirement behavioural rules (*individual rationality* and *family bounded rationality*), we compare (from 1995 to 2090) two alternative social security policy scenarios (***B*** and ***M***). In the ***basic scenario*** (***B***) we assume that the previous state of affairs remains the same, while in the ***modified scenario*** (***M***) we consider the impact of the reform to reduce future seniority pensions.

In what follows, by considering the mean values of 10 Monte Carlo replications, we compare the expected gross life-time incomes from wages and pensions of the generations born between the '50 and the '79. In this way, we can analyse the evolution of life-time incomes under defined benefit system (considering the individuals born until 1959), under the mixed one (considering those born between 1960 and 1976) and under the defined contribution (considering the individuals born from the 1977).[48]

4.1. Total expected life-time income.

Let us start our analysis considering the total expected life-time income of the 6 generations and denoting with W_{IR}^{M} and W_{IR}^{B} (W_{FBR}^{M} and W_{FBR}^{B}) total expected life-time income from wages and pensions, respectively under ***M*** and ***B*** with ***IR*** *individual rationality* (***FBR*** *family bounded rationality*) retirement behaviour. Fig. 1 reports the average per capital total expected life-time income of five generations of Italian citizens (males and females), during the average estimated life expectancy (equal to 74 year for males and 81 year for females). In general, under *individual rationality* the estimates of total expected life-time income show a sharp increase for the second generation and smaller ones for the third and fourth ones (born in the '60ies). The trend is instead decreasing for the last two generations. However, the ones born in the late '70ies have a higher total expected life-time income than the first generation (born in the early '50ies). The impact of the reform proposed by the Italian Welfare Minister is to increase the total expected life-time income of the first four generations (born in the '50ies and '60ies) in a limited and decreasing way.

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[47] The effects on pension expenditures, income concentration and poverty of this first draft of the reform have been analysed in Vagliasindi *et al*. (2004a, 2004b), which also considers the incentives provided in the first phase of the reforms extended to all workers (public and private employees).

[48] Unfortunately, the previous linkage of the pension regimes with the age of individuals is to some extent arbitrary, e.g. some individual born in 1975 or 1976 will be under the defined contribution regime instead of the mixed one. However, this distinction is true on average and very useful for comparing life-time income from labour and pensions of different generations and to attribute them to the influence of different regimes.

Under *family bounded rationality* the estimates of the total expected life-time income also show a sharp increase for the second generation, but they remain stable for the third and fourth ones (born in the '60ies). Afterwards, total expected life-time income shows a sharp decrease for the generations born in the '70ies, so that the last generation enjoys roughly the same total expected life-time income as the first generation. In this case the impact of the reform is larger and the increase in total expected life-time income affects all the generations apart from the last one.

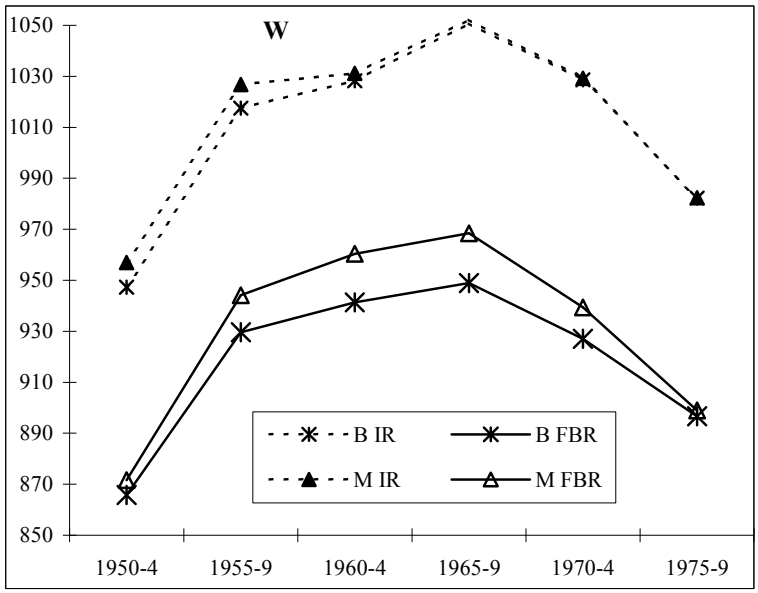


Fig. 2 Average total expected life-time income (from wages and pensions) per worker
(hp. B and M, thousand €)

In practice, the retirement behaviour due to *individual rationality* implies greater reactions from future generations to the changes in the pension regimes, due to the past reforms and to the recent one proposed by the Italian Welfare Minister, allowing them to increase their total expected life-time income. The difference in the trend of per worker total expected life-time income, brought by the two different retirement behaviours, is increasing over time and, therefore, seems to depend on the changes in incentives brought by the transition to the new social security regime.

In what follows, we assess whether the expected per worker expected life-time income trends are similar for males and females. Let us consider total expected life-time income by sex under the ***modified*** and the ***basic*** scenarios, with *individual* and *family bounded* rationality. Fig. 3a and Fig. 3b report the expected life-time income of five generations of male and female workers (entitled to pension treatment), assuming a life expectancy of 74 year for males and 81 year for females.

In general, male generations enjoy, under *individual* and *family bounded* rationality, higher expected life-time income than female generations.

The trend displayed by males' expected life-time income (in Fig. 3a) is similar to per worker total expected life-time income (in Fig. 1). However, in relative terms under *individual* rationality, the first generation starts from a higher level and the last generation enjoys roughly the same total expected life-time income as the first generation. Instead, under *family bounded* rationality, the decrease in expected life-time income is sharper for the generations born in the '70ies, so that the last generation enjoys a total expected life-time income that is about 10% less than the one of the first generation.

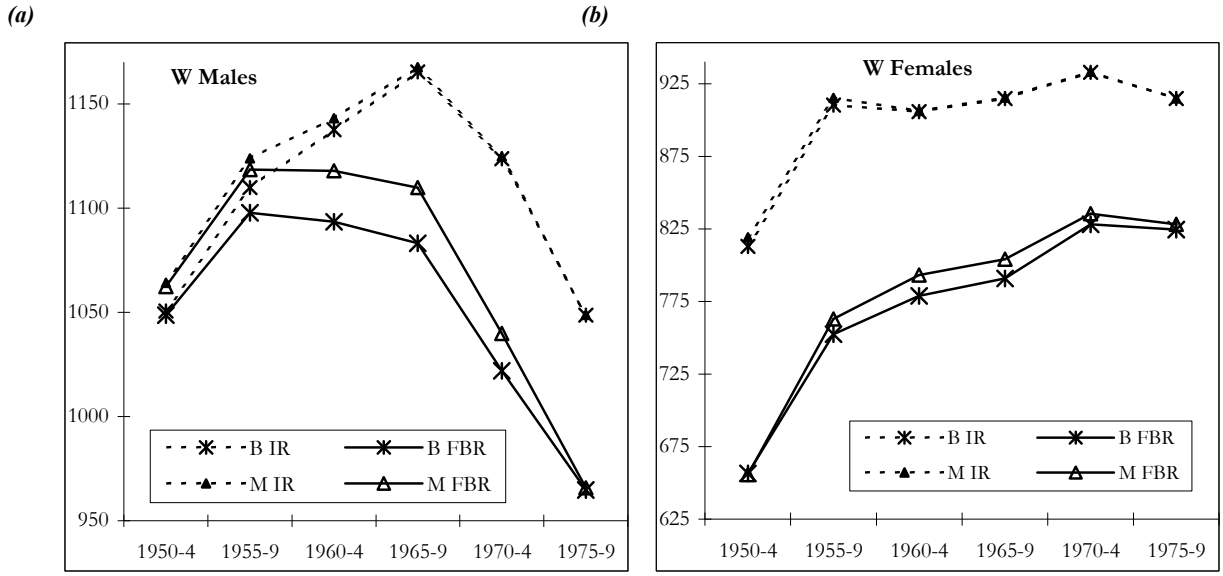


Fig. 3 Average total expected life-time income per male and female worker (hp. B and M, thousand €)

The impact of the reform proposed by the Italian Welfare Minister on male expected life-time income depends on the assumed retirement behaviour. Under *individual* rationality, the expected life-time income of the first four generations (born in the '50ies and '60ies) is increased in a limited and decreasing way. Under *family bounded rationality* the reform has a larger impact and affects the expected life-time income all the generations, except the last one.

Finally, in the case of male total expected life-time income (in Fig. 3a), as in the case of per worker total expected life-time income (in Fig. 1), the difference brought by the different retirement behaviour in the trend are increasing with time and, hence, may be attributed to the change of social security regime.

The trends are very different for females since they are distinct right from the start under the two different retirement behaviours and they are increasing. Specifically, under *individual rationality* the expected life-time income of female workers shows a sharp increase for the second generation and very small changes for the other ones (born in the '60ies and '70ies). The total increase of income is around 12%. The reform brings a small increase in the total expected life-time income of the first and second

generations (the ones born in the '50ies). The total increase of income from these generations is around 11%.

Under *family bounded rationality* the estimates of total expected life-time income also show a sharp increase for the second and last generation but a smaller one for the other. Accordingly, the last generations born in the '70ies, enjoys a higher expected life-time income than the first generation (by around 25.6%). The reform produces a larger impact, by increasing substantially female expected life-time income, with the exception of the first and the last generation.

In practice, our expected life-time income estimates show how the differences between sexes decrease because: (***i***) while female expected life-time income increases sharply at the beginning of '50, and the male's one decreases during the '70s, (***ii***) even if we introduce the seniority pension reform, female expected life-time income grows less than male expected life-time income.

In general, the retirement behaviour under *individual rationality* seems to imply greater reactions (that is, postponement of retirement) from males and females, in order to reach higher per worker expected life-time income levels contrasting the changes in the pension regimes (due to the past reforms) and the recent ones proposed by the Italian Welfare Minister.

4.2. Ex ante lifetime-income from wages and pension.

Male and female expected life-time income trends are influenced by the different sources of income and the reactions to the policy measure. In what follows, we focus on the impact of the changes in the pension regimes (and whether it has favoured females), as well as in the reasons of the impact of the recent reforms of seniority pensions (that seems to increase expected life-time income instead of decreasing it). In particular, we try to address these questions, by examining separately expected life-time income from wages and pension WY_{IR}^{M} and WY_{IR}^{B} (WY_{FBR}^{M} and WY_{FBR}^{B}), respectively under ***M*** and ***B*** (i.e. in the ***modified*** and in the ***basic*** scenarios), with *individual* and *family bounded* rationality.

In Fig. 4a and Fig. 4b we represent the average expected life-time income from wages and pension of five generations of workers. The estimates of expected life-time income from wages show a sharp increase for the second generation and smaller ones for the third and fourth ones (born in the '60ies). The trend is instead slowly decreasing for the last two generations. Hence, these generations (born in the '70ies) have a higher total expected life-time income than the first generation (born in the early '50ies). With *individual rationality*, workers enjoy higher expected life-time income from wages and the impact of the reform proposed by the Italian Welfare Minister is to increase the total expected life-time income of the first four generations (born in the '50ies and '60ies) in a limited and decreasing way, due to an increased retirement age. Under *family bounded rationality*, the impact of the reform is

larger and the increase in total expected life-time income affects all the generations, increasing the length of their working period, apart from the last one. On the other hand, apart from the second generation, expected life-time income from pension show a decreasing trend (-28.5% under ***IR*** and -15.1% under ***FBR***); smaller in scenario M (-26% under ***IR*** and -9% under ***FBR***).

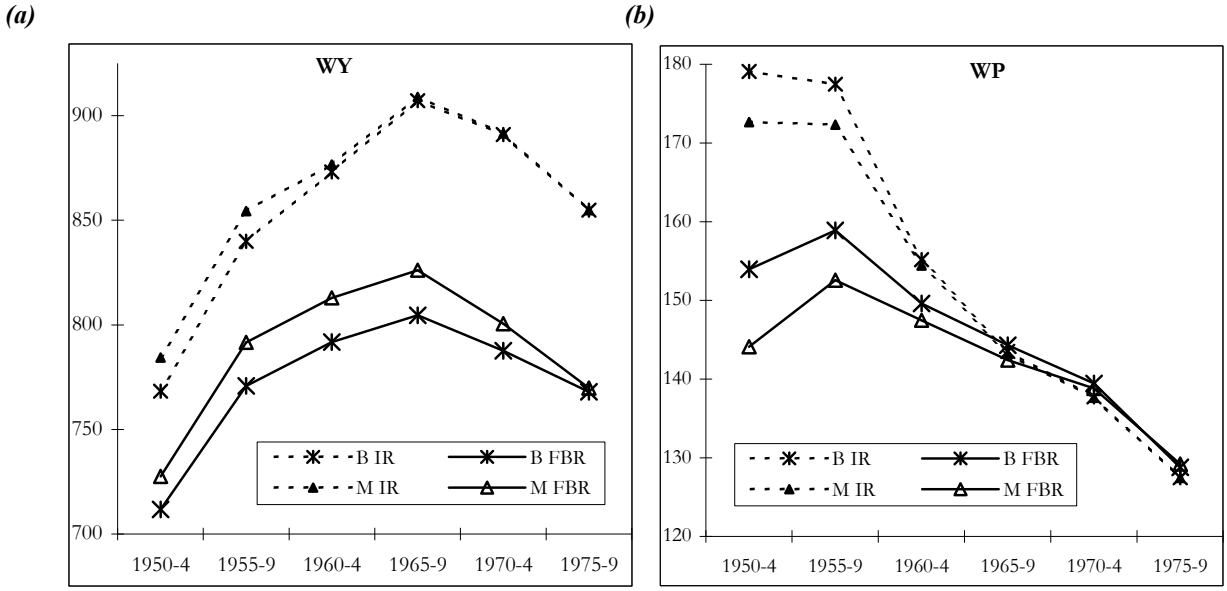


Fig. 4 Expected life-time income from wages WY and pensions WP per worker (hp.B and M, thousand €)

Let us now consider the trend of males expected life-time income from wages and pension MWY_{IR}^{M} and MWY_{IR}^{B} (MWY_{FBR}^{M} and MWY_{FBR}^{B}), respectively under ***M*** and ***B*** (i.e. in the ***modified*** and in the ***basic*** scenarios) with *individual rationality* (*family bounded rationality*) retirement behaviour. In Fig. 5a and Fig. 5b we report the average expected life-time income from wages and pension of five generations of male workers, entitled to pension treatment, assuming a life expectancy of 74 year.

