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A Simulation in IFSIM

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Abstract

The poverty outcome in old age is affected by labour market reforms. Using our in house agent based simulation model IFSIM we show that sharing equally the parental leave can increase or reduce poverty among the elderly depending on the macro and behavioural responses that the Reform off-sets. In general, it can be good for (elderly) women provided that (i) it spurs them to work more, particularly in older ages (ii) it does not slow down economic growth (hence pension income growth) below a level when working more does not pay. Our simulations show that the effect of this Reform on poverty and gender inequality is time dependent: different outcomes might be expected for different generations depending on whether the balancing mechanism (in the state income pension) is present or not. In general, the Reform might not lead to positive outcomes if it occurs in conjunction with the striking of the automatic balancing, unless a behavioural response to work more among older workers (in response to the balancing) is also unleashed.

Sammanfattning

Äldre personers ekonomiska situation och eventuella fattigdom påverkas bland annat av reformer på arbetsmarknaden. I denna rapport används Institutets för Framtidsstudier agentbaserade simuleringsmodell för att undersöka om lika delning av föräldraledigheten kan öka eller minska fattigdomen bland de äldre: Vilka beteendeförändringar och makroeffekter kan reformen ge upphov till? I allmänhet kan delad föräldraledighet vara bra för (äldre) kvinnor förutsatt att (i) det ger incitament att arbeta mer, speciellt nära pensionsåldern, samt att (ii) reformen inte saktar ner tillväxten i ekonomin (och därigenom pensionsindexets tillväxt) under en nivå där ökat arbetsutbud inte längre lönar sig. Våra simuleringar visar att effekten av delad föräldraledighet på fattigdom och könsjämlikhet också beror på tidsperioden. Olika utfall kan förväntas för olika generationer beroende på om den automatiska balanseringsmekanismen (i det allmänna pensionssystemet) slår till. Generellt kan reformen leda till negativa effekter om den sker i samband med att den automatiska balanseringen blir aktiv, såvida inte beteendeeffekter (av balanseringen) ökar arbetsutbudet så mycket att det motverkar den direkta balanseringseffekten.

1 Introduction

This paper aims to study the theoretical linkages between the design of the pension system and that of the labour market and their interplay in determining poverty outcomes in old age, particularly from a gender perspective. Furthermore we aim to include macro feedbacks in our analysis of individual behaviours coming from the presence of automatic stabilisers which are meant to keep the pension system financially sustainable.

The starting point for anyone interested to study gender inequality in old age, particularly in terms of pension incomes, is to frame the problem as one which arises during the working age. From a life cycle perspective it is well known that women tend to have different labour market histories than men: they are more likely to spend time out of the labour force due to child-caring responsibilities, they are more likely to work part time and earn lower wages. This gender gap during working years, together with e.g. longer life expectancy, are the natural reasons for gender differences in income during retirement (i.e. women having lower pensions than men and higher risk of poverty in old age) unless the pension system is designed so as to specifically correct for this (see Ginn, Street and Arber 2001).

In Sweden, today we do observe a net gender difference in pension incomes and poverty rates. Retired women earn on average a pension which is 85% that of an equivalent male pensioner (SEB, 2007) but this ratio can be as low as 70% among low income groups (Normann, 2008). The poverty risk for elderly women is one of the highest in Europe, with 18% of over 65 women being poor against 9% of men (Zaidi, 2007). These inequalities are obviously matured in the course of the old pension system (pre-2003). An important question is to understand how much of an improvement the current pension system will be able to deliver to those who will retire entirely under it, particularly from a gender perspective, and especially considering that it is

more of an individualistic insurance system (i.e. more reliant on the individual contributions), with allegedly more labour supply incentives built-in.

Furthermore, in Sweden, where female labour market participation is relatively high today (ca. 70%), we still observe differences between men and women indicating that certain inequalities coming from the working years might not disappear among future generations of retirees. Currently, around 35% of women still work part time, a much higher proportion than men. Also, the average time spent in the labour market is lower for women (ca. 37 years against 40 for men), the average wage is lower (84-92% that of a man with the same job) and the retirement age is earlier (61.6 for women against 62.3 for men). When it comes specifically to parental leave, we know that for every child 80% of the allocated time is taken out by the woman; the woman tends to take out also most of the subsequent leave for caring for sick children (VAB).