The trend displayed by males' expected life-time income from wages (in Fig. 5a) is similar to per worker expected life-time income from wages (in Fig. 4a). Roughly, the first generation starts from the very same level. However, while under *individual* rationality, the last generation enjoys a greater expected life-time income than the first generation (by 8.1% under B by 5.1% under M), the opposite is true under *family bounded* rationality (that is, a decrease of expected life-time income by 2.8% under B and –by 5.2% under M). At the same time, expected life-time income from pension shows a decreasing trend (by39% under ***IR*** and by 32.5% under ***FBR***); smaller in scenario M (by 17.3% under ***IR*** and by 11.9% under ***FBR***). The impact of the reform on male total expected life-time income depends on the assumed retirement behaviour. Under *individual* rationality, the expected life-time income of the first four generations (born in the '50ies and '60ies) is increased in a limited way also decreasing over time.

Under *family bounded rationality* the reform has a larger impact and affects the expected life-time income all the generations apart from the last one.

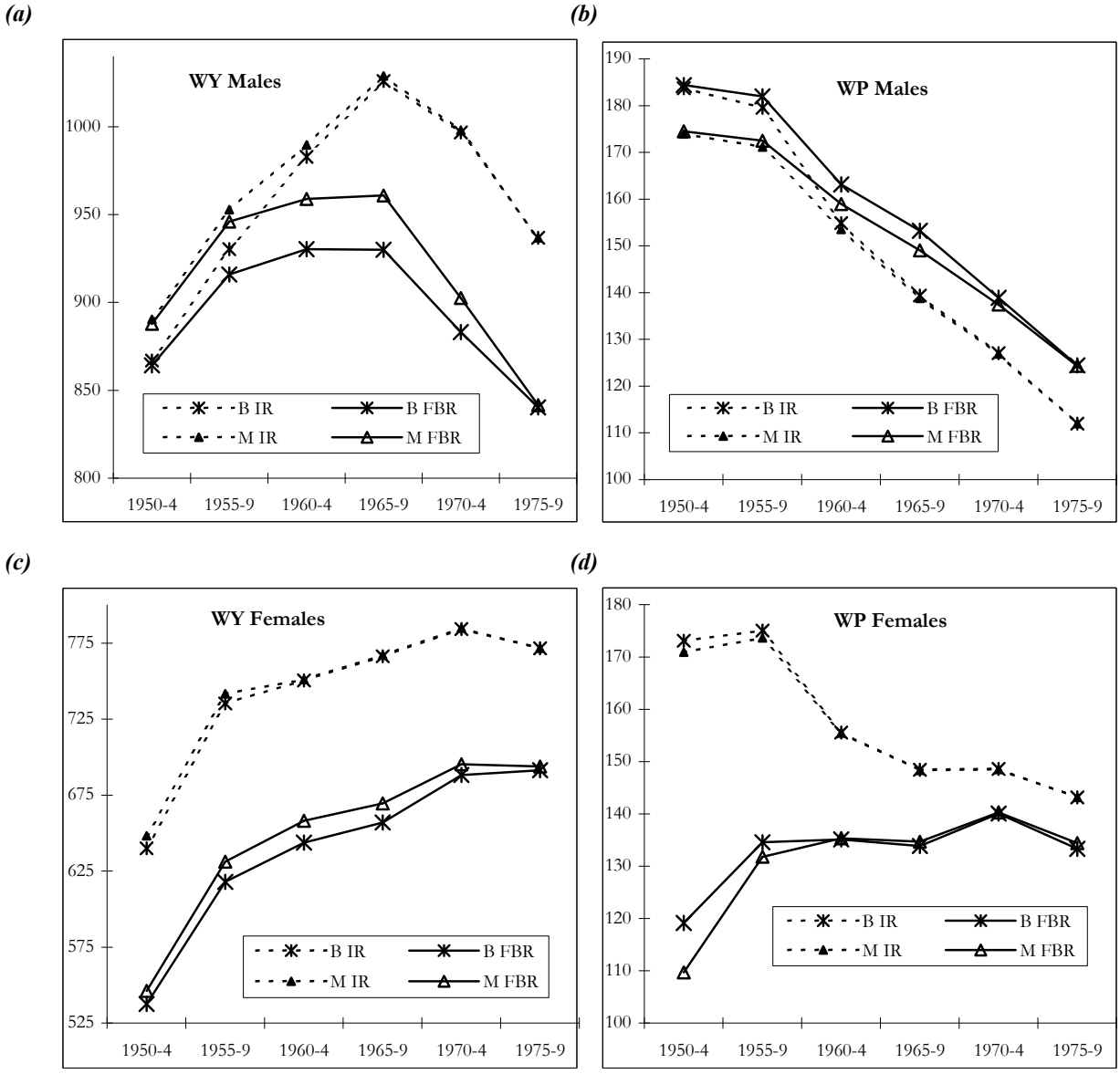


Fig. 5 Gender expected life-time income from wages WY and pensions WP per worker
(hp.B and M, thousand €)

Finally, the difference brought by the different retirement behaviour in terms of trends of male expected life-time income from wages and pension (Fig. 5a and Fig. 5b) is increasing over time, which seems linked to the transition to the new defined benefit social security regime. Due to the higher retirement age under *individual* rationality, the increase of the expected life-time income from wages compensates for the decrease of the expected life-time income from pension, resulting in an increase in total male expected life-time income.

Finally, in Fig. 5c and Fig. 5d we consider the trend of females expected life-time income from wages and pension FWY^{M}_{IR} and FWY^{B}_{IR} (FWY^{M}_{FB} and FWY^{B}_{FB}), respectively under ***M*** and ***B*** (i.e. in the ***modified*** and in the ***basic*** scenarios) with *individual rationality* (*family bounded rationality*).

Under *individual rationality* the estimates of female expected life-time income from wages show a sharp increase for the second generation and the others till the ones born in the early '70ies. Expected life-time income from wages shows a smaller increasing trend (by 20.6%) under *individual* rationality, than under *family bounded* rationality (where it increases by 28.6%). This increasing trend is less significant in scenario M, decreasing to 19% under *individual* rationality and to 27% under *family bounded* rationality. Considering expected life-time income from pension we see opposite trends: while under *individual* rationality, we have a decreasing trend –so that the last generation enjoys a greater expected life-time income than the first generation (by 16.3% under B and by 17.3% under M) - the opposite is true under *family bounded* rationality (where the increase is equal to 11.9% under B and 22.6% under M). Overall, the reform increases also female total expected life-time income of the first two generations under *individual* rationality in a limited (and decreasing) way and also increase all generations' expected life-time income (apart from the first one, due to the family constraint) under *family bounded* rationality.

4.3. Gender gap analysis.

Our gender analysis can be examined considering the evolution of the gender gap GR and GP that can be defined respectively as the percentage difference between male and female expected life-time income from wages and pensions:

[13] $GY = (MWY-FWY)/MWY$

[14] $GP = (MWP-FWP)/MWP$

Summing up, our results show how the differences between sexes decrease:

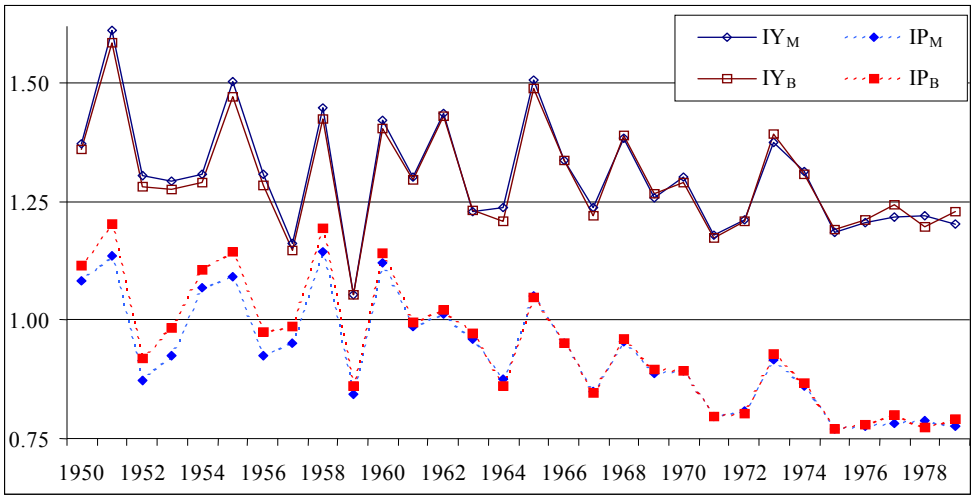
(i) Under B, the higher increases in female expected life-time income reduces the gap from 26% and 5.8% to 17.6% and -27.8%, respectively in terms of expected life-time income from wages and pension under individual rationality (and from 37.8% and 35.4% respectively to 17.7% and -7.1%, under family bounded rationality). Accordingly, the total gap decreases from 22.6% to 12.8% under individual rationality (and from 37.4% to 14.5%, under family bounded rationality).

(ii) Under M, the gap from 27.2% and 1.7% reduces to 17.6% and -27.8%, respectively in expected life-time income from wages and pension under individual rationality (and from 38.5% and 37.2% respectively to 17.5% and -8.1%, under family bounded rationality). Therefore, the total gap decreases

from 23.0% to 12.8% under individual rationality (and from 38.3% to 14.2%, under family bounded rationality).

The reform increases the gap for all intermediate generations (apart from the last ones, under *family bounded* rationality), leading males to postpone retirement, increasing expected life-time income from wages and overweighing, in this way, the reduction in the female pension benefit gap.

(a)



(b)

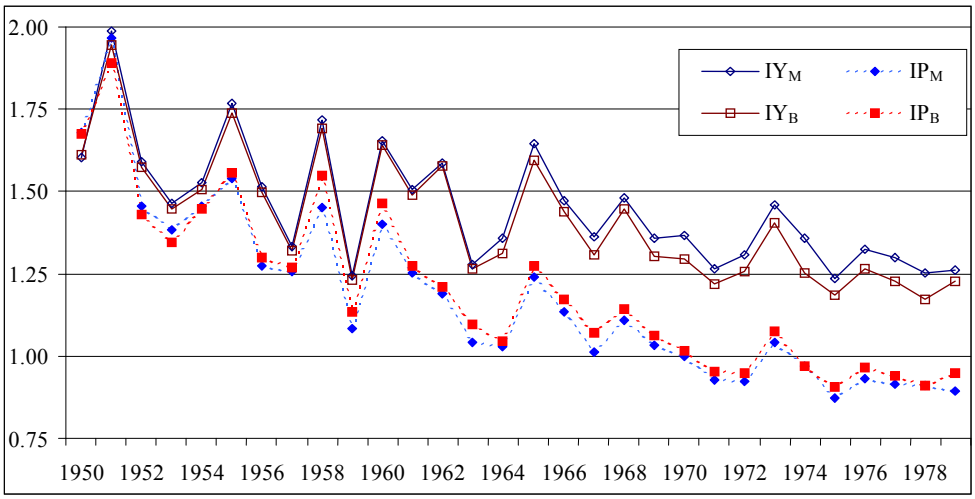


Fig. 6 IY and IP ratios under *individual* (a) and *family bounded* (b) rationality (hp.B and M)

Expected life-time income from wages is higher under *individual* rationality, depending on the later retirement age. This also accounts for the lower pension expected life-time income (given the shorter period in which the benefit is enjoyed, for males, in absence of family constraints).

The previous gender analysis can be extended using as indexes the ratio between male and female expected life-time income from wages and pensions, respectively IY and IP and the related gender gap

GR and GP we have just examined (defined as the complement to one of the reverse of IY and IP):

[15] $IY = MWY/FWY$ $GY = 1\text{-}1/IY$

[16] $IP = MWP/FWP$ $GP = 1\text{-}1/IP$

By considering these indexes (in Fig. 6a and Fig. 6b) we find a reduction of the relative advantage of the males. In the basic case, females seem to enjoy a relatively higher pension expected life-time income, since the index IP is lower than IY. The decreasing trend is especially strong for IP.[49] The reduction of ratios is concentrated in the late '60^{ies} and '70^{ies}.

The gender gap is greater in the *family bounded* rationality case (in Fig. 6b). Trends are decreasing also in the *family bounded* rationality case. [50] Under *individual* rationality, the values of IP are lower as they are less than one, even for the late '50^{ies} generation.

These reductions depend on the faster growth of female education and salaries and on the accumulation of pensions' expected life-time income over a longer retirement period. Despite the increase in the number of contribution years, the reforms that took place in the '90s caused a notable reduction of gross expected life-time income from pensions and enhanced female "relative benefits".

[49] We have estimate, using OLS, the presence of a statistically significant (at 95% confidence level) negative trend both for IY and IP under the two hypotheses M and B. The estimated coefficients for the trend (of the 30 observations), in case of *individual* rationality, are shown below:

	IY_M	IP_M	IY_B	IP_B
Constant	1.68	1.56	1.59	1.70
	(0.152)	*(0.111)*	*(0.149)*	*(0.113)*
Trend	-0.006	-0.010	-0.005	-0.012
	(0.0023)	*(0.0017)*	*(0.0023)*	*(0.0017)*
R^2	0.15	0.52	0.10	0.61

St.d in parenthesis.

[50] The estimated coefficients for the trend (of the 30 observations), in case of *family bounded* rationality, are the following:

	IY_M	IP_M	IY_B	IP_B
Constant	2.36	2.90	2.46	2.83
	(0.186)	*(0.176)*	*(0.180)*	*(0.167)*
Trend	-0.014	-0.027	-0.005	-0.025
	(0.0029)	*(0.0027)*	*(0.0023)*	*(0.0026)*
R^2	0.44	0.77	0.53	0.77

St.d in parenthesis.

The seniority pension reform significantly decreases expected life-time income from pensions. All intermediate female generations lose more that the others in relative terms.