This paper is part of a wider research project whose aim is to answer the question: can we tackle gender inequality in old age better (and more efficiently) by changing the design of the pension system, e.g. by introducing some features which are described in the literature as particularly "gender friendly", or by changing the design and / or incentive mechanisms directed to women in the labour market? In particular, this paper focuses on the latter strategy: we want to investigate how sharing equally the parental leave between the woman and the man, by supposedly increasing the woman's labour market participation and wage, might lead to lower gender inequality in old age.

In order to study the impact of sharing the parental leave on elderly poverty and gender inequality, we have adapted our in-house agent based micro-simulation model IFSIM (see Baroni, Zamac and Oberg 2009 for a model description). Our model simulates a synthetic population for a period of 150 years, and reproduces life cycle events and incomes for a large number of cohorts, while accounting also for macro feedbacks on micro behaviours. In the baseline scenario the current Swedish pension system is simulated as well as a parental leave

system in which, upon the birth of a child, women only stay home for a total of 2 years per child. In the alternative scenario, the same pension system is accompanied by a labour market system where by default the parental leave is equally shared, so that both men and women are to spend one year each home after the birth of a child. The model outputs and compares, among other statistics, poverty ratios by sex under both scenarios. It is important to stress that the model is not predictive but only a theoretical device to experiment the net effects of one change while keeping all other parameters constant.

Our first hypothesis is that, as women share the parental leave with men, we might notice a labour supply effect consisting of women going into work (either full time or part time) in those years where they would have otherwise had to stay home; this should unleash a positive effect on their wage profile (which still might eventually trigger other labour supply effects further down the years); hence they should reach retirement with a higher amount of earned pension rights, both state and occupational. Depending on what happens to the men's wages, this should overall improve women's position relative to men and also their poverty standing. An important contribution of our model in this regard is its ability to account for macro-feedbacks coming from either the labour market (e.g. effects on growth) and from the pension features (e.g. from the growth rate of state income pension, or *inkomstpension).*

Indeed, our results show a more complex picture than what we first hypothesized through theoretical deduction only. We will see that macro feedbacks on growth for instance will work against the positive labour supply gains for women in fertile ages, so that the net effect of sharing the parental leave on their retirement income is not always positive as first thought. At the same time, macro feedbacks from e.g. the striking of the automatic balancing mechanism in the pension system also unleash behavioural responses among older women workers which partly can mitigate the more negative consequences on output growth (and poverty). In a nutshell, so many feedbacks and interactions could not be foreseen without the aide of a simulation model.

Before going any further, it is important also to give some basic definitions and measurements chosen to describe "gender inequality". In this context we refer to (i) ratios of women's pension incomes relative to men's (ii) poverty rates by sex (i.e. how many poor elderly women versus men are there). The latter measurement conforms with standard relative poverty indexes as described in e.g. Atkinson (1983). The relative measure of poverty refers to the individual' s position within the income distribution rather than her degree of deprivation in terms of absolute human needs. Usually someone is considered "poor" if their income lies below the poverty line, which is commonly set to 60% of the median income. Most often household equivalised incomes are used rather than individuals' in order to account for economies of scales related to household size. So the poverty definition refers to someone who lives in a household whose equivalised per capita income lies below the poverty line.

2 The IFSIM Agent Based Model

IFSIM belongs to a class of models known as Agent Based Models (ABM) which have been experimented within economics since the late 1980s. Quoting L. Tesfatsion, one of the most prominent ABM scholars: "ABM [..] is a method for studying systems exhibiting the following two properties: (1) the system is composed of interacting agents; and (2) the system exhibits emergent properties, that is, properties arising from the interactions of the agents that cannot be deduced simply by aggregating the properties of the agents. When the interaction of the agents is contingent on past experience, and especially when the agents continually adapt to that experience, mathematical analysis is typically very limited in its ability to derive the dynamic consequences. In this case, ABM might be the only practical method of analysis". For a thorough review on the ABM methodology see e.g. Tesfatsion and Judd (2006).

In this section we present a brief overview of our simulation model in its current form, focusing only on the parts however which are relevant to our analysis, namely the labour supply choice,

the Parental Leave benefit and the Pension System. For a full description of the model in all its components we refer to Baroni, Öberg and Zamac (2009).

In our model, there are a few distinct, but interrelated, modules handling various events on the micro and macro level. The main events being simulated are demographic (i.e. whether the individual survives, whether he gets married, and if so whether he or she has a child in that year), educational, both in terms of the level (i.e. whether the individual is in school or if not what is her highest degree), and the quality of her human capital (i.e. how skilled the individual is at any given time, also when in work), finally his or her labour market status (i.e. if in work, or retired), and his or her income (based on the type and amount of human capital accumulated). Once the income is defined a rudimentary tax and benefit system is implemented to derive disposable income.