5. Inequalities in the distribution of income and wealth from human capital

Using the MIND model we can also derive the evolution of the actual annual and life-time distribution of individual gross labour and pension incomes. This allows us to consider more in details the effective evolution of intragenerational and intergenerational inequalities and to refine the gender analysis of section 4. This section, using the Gini index, will provide us more information about the actual distribution of annual and life-time incomes from labour and pension among different generations under the two different assumed retirement behaviours (*individual* and *family bounded* rationality) and in the ***basic*** and the ***modified*** scenario. The previous analysis will be supplemented by using the Atkinson indices (Atkinson, 1980), assuming different values of relative inequality aversion. In practice while the Atkinson index with fairly low relative inequality aversion ($\varepsilon=2/3$) is used to substantiate the previous analysis, the one with a substantial inequality aversion ($\varepsilon=2$) is used to test whether the results are affected by the different trends for different level of income. Since the Lorenz curves intersect, inequality trends behave differently for low and high income individuals.[51]

In what follows we analyse the simulated annual and life-time distribution of equivalent family incomes among people over 60 years old, based on the values of 10 Monte Carlo replications, considering 90 years (covering the period from 1995 to 2090).[52] This allows us to consider the wealth from wages and pensions of elderly (people over 60 years old) for the generations born between the '35 (who have 60 years in 1995) and the '79 (who will die before 2086).

We follow the two approaches highlighted in section 2. With the *cross-sectional* approach (in Fig. 7 and Fig. 8) we consider the inequality of equivalent household income of elderly, following the trend of income concentration each five years from 2000 to 2055, considering the mean values of the Gini index obtained from 10 Monte Carlo replications.[53] Dealing with equivalent household income it is important

[51] In particular, the value used in the following are $\varepsilon=2/3$; 1; 2, corresponding to a maximum acceptable loss respectively equal to 25%; 50% and 75%, in transferring wealth from the rich to the poor. All the values for the Atkinson index are reported in Appendix A.

[52] As said before: a) between 2000 and 2020 the defined benefit system prevails, b) subsequently the mixed regime takes over (coexisting with pensions already liquidated with the previous one), c) finally, after 2035 only the defined contribution scheme survives (even if there can still be pensioners retired under the "mixed" and defined benefit regimes).

[53] Replication *i* differs from replication *j* only because of the random numbers used in the simulation of the model. 10 replications seem to be enough to ensure reliable results, reducing by 90% the variance of the mean values, introduced by the dynamic ageing approach. According to Wolf (2001) "in survey-data item-imputation applications of the multiple-imputation technique, a small number (say 3-6 replications) has been viewed as sufficient" (cf. p.24). See also, Vagliasindi et al. (2004a).

to take into account that the effects of the social security reforms may also be interfered and mediated by the family structure, and its changes in time. This represents one of the most challenging parts of our work. In particular, Fig. 7 allows us to examine the evolution of the income distribution over time among elders to gain a general idea of inequality among people over 60, while in Fig. 8 we restrict our analysis to inequality only among pensioners (taking into account the direct impact of the changes in pension regimes). Before concluding the current household income analysis, it is interesting to note the differences between the values of the Gini index of pensioners relatives to the whole elderly population. These differences are mainly attributable to retirement postponement and the increase of incomes from labour (among the over 60 years old). The level of inequality is slightly higher among pensioners only initially, while from 2010 onwards it is lower, apart from the ***FBR*** case, which exhibits long-lasting effects on inequality among pensioners, also in response to the seniority pension reform. This phenomenon could be also explained by the increase in the quota of workers among elders (especially under ***IR***) and the reduction in pension treatment over final wages (especially under ***FBR***), i.e. the decrease in the wage replacement rate (that is, the ratio of the average pension and the average wage).

Table 1 provides the quota of each generation for each period.

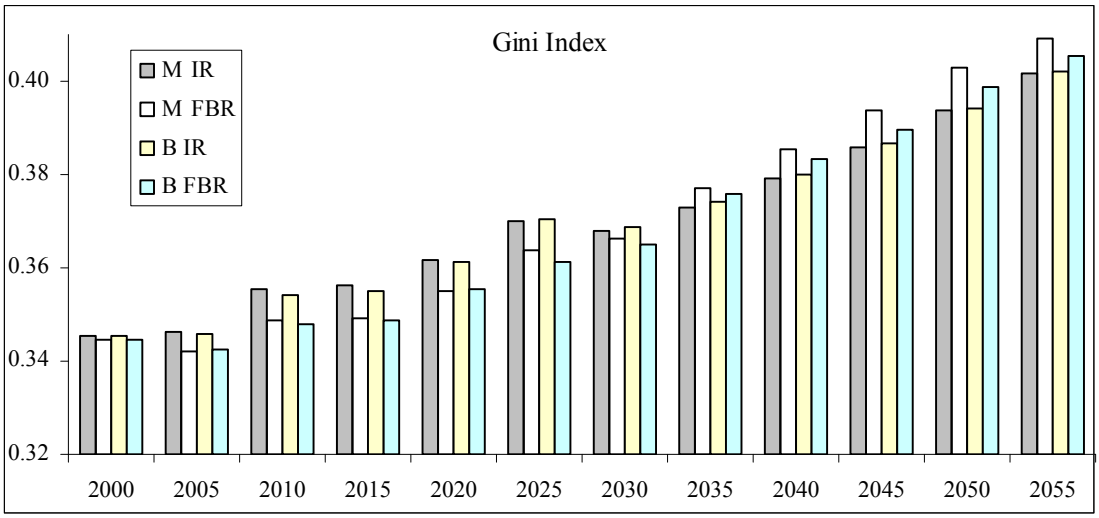


Fig. 7 Trend of Gini index of household income for the over 60 years old

The Gini inequality index shows how the inequality in the distribution of incomes increases in the whole period (apart from 2005, due probably to the increase of social allowances for disadvantaged elders in 2002). This result holds under *individual* and *family bounded* rationality, in the ***basic*** and ***modified*** scenarios. However, the two behavioural rules display slightly different profiles. In fact, *individual* rationality is characterised by the strongest increase in inequality between 2010 and 2025,

since incomes from labour increases, due to postponed retirement, in the presence of a fully rational maximisation of net welfare flows. On the other hand, *family bounded* rationality is characterised by a greater rise in income concentration among elders starting from 2020, mainly because of a greater reduction in pension benefits.

The seniority pension reform raises inequality among elders over the whole period. This increase is concentrated between 2010 and 2020 under *individual* rationality (since the extension of the working period balances out the reduction in pension treatments) and from 2025 onwards under *family bounded* rationality (since the reform produces a permanent pension postponement).

The Atkinson index with low relative inequality aversion (Table A. 1) supports the previous results.[54]

The picture is quite different if we restrict our analysis only to inequality among elderly pensioners, as in Fig. 8. In fact, income concentration shows a sensible increasing trend only starting from 2035; that is, when the defined contribution regime is generalized. Before 2035we have a quite stable level of inequality mainly due to the positive effects of the increase of social allowances for disadvantaged elders in 2002. The increasing inequality trend in Fig. 7 is due to retirement postponed and larger incomes from labour that is ignored in Fig. 8, since we deal only with pensioners.

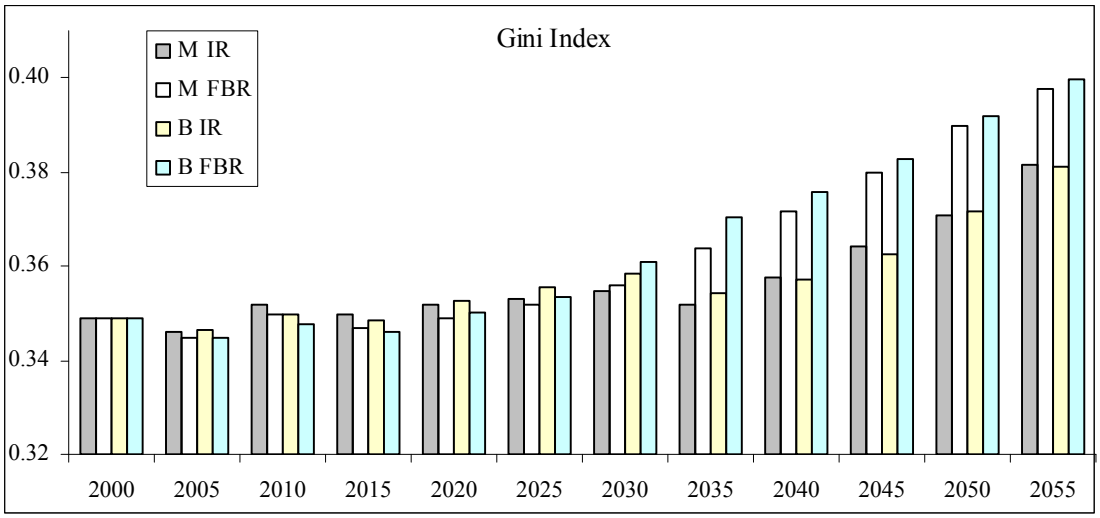


Fig. 8 Trend of Gini index of household income of elderly pensioners

Moreover, the differences due to the different behaviours are more clear-cut. Under *individual* rationality we have a reduced level of inequality, while under *family bounded* rationality we observe

[54] Some differences emerge when inequality aversion is substantial (ε=2), since the reform displays a higher concentration cost under *IR*. This is especially true, after 2035, in the ***basic*** scenario, in comparison with the seniority pension reform which has raised the statutory age, also under the defined contribution regime.

substantially higher values and an exponential growth of inequality from 2030. As before, the reform raises inequality among elderly from 2010 till 2020. However, the negative impact of the reform is reverted from 2025 onwards: myopic individuals postpone retirement because of the rise in the statutory retirement age. The economic effect of the reform vanishes in 2055 under *individual* rationality, while under *family bounded* there are long-lasting inequality reduction effects.

Also in this case, the Atkinson index (Table A. 2) confirms the previous results. In addition, when we assume a high inequality aversion data highlights a structural break around 2030, determined by the shift towards the defined contribution regime, already noticeable in the Gini index. Adopting the rational maximizing ***IR*** behaviour, when the individuals start retiring under the new regime (in 2030), we see an inequality increase absorbed immediately afterwards, as pensioners retired under the defined contribution regime drop off the simulation.[55] Then inequality displays a new increasing trend with a steeper slope.

Table 1 Quota of the examined generations present in the population of over 60 in each period

	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**
1935 - 1939	23.20%	20.52%	17.50%	14.66%	11.31%	7.41%	3.69%	1.23%	0.25%	0.01%		
1940 - 1944	5.31%	23.07%	20.32%	18.09%	15.38%	11.69%	7.67%	3.94%	1.43%	0.31%	0.02%	0.00%
1945 - 1949		3.77%	21.86%	20.06%	18.11%	15.32%	11.81%	7.77%	4.31%	1.63%	0.41%	0.04%
1950 - 1954			4.67%	20.56%	19.14%	17.10%	14.36%	10.96%	7.72%	4.49%	1.85%	0.51%
1955 - 1959				4.34%	19.79%	18.19%	16.21%	13.59%	11.03%	8.14%	5.01%	2.15%
1960 - 1964					4.29%	21.11%	19.25%	17.05%	15.09%	12.75%	9.77%	6.31%
1965 - 1969						4.28%	20.97%	19.01%	17.58%	16.14%	13.91%	10.88%
1970 - 1974							4.67%	21.68%	20.58%	19.73%	18.53%	16.50%
1975 - 1979								4.50%	18.20%	17.84%	17.52%	16.80%
Total	*28.51%*	*47.37%*	*64.36%*	*77.71%*	*88.03%*	*95.09%*	*98.65%*	*99.73%*	*96.19%*	*81.03%*	*67.02%*	*53.19%*

In concluding the current household income analysis, it is interesting to note the differences between the values of the Gini index of pensioners relatives to the whole elderly population. These differences are mainly attributable to retirement postponement and the increase of incomes from labour (among the over 60 years old). The level of inequality is slightly higher among pensioners only initially, while from 2010 onwards it is lower, apart from the ***FBR*** case, which exhibits long-lasting effects on

[55] This phenomenon is not present under *FBR*, since individuals, whose pension treatment has been computed with the defined contribution system, start retiring before the periods here considered.

inequality among pensioners, also in response to the seniority pension reform. This phenomenon could be also explained by the increase in the quota of workers among elders (especially under ***IR***) and the reduction in pension treatment over final wages (especially under ***FBR***), i.e. the decrease in the *wage replacement rate* (that is, the ratio of the average pension and the average wage).

This first step in the analysis of income distribution, using the *cross-sectional* approach, can be linked to the following one, that uses instead the *life time* approach, evaluating inequality over life time incomes considering the quota of the 9 aggregated generations (over periods of 5 years) in Table 1.

In Fig. 9 we analyse the level of inequality among the present value of lifetime equivalent family incomes (from labour and pension cumulated from the 60th year of age) of the 9 aggregated generations.

The inequality has an increasing trend for the generations born from the late '30ies to the late '50ies, a decreasing trend for the ones born in the '60ies and finally an increasing one for the generations born in the '70ies. The highest concentration level is reached by the generations born in the late '50ies. This seems to indicate a greater reactivity (in labour postponement) for this generation.