The model incorporates at present four key agents: individuals, households, networks and the State. By agents here we mean java objects belonging to a specific agent class to which certain actions and characteristics are ascribed. Individuals are of course the main agent type being simulated; they are uniquely identified, they are born, die, procreate, leave home, study, work or retire. Individuals are grouped into households which are separate agents in that they have characteristics of their own: a separate ID, a given size, number of children, household income, a history and special "links" between household members such as inheritability of certain personal features (e.g. initial skills are inherited as the average of both parents). Networks are less tangible agents but still they exist as separate entities with a specific location and group composition. At the moment networks are lists of individuals grouped by age rather than household (i.e. an individual´ s network does not include his or her household). Networks are programmed so as to be able to perform certain actions for instance retrieve network characteristics such as mean participation or education rates which can be used by the agents to make forward looking decisions. Finally the State is the only single agent in the model i.e. the single class being instantiated only once. The State performs the tax and redistribution functions,

including setting a local tax rate to keep the budget in balance, calculating and collecting income tax, paying teachers´ salaries, student allowances, parental leaves and pensions, as well as setting some policy targets through which it can affect micro behaviours and macro outcomes.

2.1 The Labour Supply Module

Labour supply is currently modeled in order to capture the choice between house making, part time work and fulltime work for married women. The model is built on a number of behavioral assumptions (e.g. that women trade leisure for work in order to smooth consumption, or that consumption aspirations depend partly on one's own consumption experience while growing up) and ad hoc parameters which we have tested by performing various sensitivity analyses. The model results appear robust against these checks (see Technical Appendix).

All men and unmarried women in the model work fulltime unless they study or are retired. Married women can also be on parental leave, plus they can choose the amount of labour supplied between three states: full time, part time or voluntary home-staying. The idea behind our model for labour supply is that women supplement their husband's income to reach an aspired equivalized consumption level[1].

The woman´ s aspired consumption is a certain proportion of the average equivalised household income in any given year. This proportion is determined by (i) the same percentile in the income distribution as the women's parent's household when she was ten years old (so as to reproduce an inter-generational transmission of preferences or consumption aspirations) (ii) the real difference between equivalized income at age ten and projected equivalized income if the woman worked fulltime (iii) the woman´s educational level (i.e. everything else being the same a more educated woman will have a higher aspired consumption).

[1] N.B. This level is reset every year and raises over time with average incomes

In making her decision, the woman´ s aspired consumption is compared to a predicted equivalized income ten years in the future under three different scenarios: working fulltime, part time or voluntary house making. The projection is made by estimating an income regression among women (and men) with similar characteristics to the woman making the choice and her husband (e.g. education), who are currently 10 years older[2]. The projection also accounts for any years spent on parental leave (since they effectively reduce the amount of work experience accumulated over a 10 year period if working full time, and the wage progression). Summing her husband´ s and her own projected income under the three labour supply choices available (and equivalising it by the household size) the woman is able to perform a simple check of which option gives her the highest payoff relative to her needs.

A cost of child care is deducted from the projected income before it is compared to the aspired consumption. If the woman does not work the cost of child care is zero and if she works part time it is lower than if she would work full time. The projected, equivalized, consumption if working e.g. part time, is:

$$projectedconsumption_{pt} = \frac{discountfactor_I^{10}(0.5\,predinc_m + predinc_{fpt} - childcare_{pt})}{\sqrt{familysize}}$$

Where the subscript *pt* stands for part time the subscript *m* for male, the subscript *f* for female and the subscript *I* identifies a factor as being individual specific. In this decision the woman considers only half of the husband's income as shared between them (i.e. assuming that only half of his income would directly benefit her consumption)[3].

[2] N.B. Women who are above 56 will include pension income in their projection.
[3] This assumption is consistent with the fact that the woman here is benchmarking her available resources against an aspired consumption level which is individual rather than for the whole household.

If the projected equivalized consumption is above the aspired equivalized consumption if not working then the woman does not work. If part time suffices for reaching the aspired equivalized consumption then the woman works part time and if only working fulltime suffices she works fulltime. If neither choice makes her reach the aspired equivalized consumption then she chooses the alternative with the highest projected equivalized consumption. Because of the fact that the cost of childcare is larger when working more it needn't be that working fulltime is the alternative that gives the highest equivalized consumption for all women.