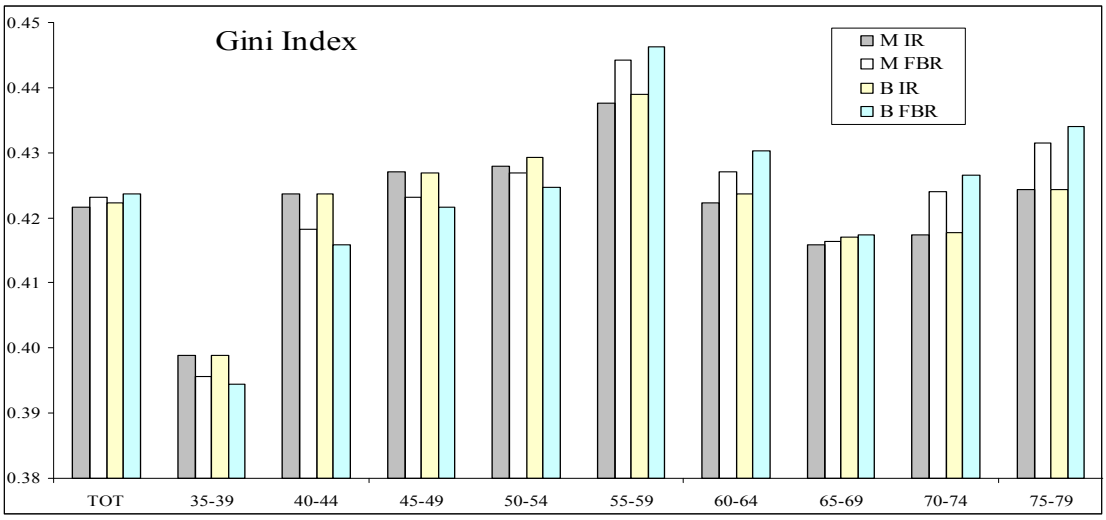


Fig. 9 Trend of Gini index of total lifetime household income for the over 60

Overall we found higher inequality under *family bounded* rationality and in the ***basic*** scenario. This is not true for the first four generations. Overall, the effects of the reform are quite negligible. They generally depend on the generation considered and the behavioural rule assumed. Under *individual* rationality, there is a small decrease of inequality only for generations born in the '50ies and the '60ies. This is probably due to the strong reactions to the seniority pension reform that leads less advantaged early pensioners to increase their life-time incomes. Inequality remains substantially the same for all other generations. Instead, under *family bounded* rationality inequality increases among older

generations (individuals born before the second half of the '50ies), whereas it decreases among the younger ones. This is probably due to the lower reactions to the seniority pension reform and the long lasting effects of the reform under ***FBR***.

In Table A. 3, the Atkinson indices show the very same trends, independently from inequality aversion. In general, the higher the value of inequality aversion the larger income concentration is under *individual rationality*, in comparison with the outcomes under ***FBR***.[56]

In Fig. 10 we consider only inequality among elderly pensioners (over 60), selecting only actual levels of life-time income from pension. The inequality trend is increasing, even though the initial increase is quite reduced. This is a general consequence of the new design of the pension system provided by the reforms of the '90ies (Bianchi *et al*., 2003), aggravated by the seniority pension reform; to some extent under *individual rationality* and more strongly if *family bounded rationality* is assumed. The negative impact on inequality in life-time income from pensions regards all generations, but it is stronger on younger ones.

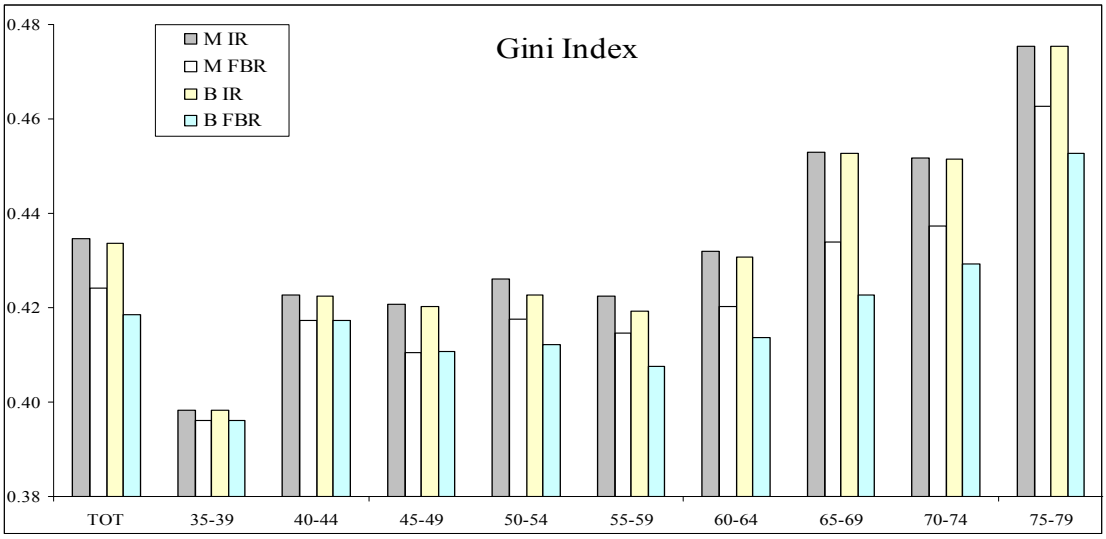


Fig. 10 Trend of Gini index of total lifetime household income for pensioners

Assuming a high inequality aversion the Atkinson index (Table A. 4) exhibits a somehow different picture, even if also in this case the reform produces higher level of concentration both under ***IR*** and ***FBR***. The generations with the lower inequality levels are the intermediate ones (born during the '60ies), that falls under the mixed regime (half defined benefit, half defined contribution). The younger generations, whose pension system is the defined contribution regime, exhibit a slightly lower

[56] This result is not entirely surprising, since while the rational maximising behaviour ***IR*** tend to preserve more inequalities, under ***FBR*** income losses, due to early retirement, are quite higher for high income workers.

inequality level than the oldest ones.[57]

To get comparable data and derive a more realistic indicator of welfare, in Fig. 11 we consider the concentration of "annual equivalent" values of lifetime incomes of the 9 generations cumulated from the 60th year of age, obtained by discounting the actual value of wealth for the length of the period over which annual incomes (from labour and pension) are obtained.[58]

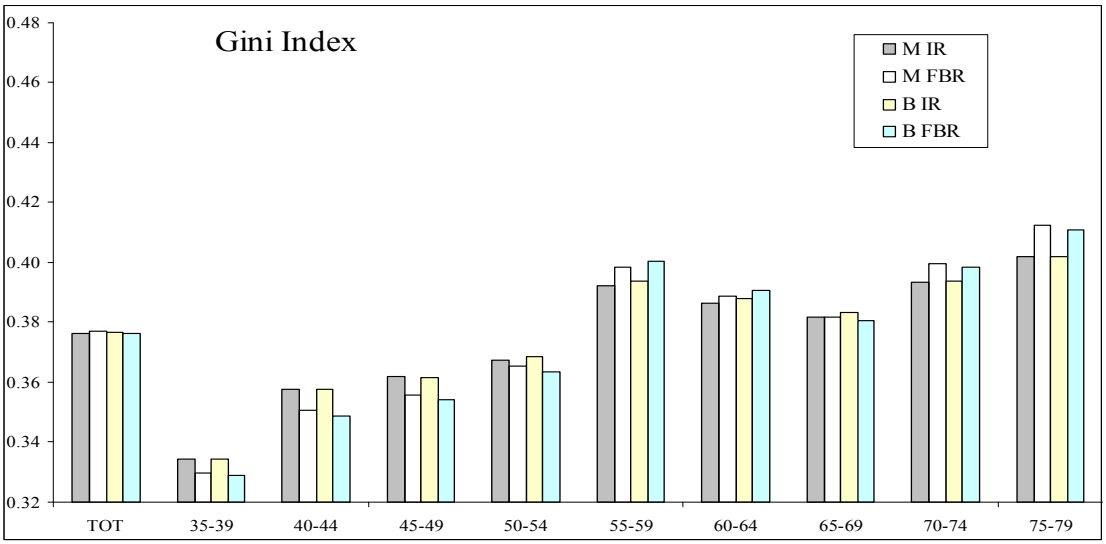


Fig. 11 Trend of Gini index of annual lifetime household income for the over 60

The overall trend displayed in Fig. 11 is similar to the previous one, in Fig. 9, but it presents a clearer trend. The last generation has now the highest inequality and overall there is lower inequality and reduced fluctuations. The seniority pension reform produces now a small negative impact on all generations apart from the middle ones (born between '55 and '64).

Considering the annual lifetime incomes of the 9 aggregated generation of elderly pensioners in Fig. 12 we find similar features to the ones in Fig. 10. However, inequality is lower and has a clearer increasing trend (as before, sharper under *individual* rationality). The negative impact of the seniority pension reform is more evident, especially under *family bounded rationality*. In this case the negative impact is stronger on younger individuals.

Overall, the Atkinson indices (in Table A. 5 and Table A. 6) present the same trend and features, even if it is a bit smoother and clearer than in case of total lifetime equivalent income.

[57] This seems to suggest that the new regime, as the old one, tend to preserve dispersion even if mitigated by the smaller differences in lifetime social security contributions (with respect to final earnings).

[58] Till now we assessed inequality considering actual lifetime incomes of elderly, that may differs among males (or females) due to the actual length of the individual life (different from the expected ones: 74 years for males and 81 years for females).

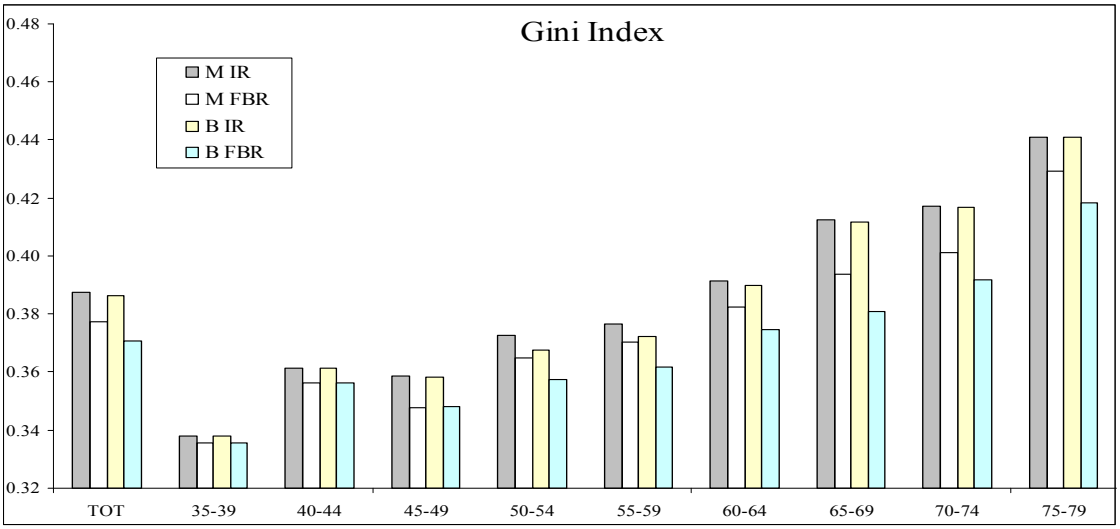


Fig. 12 Trend of Gini index of annual lifetime household income for pensioners

6. Relative poverty trends in the distribution of income and wealth from human capital

Once analysed inequality trend, we may be interested in briefly considering the evolution of poverty. In what follows, focusing on relative poverty, we analyse its trends using the Sen index modified by Shorrocks (1995) and all its several dimensions (diffusion, intensity and concentration).[59]

As before, we will follow the *cross-sectional* and *life time* approaches. In particular, Fig. 13 reports the poverty trends of equivalent family incomes of elderly (on the left) and pensioners (on the right) over the period 2000-2055, while Fig. 14 considers the simulated distribution of annual lifetime equivalent family incomes[60] of the elderly, looking both at the wage and pension incomes as a whole (on the left) and at the only amount of pensions collected by the agents (on the right).

In Fig. 13 the Sen index shows different trends, depending on the unit of analysis. If the elders are considered, the increase of social pension aimed at supporting low incomes sensibly decreases poverty, even if only in the short run, while overall it continues to rise especially after the generalization of the defined contribution regime (2035). The recent seniority pension reform (scenario ***M***) seems to produce a positive effect on poverty only under *family bounded* behaviour. In particular, the Sen index reproduces the increasing path of the diffusion index even if mitigated in the initial period (up to 2015) by the inverse trend shown by intensity and income concentration (Table B. 1). The impact of a larger number of poor families is hence not mitigated by the fact the new poor are close to the poverty line.

Similarly poverty among pensioners' families increases over time, presenting a short run decrease

[59] The values of the poverty indices are reported in Appendix B.

[60] As far as the poverty threshold is defined as in equation [11], total and annual life time incomes present exactly the same trends and values in terms of poverty.

due to the income support action approved in 2002. As in the previous case, the leading force seems to be the poverty diffusion, whose rise encounters lower opposition by the smoother decreasing trends in intensity and concentration (Table B. 2). However, the two behavioural rules are characterised different trend. The increase, indeed, is quite steeper under *family bounded* rationality, while *individual* rationality seems able to slow down the rise. Even in this case the reform has a positive effect on poverty only under *family bounded* rationality, with a quite substantial impact from 2030, due to the rise in the statutory age.

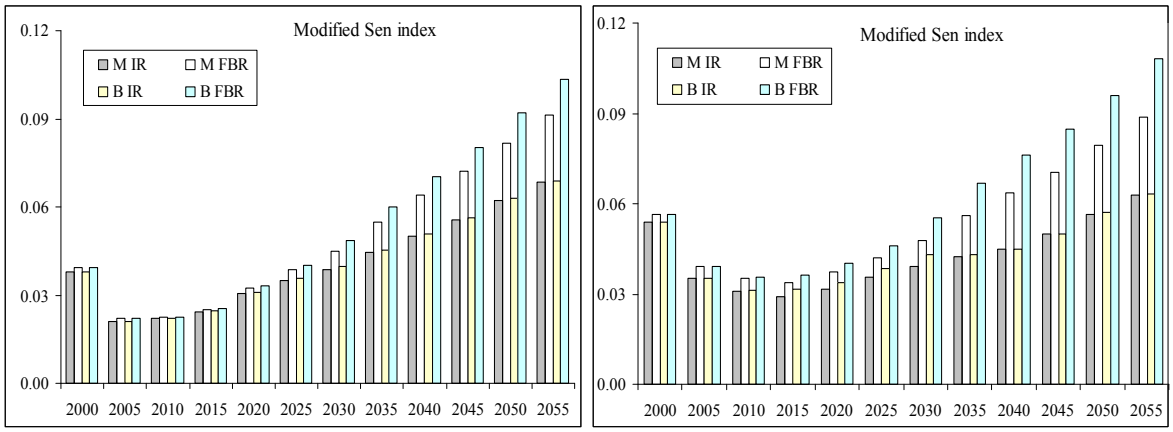


Fig. 13 Modified Sen index of household income for the over 60 and for pensioners

In Fig. 14 we consider the lifetime approach that suggests quite opposite conclusions, since relative poverty is decreasing.

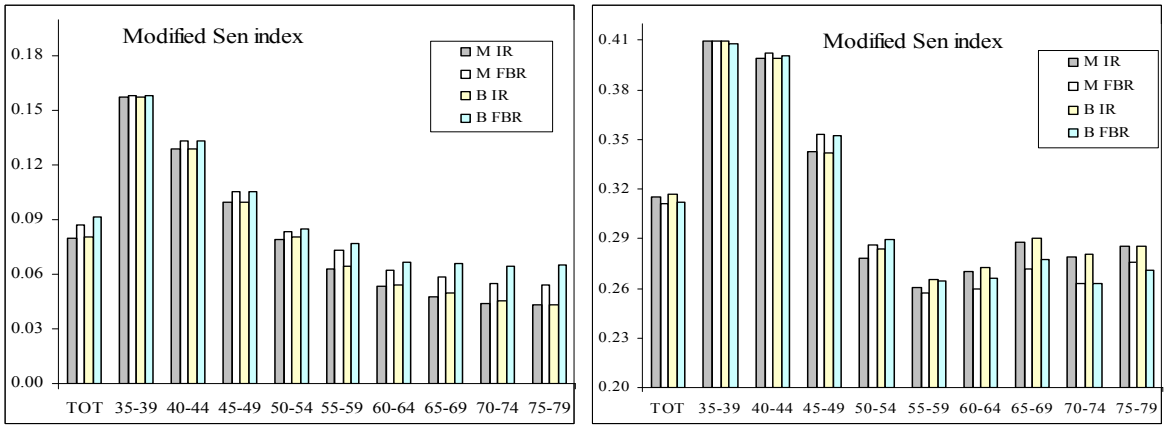


Fig. 14 Modified Sen index of lifetime household income for the over 60 and for pensioners

However, relative poverty patterns depend on the unit of analysis: (***i***) while for the over 60, poverty is always higher under *family bounded* rationality and tends to stabilize starting from the '60ies, (***ii***) for younger generations of pensioners poverty is higher under *individual* rationality and shows a renewed

increasing trend.[61]

The Sen index follows in both cases the trend of the diffusion index. However, while in the first case both intensity and concentration display a flat path, among pensioners they show a slightly increasing trend that partially compensate for the rise in diffusion, especially for younger generations (Table B. 3 and Table B. 4.).

On the whole, the effect of the seniority pension reform is quite negligible, apart from the positive impact the manoeuvre produces on the elders in the case of family bounded rationality. In particular, the younger the generation the stronger the impact is. A very significant exception is given by the last generation when we focus only on pension income and family bounded rationality. In fact, poverty increases since the higher level of diffusion is no longer compensated by the lower values of poverty intensity and concentration.

7. Expected life-time incomes: a concise sensitivity analysis.

Sensitivity analysis is used to ascertain whether, and in what measures, the model's results depend upon a given configuration of the main input parameters. This methodology is an important tool in order to scrutinise the qualitative properties of a given model, to understand the level of uncertainty of future estimates, as well as a powerful device for checking the robustness and reliability of its analysis, in order to use it for socio-economic policy purposes.[62]

Nevertheless, one of its fundamental and crucial function is to supply correct and reliable hints to model users - that usually are authorities and policy makers – and the major unresolved issue of how to deal with uncertainty. In practice, it is employed to highlight among the results of the analysis the ones that are robust to changes in a given set of economic fundamentals and reveal instead the ones that are more sensible to given environmental settings. In the present circumstances, it means an appropriate and reliable answer to key issues such as: "may gender or pension problems vanish if a growth-enhancing policy achieves different values of economic variables (e.g. growth rate)?". It is not a case that, usually in generation accounting analysis, the exogenous values of the interest rate and the growth rate are modified, to see how the conclusion of the base hypothesis changes.[63]

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[61] In particular, under *individual* rationality we have a lower poverty diffusion, since individual closer to the poverty threshold escape from poverty. However, the Sen index rises due to the substantial increase in poverty intensity and concentration.

[62] Such methods have been devised and applied to many different topics, such as probabilistic population projections, e.g. see Lutz, Scherbov (1998), or to computable general equilibrium models, cf. Pagan, Shannon (1985), also in the presence of multiple equilibria, see Berliant, Dakhlia (2002).

[63] See for instance the main generation accounting applied to Italy Franco et al. (1994), Sartor (1997).

In the following section, without any pretence of completeness given our aims, we just consider two different macro scenarios tested using both the ***IR*** and ***FBR*** behavioural rules, in order to better asses how sensible previous results (of section 4) are to changes in the parameters set (i.e. in human capital and growth and modification of the financial variable such as the real interest rate).[64] In particular, we will consider, under the ***basic*** and ***modified*** hypotheses, only three alternative macroeconomic scenarios, comparing the base simulation (case ***BS***) with real income per-capita growth rate *g* equal to 1% and a future real discount rate *r* of 2.5%[65] with other two simulations, ***EG*** and ***R***:

i. under ***EG***, we simulate stronger economic development trends, setting the growth rate *g* equal to 1.5% also due to an increase in higher education attainments;[66]

ii. under ***R***, the real interest rate *r* is equal to 5% while the other parameters are left unchanged.

EG also considers the impact that an increase in the performance of public education systems and technological development - some of the most important elements in realising the Lisbon agenda for growth and competitiveness - can have in arresting, and possibly inverting, the decreasing trend in our living standard , in terms of expected labour and pension life-time incomes. We cannot disregard the role of market interest rate *r*. Although its variation is linked to the performance of the economic system as a whole (e.g. the growth rate *g*), we assess its impact *ceteris paribus* (case ***R***).[67]

Fig. 15 reports the expected wealth of six generations of male Italian citizens under the three alternative macro-scenarios, under *individual rationality*.

In general, scenario ***EG*** raises expected life-time income from labour and pension, increasingly for younger generations. Workers tend to anticipate retirement, since they accumulate faster and can reach pension benefits equivalent to the baseline case and enjoy them for a longer period. The impact of higher educational achievements and growth rate (***EG***) is not surprisingly mainly affecting younger

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[64] Further details on sensitivity analysis experiments performed on the MIND model are reported in Bianchi et al. (2005).

[65] Specifically, the annual average wage growth rate we use in the baseline case is slightly lower than the real per capita GDP growth rate realized on average in the period 1996–2003, given also the decreasing trend displayed by the series. Obviously, for each individual, the wage varies also according to her career, as described in section 2.2. The discount rate represents the average after tax interest rate consumers can obtain in the market. Accordingly, the used value (2.5%) may perhaps represent an optimistic hypothesis on the average interest rate consumers can obtain from their assets in the long run.

[66] In particular, we assume a different probability distribution of the educational levels reached by the individuals more favorable towards higher level of education. The probability to obtain the higher degrees is about 9% higher than in the baseline case – that is $P_{eg}=P_{bs}*(1+0.09)$. This may provide some material to answer the initial hypothetical question.

[67] In this section we will analyse the effects of ***EG*** and ***R*** on expected lifetime incomes. It would be interesting to scrutinize the impacts that these changes of economic fundamentals may produce in income distribution and poverty trends. However, the strong interactions that the factors here explored may have with labour market forces can generate behavioural changes and quite complex relationships, that deserves a deeper investigation and defer to future researches.

generations. In particular, on the whole, the consequent rise of earnings may compensate for the decreasing trend registered in the baseline scenarios by those born in the '70ies. In fact, also expected life-time income from pension shows a less steep trend, also because the capitalization rate used in computing pension treatments under the defined contribution regime is more favourable.[68]

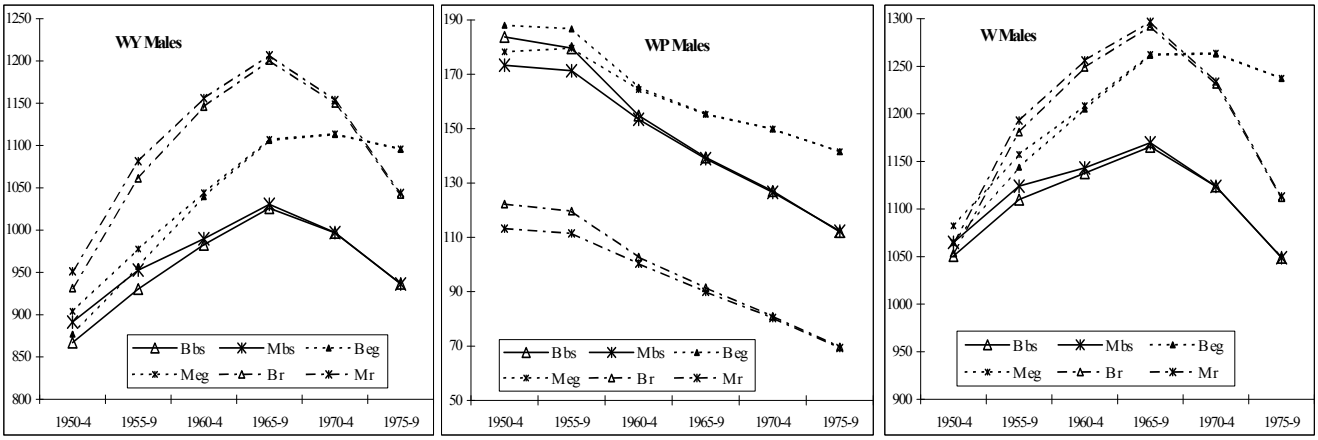

Fig. 15 Expected life-time income from wages WY and pensions WP per male worker under *IR*
(hp.B and M, thousand €)

Under ***R*** male workers tend to anticipate retirement too, being more profitable to enjoy pension benefits sooner. Even if they work less, they enjoy greater expected lifetime labour income, since they are cumulated with a higher interest rate. Obviously, workers have longer retirement periods and lower pension treatments. Accordingly, expected life-time income from pension decreases, since it is also discounted with a higher interest rate.

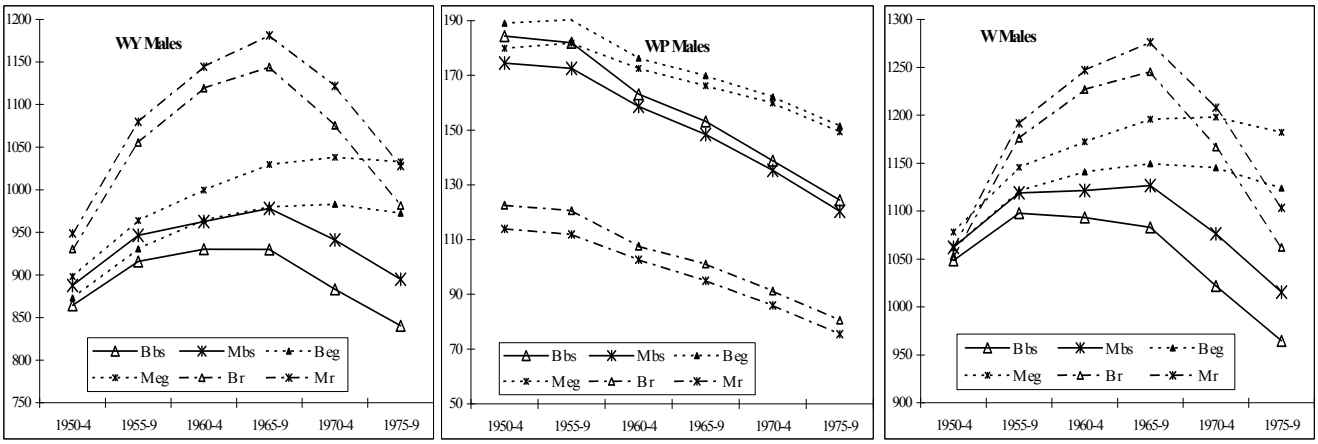

Fig. 16 Expected life-time income from wages WY and pensions WP per male worker under *FBR*
(hp.B and M, thousand €)

[68] The defined contribution pension treatments are a linear transformation of the so called "*montante contributivo*", that is the future value of all the contributions paid to the system by the agent during her working life, computed at the time of retirement, capitalized with a rate equal to a 5 years moving average of the GDP growth rate.

The positive effect observed in the previous case on the younger generation is no longer present, since pension computations are not affected.

The previous conclusions are quite analogous to the ones under ***FBR*** (Fig. 16).

The impact of the seniority pension reform, described in section 4 for the baseline case (***BS***), still holds in both of the scenarios.

The effect of the two alternative scenarios ***EG*** and ***R*** on female workers (Fig. 17 and Fig. 18) are crystal clear. In particular, better economic performances and higher levels of education generate a faster and stronger path of accumulation of lifetime labour income that consequently reflect also over expected lifetime income from pension. This shows in the long run an increasing trend also under ***IR***, e.g. pension wealth of last generations is slightly higher than that of older generations of female workers. Accordingly, they have lower pension treatments and pension wealth.

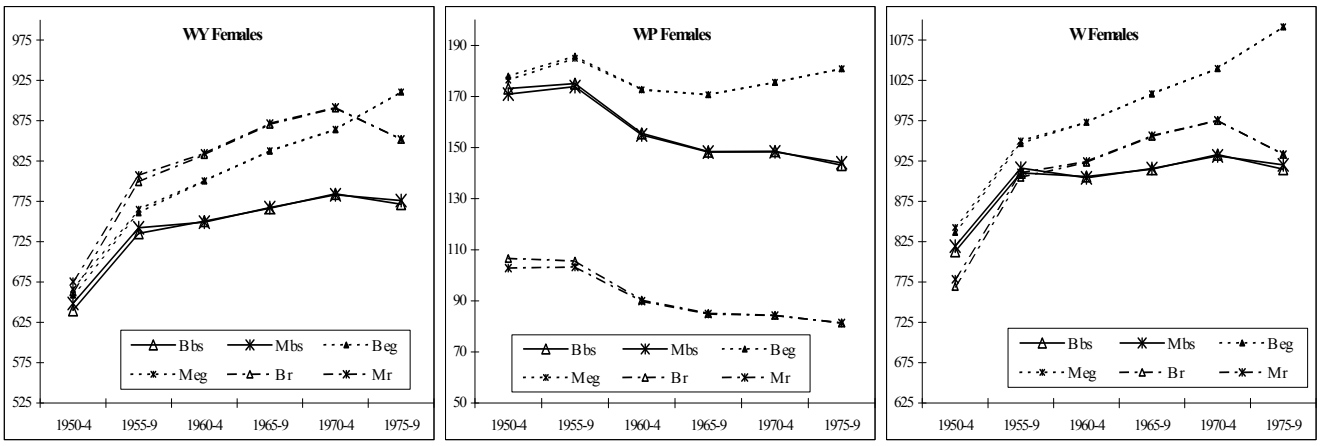

Fig. 17 Expected life-time income from wages WY and pensions WP per female worker under *IR*
(hp.B and M, thousand €)

The impact of an increase in interest rates (***R***) has the same very consequences that we have already observed for male workers.

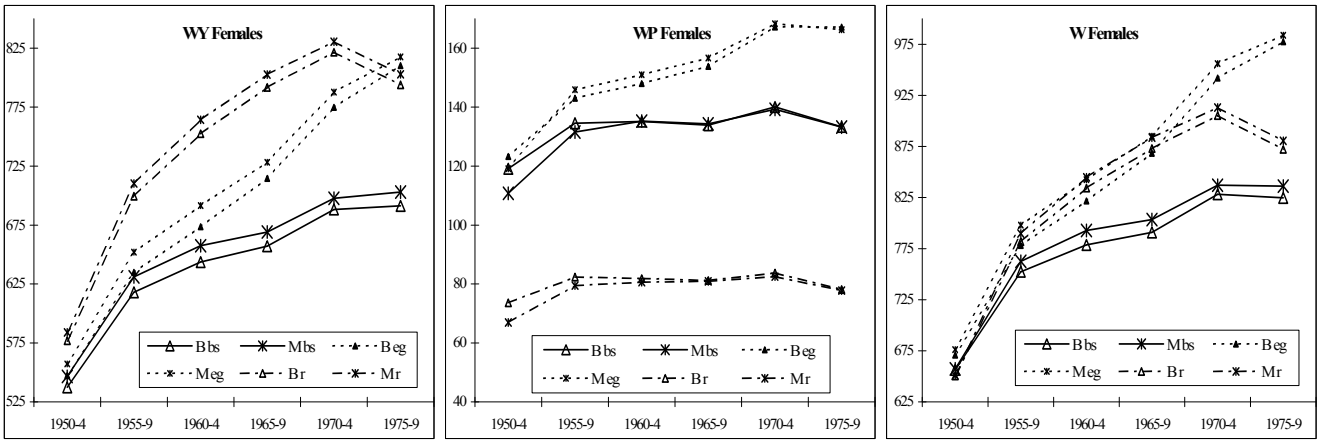

Fig. 18 Expected life-time income from wages WY and pensions WP per female worker under *FBR*
(hp.B and M, thousand €)

Even in this case, the previous conclusion on the effects of the seniority pension reform seems robust to changes. The positive influence over the intermediate generations is slightly accentuated under case ***EG***.

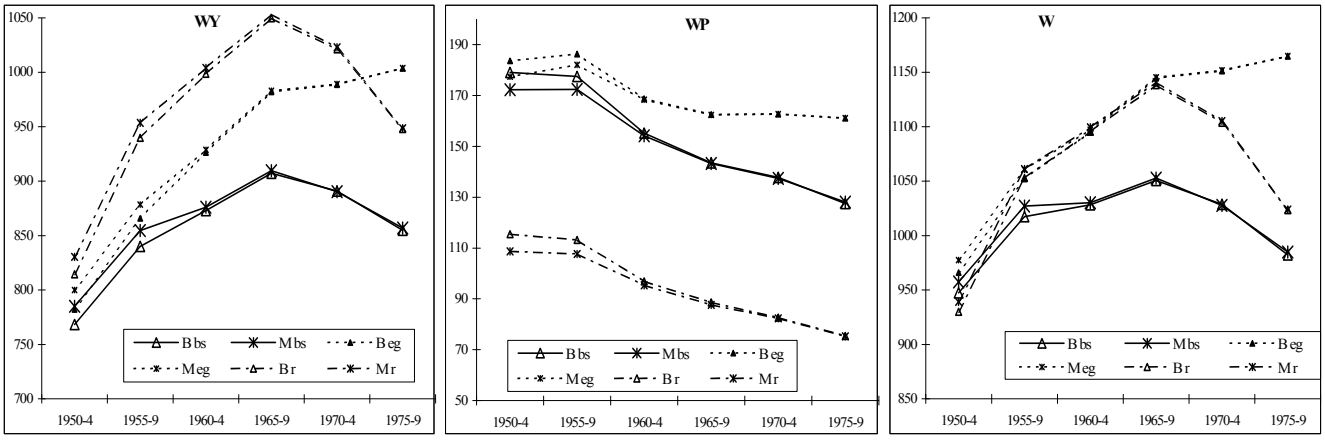

Fig. 19 Expected life-time income from wages WY and pensions WP per worker under *IR*
(hp.B and M, thousand €)

Focusing on the average expected life-time income from labour and pension (of male and female workers) - ***IR*** in Fig. 19 and ***FBR*** in Fig. 20 - our previous conclusions still hold. Both under ***EG*** and ***R*** lifetime labour income tend to strongly rise. However, while with stronger economic performances (***EG***) the pattern is modified with respect to the baseline case (***BS***), being the trend always increasing, the rise in interest rates just produces a substantial upward translation. The same is true also for expected life-time income from pension, but with a reverse sign under ***R***.

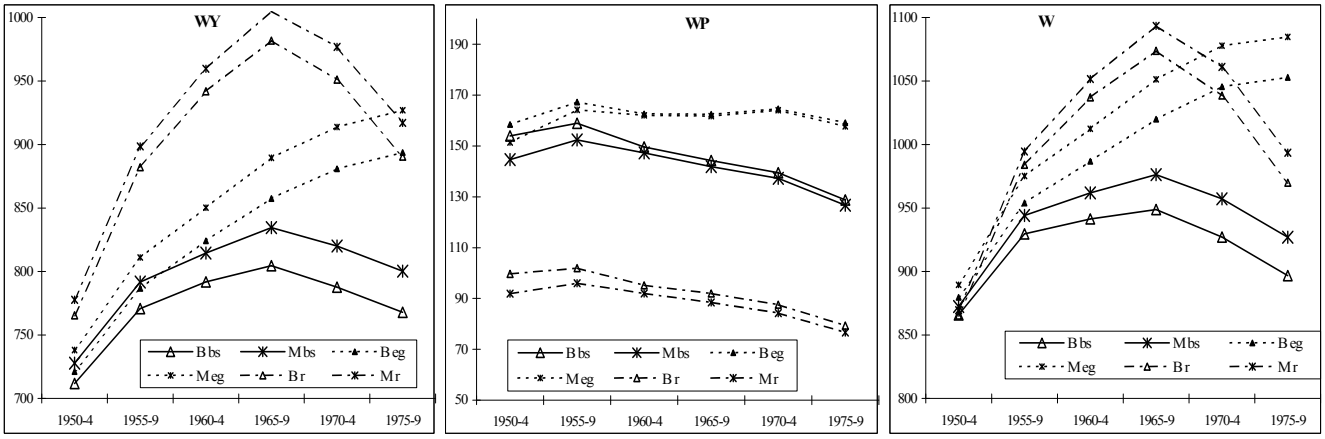

Fig. 20 Expected life-time income from wages WY and pensions WP per worker under *FBR*
(hp.B and M, thousand €)

It is worth to notice that better performances of the productive system and of the public education

may on average overcome the decrease in expected lifetime pension income, under ***FBR***.

8. Conclusive Remarks.

As data on lifetime incomes is not easily available for the Italian population, we used MIND, an agent based dynamic microsimulation model, to investigate distributional and poverty issues by generations and genders, focussing on the pension system and the potential effects of the introduction of the new seniority pension reform. In particular, we investigate its economic impact on *expected life-time* incomes from labour and pension, by gender and among different generations, and on *inequality and poverty* trends among elder individuals (i.e. over 60) and pensioners simulating a period from 1995 and 2090 under two different behavioural rules, *IR* and *FBR*.[69]

Our analysis showed how different methods and measures may give rise to slightly different results. In this respect, we considered alternative possibilities, trying to define the best units of analysis in order to produce robust conclusions well placed to answer the complex issue of public policy evaluation.

In particular, the study considered *expected life-time* incomes from labour and pension of individual born from 1950 to 1979, but it is also extended to analyse inequality and poverty trends. In this case, it studied *equivalent family incomes* taking into consideration the distribution of (***i***) current annual incomes of elder individuals (older than 60) and pensioners adopting a *cross-sectional approach* and (***ii***) actual life time incomes (total and annual) of elder individuals and pensioners (considering generations born from 1935 to 1979) implementing a *life-time approach*. Using these methodologies, we defined new methodological tools (starting from intergeneration accounting) and provided a preliminary analysis of the distributional effects caused by policy changes, both for the cohorts involved in the pension transition period and for those subject to the new defined contribution system.

The main focus of the analysis has been the estimation of expected lifetime incomes from labour and pension and its level among different generations and between genders. Notably, given the significant disparities in the opportunities available in education and in the workplace in Italy, such differences may have relevant policy implications.

Our estimates of expected life-time incomes from labour showed how gender differences tend to shrink over generations, although the dynamics are different for the previous system and the recent seniority pension reform, depending also on the degree of rationality of the agents. Specifically, the

[69] Under *individual rationality* ***IR***, the average disutility of labour is 0.25 and retirement depends only on a rational comparison (with a discount rate 2.5%) between expected utility of the flow of future incomes from labour and pension benefits. Under *family bounded rationality* ***FBR***, workers are eager to retire (valuing 0.125 the benefit from labour income), more myopic (using a higher discount rate 8%) and females may anticipate retirement if husbands are retired). Cf. par 2.2.

reform increased the gap for all intermediate generations (apart from the last ones, under *FBR*) leading males to postpone retirement, increasing life-time income from wages - contrasting in this way the reduction in female pension benefit gap. The analysis of the expected gross life-time income has provided interesting information: (***i***) male generations enjoy, under *IR* and *FBR*, higher expected life-time incomes, (***ii***) the reform, postponing retirement, increases male expected life-time income in a decreasing way - limited to the first four generations (born in the '50ies and early '60ies) under *IR*, larger on all generations (apart the last one), under *FBR* - (***iii***) similarly, but in a minor scale, the reform leads to an increase in female expected life-time incomes due to less significant retirement postponement.

We also refined the previous analysis investigating how ***a***) actual incomes are distributed, following two complementary approaches and ***b***) results change through a concise sensitivity analysis, considering higher education achievements (increasing not just by 10% but by 20%) jointly with a higher basic growth rate (from 1% to 1.5%) or alternatively only an increase in the real interest rate (from 2.5% to 5%).

Specifically, we examined the consequences of the pension system and seniority reforms, taking into account that elder individuals live in families, and by considering the equivalent family incomes of individuals older than 60 years (restricting to pensioners). Using the *cross-sectional approach* we determined current income inequality and poverty over these groups of individuals; while under the *life time approach* we evaluated them over ex post life-time incomes. It emerged that different conclusions can be reached depending on the approach used, the type of income considered (labour and pension incomes or just pensions) and the generation examined.

The *cross sectional approach* suggested a generalised increasing inequality trend, due to changes in the pension system. This result is exacerbated under *FBR*, due to early retirement. Overall, the seniority reform has a negative impact raising inequality among elders, and also among pensioners, till 2025. Afterwards, it decreases inequality, forced individuals to postpone retirement.

The *life time* method produced, instead, less clear cut results, considering over 60 years old individuals. Specifically, different conclusions may emerge according to the type of incomes we consider (including labour or just pensions) and the analysis adopted (total or annual *life time*). If we focus only on life-time income from pension, the inequality trend is increasing for the younger generations. Overall, the seniority reform has a negative impact raising inequality: (***i***) in a limited way and just for the generations born in the '50ies and early '60ies under *IR* and (***ii***) more significantly, and affecting also younger generations, under *FBR*. The analysis of the annual *life time* income from

pension confirms the increasing income inequality trend and substantiates a significant negative impact of seniority pension reforms on inequality, especially under *FBR* since generations born in the '50ies.

Alternatively, considering also labour incomes, middle generations show the highest level of inequality, due to the retirement postponement (that also produces an increase of inequality with the seniority reform) and to the changes in pension regime, as a structural break in the pension regime emerges (that initially decreases inequality, for the generation born in the early 60ies). However, the increasing inequality trend reappears afterwards, also under the defined contribution regime. Overall, the seniority reform has a negative impact raising inequality, before the structural break (till the generation born in the late '50ies), and a positive one afterwards, decreasing inequality, especially under *FBR*, leading to postponed retirement. Finally, analysing the annual *life time* incomes, we found an overall increasing income inequality trend (with a structural break for the generations born in the '60ies). We also corroborated a significant initial inequality increase, due to seniority pension reforms (especially under *FBR*) for generations born in early '50ies, and a decreasing inequality afterwards, especially under *FBR*, for generations born in late '60ies and finally a significant inequality increase (only under *FBR* in the '70ies).

The two approaches produced different paths also with respect to relative poverty. More precisely, the *cross sectional approach* seemed to lead to an increase in poverty. Instead, if we consider life time incomes the increase in poverty progressively disappeared. It is also worth to notice how the analysis of pensioners showed a resurgence of poverty for those generations under the mixed and the defined contribution regimes. In general, the reform tends to decrease poverty, due to a reduction in the diffusion of poverty, as a consequence of the postponement of retirements. However, the effects can diverge, in the *life time* approach, if we consider only pensioners, under *family bounded* behaviour, due to an increase in poverty intensity and income concentration.

We have also undertaken a concise sensitivity analysis. Under the hypothesis of a joint increase in high education achievements (from 10% to 20%) and in the basic growth rate (from 1% to 1.5%), we found higher expected life-time incomes from labour and pensions with a very positive aggregate impact on younger generations. For males, the final decreasing trend in expected life-time incomes from labour is reverted, while the decreasing trend in expected life-time incomes from pensions is mitigated. Females display increasing trends in expected life-time incomes from labour (exponential) and pensions. On the other hand, with a higher real interest rate (from 2.5% to 5%) males and females generations enjoy, under *IR* and *FBR*, increasingly higher (lower) expected life-time incomes from labour (pensions), with a positive aggregate impact.

Further investigations are possible and we plan to refine our analysis, especially considering actual lifetime incomes in future research. Moreover, alternative indicators can be developed in order to draw general conclusions on the factors determining workers' pension choices. For instance, starting from single agents, belonging to different generations, one could estimate alternative explanatory variables, consisting in money's worth measures, such as pension life-time income and its marginal variations. Building upon the analysis proposed by Contini and Fornero (2003), we will evaluate the changes that these indicators will be subject to in the coming years as a result of the pension reforms path.

9. References.

Acemoglu, D. and Pischke, J., 1998, *Why do Firms Train? Theory and Evidence*, Quarterly Journal of Economic, Vol. 113, 79-119.

Aghion, P. and Bolton, P., 1997, *A Theory of Trickle-Down Growth and Development*, Review of Economic Studies, Vol. 64, 151-72.

Aghion, P. and Howitt, P., 1998, *Endogenous Growth Theory*, MIT Press, Cambridge, MA.

Albanesi, S. and C., Olivetti, 2005, *Home Production, Market Production and the Gender Wage Gap: Incentives and Expectations*, Working Papers, Department of Economics, Boston University.
www.bu.edu/econ/Working%20Papers/ papers/Olivetti%20Claudia/wp2005/draft040705.pdf

Altonji, J. G. and R. M. Blank, 1999, *Race and Gender in the Labor Market*, Handbook of Labor Economics, Volume 3, North-Holland.

Ando, A., Guiso, L., and I. Visco, 1994, *Saving and the Accumulation of Wealth*, Cambridge University Press, Cambridge.

Andreassen, L., Fredriksen, D. and Ljones, O., 1996, *The future burden of public pension benefits: a microsimulation study*, in Microsimulation and Public Policy, ed. Harding, A., North–Holland, 329-357.

Atkinson, A. B., 1980, *On the measurement of inequality, in Wealth, Income and Inequality*, Oxford University Press, Oxford.

Auerbach A. J., Kotlikoff L. J., 1987, *Dynamic Fiscal Policies*, Cambridge University Press, Cambridge.

Auerbach A. J., Gokhale J., Kotlikoff L. J., 1991, *Generational Accounting: A Meaningful Alternative to Deficit Financing*, in Braddford, D. ed., Tax Policy and the Economy, MIT Press, Cambridge MA.

Banca d'Italia (1986), *La ricchezza delle famiglie in Italia (1975-1985)*, Bollettino Economico No. 7, 11-23.

Banca d'Italia, 1997, *I bilanci delle famiglie italiane nell'anno 1995*, Supplemento al bollettino statistico, 14, Roma.

Barro, R., Sala-i-Martin, X., 1995, *Economic Growth*, New York: McGraw-Hill.

Becker, G. S., 1957, *The Economics of Discrimination,* University of Chicago Press, Chicago.

Becker, G. S., 1964, *Human Capital*, Columbia University Press, New York.

Becker, G. S., 1985, *Human Capital, Effort and the Sexual Division of Labor*, Journal of Labor Economics, 3(1), 33-58.

Bénabou, R., 2002, *Unequal Societies: Income Distribution and the Social Contract*, American Economic Review, 90(1), 96-129.

Berliant M., and S. Dakhlia, 2002, *Sensitivity Analysis for Applied General Equilibrium Models in the Presence of Multiple Equilibria*, Economic Theory, 19(3), 459–476.
econwpa.wustl.edu:8089/eps/ge/papers/9709/9709003.pdf

Bianchi, C., Romanelli, M., Vagliasindi, P., 2003, *Microsimulating the Evolution of Italian Pension Benefits: the Role of Retirement Choices and Lowest Pensions Indexing*, Labour, 17, Special Issue, 139-173.

Bianchi, C., Romanelli, M., Vagliasindi, P., 2005, *Policy analysis using a microsimulation model of the Italian households*, in New Tools of Economic Dynamics, eds. J. Leskow, M. Puchet and L. Punzo, Springer, Berlin Heidelberg New York.

Blau, F. D., and L. L, Khan, 1997, *Swimming Upstream: Trends in the Gender Wage Differantial in the 1980s*, Journal of Labor Economics, 15(1), 1-42.

Blinder, Alan S., 1973, *Wage Discrimination: Reduced Form and Structural Variables*, Journal of Human Resources, 8, 436-455.

Boll S., Reffelhuschen B., Walliser J., 1994, S*ocial Security and Intergenerational Redistribution. A Generational Accounting Perspective*, Public Choice, 81, pp. 79–100.

Brandolini, A., 1999, *The Distribution of Personal Income in Post-War Italy: Source Description, Data Quality, and the Time Pattern of Income Inequality*, Giornale degli Economisti e Annali di Economia, 58 (2), 183-239.

Brandolini A., L. Cannari, G. D'Alessio and I. Faiella, 2004, *Household wealth distribution in Italy in the 1990s*, Temi di discussione n 530, Bank of Italy, Rome.

Brugiavini A. Maser K. Sundén A., 2005, *Measuring pension wealth,* Luxembourg Wealth Study meeting proceedings, `www.lisproject.org/lws/files/brugiavini_rev.pdf`.

Brugiavini, A., and Fornero, E., 2001, *A Pension System in Transition: the Case of Italy*, in Pension Systems and Retirement Incomes across OECD Countries, eds., R. Disney and P. Jhonson, Edward Elgar, London.

Cannari, L., G. D'Alessio, 1993, *Non-Reporting and Under-Reporting Behavior in the Bank of Italy's Survey of Household Income and Wealth*, Bulletin of the International Statistical Institute -Proceedings of the ISI 49th Session,tome LV, four books, ISI, n.3,agosto-settembre, 395-412.

Cannari, L., Nicoletti Altimari, S., 1999, *Microsimulation model of demographic and development and households' economic behaviour*, University of Pennsylvania, Ph. D. Dissertation.

Cannari, L., R. Violi, 1995, *Reporting Behaviour in the Bank of Italy's Survey of Italian Household Income and Wealth*, Research on Economic Inequality, Vol. VI, JAI Press Inc., 117-130.

Chakravarty, S. R, 1997, *On Shorrocks' Reinvestigation of the Sen Poverty Index*, Econometrica, 65(5), 1241-1242.

Contini, B., and Fornero, E., 2003, *Labour and retirement choices of the elderly in Italy*, mimeo, Center for Research on Pensions and Welfare Policies: `http://cerp.unito.it`

Contini, B. ed., 2002, *Labor Mobility and Wage Dynamics in Italy*, Rosenberg & Sellier, Torino.

Cowell, F. A., 2000, *Measurement of Inequality*, in Handbook of Income Distribution, eds., A. B. Atkinson and F. Bourguignon, North-Holland.

Fan C. S., Lui H-K (2003) *Structural Change and the Narrowing Gender Gap in Wages: Theory and Evidence from Hong Kong*, Labour Economics 10 (October): 609–626

Franco D., Gokhale J., Guiso L., Kotlikoff L.J., Sartor N., 1994, *Generational Accounting. The case of Italy*, eds. Ando A., Guiso L., Visco I., Cambridge U.P., Cambridge (MA).

Galor, O. and D. N. Weil, 1996, *The Gender Gap, Fertility, and Growth*, American Economic Review, 86(3), 374-387.

Galor, O. and Zeira, J., 1993, *Income Distribution and Macroeconomics*, Review of Economic Studies, 60(1), 35-52.

Goldin, C, 1990, *Understanding the Gender Wage Gap: An Economic History of American Women*, Oxford University Press.

Goldin, C., 2002, *The Rising (and then Declining) Significance of Gender*, NBER Working Paper No. W8915.

Homer S, and Sylla R, 1991, *A History of Interest Rate*, Rutgers University Press London.

Jappelli T., Pistaferri L. (2000) *The Dynamics of Household Wealth Accumulation in Italy*, Fiscal Studies, 21, 269-295.

Katz, E. and Ziderman, A., 1990, *Investment in General Training: the Role of Information and Labour Mobility*, Economic Journal, Vol. 100, 1147-58.

Kotlikoff, L.J., 1993, *Generationl Accounting – Knowing who pays, and when, for what we spend*, New York Free Press.

Kuan Xu and L. Osberg, 2002, *The social welfare implications, decomposability, and geometry of the Sen family of poverty indices*, Canadian Journal of Economics, 35(1), 138-152.

Leombruni R. and Richiardi M. eds., 2004, *Industry and Labor Dynamics: the Agent-based Computational Economics Approach*, World Scientific Press, Singapore.

Lopez-Claros, A., and Z., Saadia, 2005, *Women's Empowerment: Measuring the Global Gender Gap*, World Economic Forum, Geneva, Switzerland.
www.weforum.org/pdf/Global_Competitiveness_ Reports/Reports/gender_gap.pdf

Lutz, W., Scherbov, S. 1998, *Sensitivity Analysis of Expert-Based Probabilistic Population Projections in the Case of Austria*, IR-97-048, IIASA, www.iiasa.ac.at/Publications/Documents/IR-97-048.pdf

Marotta G. (1988) *Gli stati patrimoniali dell'operatore famiglie in Italia, 1975-1986*, Notiziario economico bresciano, 20-30.

Mincer J., 1974, *Schooling, Experience and Earnings*, Columbia University Press, New York.

Oaxaca, R., 1973, *Male-Female Wage Differentials in Urban Labor Markets*, International Economic Review, 14 (October), 693-709.

OECD 1998, Human Capital Investment, Paris.

O'Neill, J., and S. Polachek, 1993, *Why the Gender Gap in Wages Narrowed in the 1980s*, Journal of Labor Economics, 11(1), 205-228.

O'Neill, J., 2003, *The Gender Wage Gap in Wages, circa 2000*, American Economic Review, 93(2), 309-314.

Pagan, A. R., Shannon, S., 1985, *Sensitivity Analysis for Linearised Computable General Equilibrium Models*, in Piggott J. and Whalley J. (eds) New Dimensions in Applied General Equilibrium Analysis, Cambridge University Press, London, 104-18.

Pagliano P., Rossi N., 1992. *The Italian Saving Rate: 1951 to 1990 Estimates*, in G. Marotta, P. Pagliano and N. Rossi, *Income and Saving in Italy: a Reconstruction*, Banca d'Italia, Temi di discussione, 169, June.

Pantaloni, M., 1889, *Principii di economia pura*, Manuali Barbèra di Scienze Giuridiche, Sociali e Politiche, Barbèra, Firenze.

Sartor N., 1997, *Finanza Pubblica e Sviluppo Demografico: un'Analisi basata sui Conti Generazionali*, Contributi di Ricerca Fondazione Giovanni Agnelli, Torino.

Sartor, N., Franco, D., 2005, *Notional Defined Contribution in Italy – Unsatisfactory Present, Uncertain Future*, in Non-Financial Defined Contribution (NDC) Pension Schemes: Concept, Issues, Implementation, Prospects, eds., R. Holzmann and E. Palmer, Washington, World Bank (in corso di pubblicazione).

Schultz, T. W., 1960, *Capital Formation by Education*, Journal of Political Economy, vol. 68, 571-83.

Schultz, T. W., 1961, *Investment in Human Capital*, American Economic Review, vol. 51, 1-17.

Shorrocks, A. F., 1995, *Revisiting the Sen Poverty Index*, Econometrica, 63, 1225–1230.

Stevens, M., 1994a, *Labour Contracts and Efficiency in On-the-Job Training*, Economic Journal, Vol. 104, 408-19.

Stevens, M.,. 1994b, *An Investment Model for the Supply of Training by Employers*, Economic Journal, Vol. 104, 556-70.

Stevens, M., 1994c, *A Theoretical Model of On-the-Job Training with Imperfect Competition*, Oxford Economic Papers, Vol. 46, 537-62.

Stevens, M. (1996), "Transferable Training and Poaching Externalities", in A. Booth and D.

Stock, J. H. and D. A. Wise, 1990, *Pensions, the option value of work, and retirement*, Econometrica, 58(5), 1151-1180.

Tresoldi and Visco (1975) *Un tentativo di stima della ricchezza delle famiglie (1963-1973)*, Rivista di diritto finanziario e scienza delle finanze, 34, 516-524.

Vagliasindi P. A., M. Romanelli, C.Bianchi, 2004a, *Demographic evolution and inequalities among families of pensioners in italy: microsimulating regional dynamics*, Genus, LX, 2, 83-131.

Vagliasindi P., Romanelli, M. and Bianchi,C., 2004b, *Early Retirement From the Labour Market: Policy Experiments in the Italian Case*, in Leombruni R. and Richiardi M. eds., 164-196.

Vagliasindi P., Romanelli M. and C. Bianchi, 2004c, *Reforming the Italian Pension System in the XXI Century: the Issue of Seniority Pensions Once Again*, Advances in Complex Systems, 7(2), 241-264.

Wolf, D. A., 2001, *The role of microsimulation in longitudinal data analysis*, Papers in Microsimulation Series, 6, CPR, The Maxwell School, Syracuse University, Syracuse.

Zotteri, S., 2002, *Heterogeneity in human capital and economic growth*, Temi di Discussione n 455 (October), Bank of Italy, Rome.

Appendix A: Values of Atkinson index

Table A. 1 Atkinson indices of household income for the over 60

	ε=2				ε=1				ε=2/3			
Year	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
2000	0.326	0.324	0.326	0.324	0.181	0.180	0.181	0.180	0.126	0.126	0.126	0.126
2005	0.319	0.317	0.319	0.317	0.179	0.176	0.179	0.176	0.125	0.123	0.125	0.123
2010	0.338	0.326	0.337	0.325	0.189	0.183	0.188	0.182	0.133	0.128	0.132	0.127
2015	0.346	0.335	0.343	0.333	0.192	0.184	0.190	0.183	0.133	0.128	0.133	0.128
2020	0.373	0.359	0.372	0.357	0.201	0.193	0.200	0.193	0.140	0.135	0.140	0.135
2025	0.383	0.366	0.382	0.360	0.211	0.203	0.212	0.200	0.147	0.142	0.148	0.140
2030	0.400	0.370	0.401	0.366	0.211	0.206	0.213	0.205	0.146	0.145	0.148	0.145
2035	0.401	0.397	0.406	0.384	0.217	0.217	0.218	0.215	0.151	0.153	0.152	0.152
2040	0.409	0.405	0.409	0.397	0.223	0.226	0.224	0.224	0.156	0.159	0.156	0.158
2045	0.418	0.413	0.419	0.403	0.230	0.233	0.230	0.229	0.161	0.165	0.160	0.163
2050	0.435	0.423	0.428	0.413	0.237	0.242	0.236	0.238	0.166	0.172	0.166	0.170
2055	0.441	0.436	0.446	0.420	0.245	0.248	0.243	0.241	0.173	0.176	0.170	0.173

Table A. 2 Atkinson indices of household income for pensioners

	ε=2				ε=1				ε=2/3			
Year	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
2000	0.359	0.360	0.359	0.360	0.191	0.191	0.191	0.191	0.131	0.131	0.131	0.131
2005	0.341	0.353	0.342	0.353	0.184	0.184	0.185	0.184	0.127	0.127	0.127	0.127
2010	0.345	0.348	0.344	0.347	0.189	0.188	0.188	0.187	0.131	0.130	0.130	0.129
2015	0.344	0.347	0.347	0.348	0.188	0.185	0.188	0.186	0.130	0.128	0.129	0.128
2020	0.353	0.359	0.356	0.363	0.192	0.189	0.193	0.190	0.132	0.130	0.133	0.131
2025	0.359	0.367	0.363	0.367	0.194	0.193	0.197	0.194	0.134	0.133	0.135	0.134
2030	0.413	0.368	0.417	0.371	0.198	0.196	0.203	0.201	0.136	0.137	0.139	0.141
2035	0.364	0.383	0.372	0.384	0.195	0.205	0.197	0.211	0.135	0.143	0.136	0.148
2040	0.371	0.387	0.368	0.393	0.201	0.212	0.200	0.216	0.139	0.148	0.138	0.151
2045	0.378	0.393	0.376	0.400	0.207	0.220	0.205	0.222	0.144	0.154	0.142	0.156
2050	0.397	0.405	0.390	0.411	0.213	0.229	0.213	0.231	0.148	0.161	0.148	0.163
2055	0.406	0.422	0.413	0.424	0.223	0.237	0.222	0.239	0.156	0.167	0.155	0.169

Table A. 3 Atkinson index of total lifetime household income for the over 60

	ε=2				ε=1				ε=2/3			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.542	0.539	0.542	0.538	0.260	0.257	0.260	0.256	0.175	0.173	0.175	0.172
40 - 44	0.575	0.570	0.575	0.568	0.288	0.282	0.288	0.280	0.195	0.191	0.195	0.189
45 - 49	0.606	0.599	0.606	0.597	0.296	0.292	0.296	0.290	0.200	0.197	0.200	0.195
50 - 54	0.618	0.609	0.617	0.608	0.300	0.297	0.301	0.295	0.202	0.200	0.203	0.199
55 - 59	0.632	0.632	0.632	0.637	0.312	0.317	0.314	0.319	0.215	0.220	0.216	0.222
60 - 64	0.580	0.566	0.582	0.568	0.288	0.289	0.290	0.292	0.195	0.199	0.196	0.201
65 - 69	0.561	0.547	0.565	0.549	0.281	0.277	0.283	0.278	0.190	0.189	0.191	0.190
70 - 74	0.572	0.561	0.575	0.569	0.285	0.285	0.286	0.288	0.193	0.195	0.193	0.198
75 - 79	0.574	0.578	0.574	0.582	0.290	0.292	0.290	0.295	0.197	0.200	0.197	0.203
Total	*0.586*	*0.579*	*0.587*	*0.581*	*0.289*	*0.287*	*0.290*	*0.288*	*0.196*	*0.196*	*0.196*	*0.197*

Table A. 4 Atkinson index of total lifetime household income for pensioners

	ε=2				ε=1				ε=2/3			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.579	0.577	0.579	0.578	0.256	0.254	0.256	0.255	0.182	0.181	0.182	0.181
40 - 44	0.610	0.606	0.610	0.606	0.271	0.265	0.271	0.265	0.210	0.208	0.210	0.208
45 - 49	0.626	0.609	0.626	0.610	0.271	0.261	0.271	0.262	0.213	0.208	0.213	0.207
50 - 54	0.632	0.613	0.631	0.609	0.267	0.256	0.267	0.255	0.235	0.227	0.230	0.220
55 - 59	0.622	0.601	0.619	0.595	0.251	0.245	0.249	0.241	0.240	0.229	0.237	0.222
60 - 64	0.559	0.549	0.557	0.530	0.226	0.224	0.225	0.219	0.262	0.244	0.261	0.236
65 - 69	0.594	0.576	0.592	0.556	0.235	0.229	0.235	0.222	0.297	0.267	0.296	0.252
70 - 74	0.646	0.575	0.647	0.572	0.241	0.242	0.242	0.243	0.294	0.263	0.294	0.248
75 - 79	0.603	0.615	0.603	0.611	0.261	0.265	0.262	0.268	0.311	0.283	0.310	0.265
Total	*0.610*	*0.592*	*0.609*	*0.586*	*0.253*	*0.249*	*0.253*	*0.247*	*0.252*	*0.236*	*0.250*	*0.228*

Table A. 5 Atkinson index of annual lifetime household income for the over 60

	ε=2				ε=1				ε=2/3			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.302	0.296	0.302	0.295	0.169	0.165	0.169	0.164	0.118	0.115	0.118	0.114
40 - 44	0.337	0.327	0.337	0.325	0.191	0.184	0.191	0.182	0.133	0.128	0.133	0.126
45 - 49	0.360	0.343	0.359	0.342	0.199	0.191	0.199	0.190	0.137	0.132	0.137	0.131
50 - 54	0.389	0.377	0.385	0.369	0.210	0.205	0.210	0.202	0.144	0.142	0.145	0.14
55 - 59	0.447	0.443	0.445	0.438	0.242	0.246	0.242	0.247	0.17	0.175	0.171	0.177
60 - 64	0.428	0.411	0.429	0.404	0.233	0.231	0.234	0.230	0.16	0.161	0.161	0.162
65 - 69	0.427	0.404	0.430	0.391	0.230	0.223	0.231	0.220	0.157	0.155	0.158	0.153
70 - 74	0.450	0.430	0.452	0.418	0.243	0.241	0.244	0.238	0.168	0.169	0.168	0.167
75 - 79	0.453	0.482	0.453	0.467	0.249	0.254	0.249	0.249	0.172	0.177	0.172	0.176
Total	*0.405*	*0.396*	*0.405*	*0.388*	*0.219*	*0.217*	*0.220*	*0.215*	*0.152*	*0.151*	*0.152*	*0.15*

Table A. 6 Atkinson index of annual lifetime household income for pensioners

	ε=2				ε=1				ε=2/3			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.329	0.330	0.329	0.330	0.164	0.163	0.164	0.163	0.126	0.126	0.126	0.125
40 - 44	0.362	0.353	0.361	0.353	0.174	0.169	0.174	0.169	0.151	0.151	0.151	0.150
45 - 49	0.384	0.369	0.384	0.370	0.173	0.164	0.173	0.165	0.154	0.150	0.154	0.149
50 - 54	0.423	0.399	0.418	0.394	0.180	0.171	0.178	0.168	0.184	0.177	0.178	0.169
55 - 59	0.438	0.419	0.431	0.403	0.179	0.176	0.175	0.169	0.199	0.189	0.194	0.181
60 - 64	0.408	0.406	0.405	0.393	0.162	0.165	0.161	0.159	0.226	0.210	0.224	0.201
65 - 69	0.433	0.430	0.432	0.414	0.169	0.167	0.169	0.159	0.261	0.232	0.260	0.216
70 - 74	0.478	0.435	0.479	0.424	0.182	0.183	0.182	0.182	0.262	0.229	0.261	0.213
75 - 79	0.460	0.473	0.461	0.465	0.202	0.207	0.203	0.208	0.278	0.250	0.277	0.231
Total	*0.418*	*0.405*	*0.416*	*0.397*	*0.176*	*0.174*	*0.175*	*0.171*	*0.208*	*0.192*	*0.206*	*0.183*

Appendix B: Values of poverty indices

Table B. 1 Poverty indices of household income for the over 60

	Diffusion				Intensity				Gini among the poor			
Year	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
2000	0.097	0.100	0.097	0.100	0.200	0.202	0.200	0.202	0.121	0.122	0.121	0.122
2005	0.044	0.046	0.044	0.046	0.239	0.245	0.239	0.245	0.139	0.140	0.139	0.140
2010	0.051	0.052	0.051	0.052	0.221	0.219	0.222	0.220	0.133	0.131	0.133	0.131
2015	0.060	0.061	0.060	0.062	0.206	0.208	0.207	0.208	0.130	0.130	0.131	0.130
2020	0.072	0.075	0.073	0.076	0.215	0.222	0.215	0.222	0.133	0.135	0.133	0.135
2025	0.079	0.085	0.080	0.088	0.228	0.233	0.229	0.234	0.130	0.133	0.130	0.132
2030	0.084	0.096	0.086	0.103	0.236	0.241	0.238	0.244	0.127	0.129	0.127	0.131
2035	0.091	0.109	0.092	0.119	0.252	0.261	0.253	0.262	0.137	0.142	0.137	0.143
2040	0.099	0.124	0.100	0.136	0.260	0.267	0.261	0.269	0.138	0.144	0.138	0.145
2045	0.107	0.138	0.108	0.154	0.269	0.272	0.270	0.273	0.142	0.145	0.142	0.145
2050	0.117	0.154	0.118	0.173	0.276	0.279	0.277	0.281	0.147	0.146	0.147	0.150
2055	0.126	0.168	0.127	0.192	0.281	0.287	0.282	0.286	0.150	0.153	0.151	0.153

Table B. 2 Poverty indices of household income for pensioners

	Diffusion				Intensity				Gini among the poor			
Year	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
2000	0.105	0.110	0.105	0.110	0.264	0.266	0.264	0.266	0.160	0.161	0.160	0.161
2005	0.067	0.072	0.067	0.072	0.269	0.277	0.269	0.278	0.153	0.158	0.153	0.158
2010	0.064	0.070	0.064	0.069	0.246	0.259	0.249	0.261	0.143	0.154	0.146	0.156
2015	0.066	0.071	0.068	0.074	0.224	0.242	0.236	0.250	0.138	0.150	0.148	0.157
2020	0.073	0.079	0.076	0.084	0.221	0.244	0.228	0.247	0.133	0.146	0.138	0.147
2025	0.080	0.088	0.084	0.094	0.227	0.245	0.235	0.250	0.127	0.140	0.130	0.142
2030	0.084	0.097	0.089	0.110	0.239	0.253	0.249	0.261	0.127	0.138	0.131	0.142
2035	0.090	0.111	0.091	0.128	0.242	0.262	0.244	0.272	0.125	0.139	0.126	0.147
2040	0.094	0.123	0.094	0.143	0.247	0.267	0.245	0.279	0.123	0.141	0.122	0.149
2045	0.101	0.135	0.100	0.159	0.256	0.271	0.258	0.281	0.129	0.143	0.127	0.149
2050	0.111	0.150	0.112	0.177	0.265	0.278	0.265	0.287	0.134	0.143	0.133	0.155
2055	0.120	0.162	0.120	0.195	0.271	0.288	0.274	0.295	0.139	0.153	0.140	0.159

Table B. 3 Poverty indices of total lifetime household income for the over 60

	Diffusion				Intensity				Gini among the poor			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.309	0.314	0.309	0.314	0.285	0.282	0.285	0.282	0.130	0.131	0.130	0.131
40 - 44	0.260	0.270	0.260	0.270	0.272	0.272	0.272	0.272	0.126	0.129	0.126	0.129
45 - 49	0.204	0.215	0.204	0.216	0.260	0.263	0.260	0.262	0.131	0.135	0.131	0.135
50 - 54	0.152	0.160	0.154	0.162	0.276	0.276	0.275	0.276	0.134	0.137	0.134	0.136
55 - 59	0.112	0.128	0.114	0.134	0.292	0.299	0.291	0.299	0.155	0.156	0.154	0.154
60 - 64	0.097	0.116	0.099	0.126	0.282	0.278	0.283	0.274	0.141	0.135	0.141	0.134
65 - 69	0.085	0.108	0.087	0.124	0.291	0.281	0.297	0.276	0.145	0.138	0.146	0.135
70 - 74	0.080	0.105	0.081	0.123	0.282	0.273	0.288	0.274	0.153	0.144	0.153	0.142
75 - 79	0.089	0.112	0.089	0.135	0.249	0.250	0.250	0.252	0.128	0.126	0.129	0.126
Total	*0.152*	*0.168*	*0.153*	*0.176*	*0.276*	*0.275*	*0.277*	*0.274*	*0.136*	*0.136*	*0.136*	*0.135*

Table B. 4 Poverty indices of total lifetime household income for pensioners

	Diffusion				Intensity				Gini among the poor			
Generation	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**	**M IR**	**M FBR**	**B IR**	**B FBR**
35 - 39	0.589	0.601	0.588	0.599	0.428	0.421	0.428	0.421	0.273	0.265	0.273	0.265
40 - 44	0.523	0.560	0.523	0.557	0.456	0.435	0.456	0.435	0.317	0.290	0.317	0.291
45 - 49	0.419	0.468	0.419	0.467	0.468	0.439	0.468	0.440	0.345	0.310	0.344	0.311
50 - 54	0.299	0.335	0.312	0.346	0.513	0.476	0.504	0.468	0.397	0.349	0.385	0.340
55 - 59	0.253	0.273	0.262	0.290	0.560	0.515	0.553	0.501	0.451	0.395	0.439	0.375
60 - 64	0.249	0.263	0.252	0.284	0.591	0.539	0.589	0.515	0.498	0.429	0.493	0.400
65 - 69	0.248	0.264	0.250	0.289	0.634	0.562	0.634	0.529	0.546	0.461	0.544	0.419
70 - 74	0.241	0.261	0.242	0.282	0.630	0.548	0.632	0.511	0.533	0.440	0.532	0.392
75 - 79	0.258	0.285	0.259	0.304	0.605	0.532	0.605	0.492	0.500	0.416	0.500	0.369
Total	*0.339*	*0.364*	*0.342*	*0.377*	*0.521*	*0.481*	*0.520*	*0.469*	*0.400*	*0.353*	*0.398*	*0.338*