Depending on the choice made, the wage will also be affected (i.e. those working part time will receive half of what they would have got if working full time, and also accumulate only half of the work experience). More generally, wages in the model are a function of the human capital of the individual as well as the human capital composition in the economy (skilled versus unskilled[4]). The "price" of human capital (again, for skilled and unskilled separately) is set as its marginal product (hence it decreases the more human capital of one type there is in the economy). The individual wage is thus simply the product of the unitary human capital price times the individual´ s own amount of human capital (which is in turn partly inherited, partly a function of educational choices, both in terms of quantity and quality). Wages tend to increase when there is scarcity of one type of labour (e.g. skilled). Clearly these macro-feedbacks on wages will also influence the labour supply choice of married women e.g. everything else being equal, if the unitary wage for her educational level decrease, she might need to work more unless her aspired consumption decreases also by as much.

[4] In the model we assume as skilled any worker who has a University degree, while unskilled are all those who have schooling up to gymnasium.

2.2 The Parental Leave System

The parental leave benefit is modeled according to the Swedish system (2007), with some simplifications related to the rules e.g. on number of eligible days for each parent etc. In our model we assume that only the woman gets the benefit within the couple, hence the amount of the benefit is calculated on her eligible income[5].

The benefit comprises a guaranteed amount, for those who have no previous income history (such as students) and an insurance-related amount, for those who have earnings up to certain thresholds (i.e. up to 10 times the so called Basic Amount equivalent, which in our model is calculated to reproduce a level comparable with the Basic Amount for 2007 in Sweden, around 40,000 SEK per month, i.e. 4,000 Euros ca.).

Upon the birth of a child, people with no work history or students would therefore receive a minimum benefit corresponding (in daily terms) to around 0.45 percent of the Basic Amount equivalent. For a parent that is on a full time parental leave this would correspond to a monthly benefit of 13.5 percent of the Basic Amount. Most students that receive a child during their studying period would receive this amount.

People in work instead first need to have their base income calculated (for the purpose of receiving an income related benefit). The parental leave benefit amount is set to 80 percent of the individual's base income.

The benefit is paid for two years after the birth of the child, after which the individual returns to their previous labour market status. This length of the leave is higher than what is actually possible to obtain in real life. However, we do not include the right to benefits when taking care

[5] In the Swedish system, a total of 480 days of parental leave are paid jointly, 90 of which are not tradable between the partners (i.e. each parent is entitled to 90 days which are lost if not used).

of a sick child nor do we include the effect of part time work when raising children. We thus believe that adding a longer initial leave compensates for this.

Being on parental leave does not exclude per se the possibility to have another child, since the model allows women with a child older than one year of age to have another one. In these cases, during the overlapping period when the mother is looking after two children, the parental leave benefit amount is frozen.

2.3 The Pension System

The pension system is modelled according to the Swedish system with some simplifications related e.g. to the fact that the model does not yet have capital markets. Every retiree is assigned a public pension which is comprised of three elements: a premium pension, an income pension and a guarantee pension. The premium and income pension are related primarily to the amount of (notional) contributions paid by each individual during their working life and accumulated into their personal account and the rate of return determined by the Pension Authority.

The premium pension is properly funded pensions which collects 2.5% of the individual yearly salary and invest into a chosen pension fund. Since in our model we do not have capital markets, we are obliged to make some exogenous assumptions about returns to such funds. Upon retirement the value of the fund is simply annuitized by dividing it by the remaining life expectancy.

The income pension is instead based on a "notional defined contribution" model, which resembles a funded system (in that the insured pays yearly 16% of income into a personal account) but which however remains PAYG (in that his money is not invested but used to finance current pensioners' expenditure while being earmarked for the future at a given interest rate). At the time of retirement (age 65), the individual will therefore have accumulated a certain notional lump sum which is converted into a yearly pension income, IP. The pension annuity is

calculated on the basis of a unisex life expectancy of 20 years at age 65 through a so called annuitization divisor, which assigns an expected interest of 1.6% on the remaining fund after retirement. Consequently the value of the annuity is adjusted yearly for real growth deviating from 1.6% (i.e. if the growth is lower the pension benefit is reduced and vice versa), as well as occasionally by the "brake" (if the balance ratio goes below 1, seen next section).

Once the income pension is calculated, the individual will be checked to see whether additionally she will be eligible for a guaranteed pension. A guarantee pension will be awarded to all individuals, regardless of their social insurance contributions, who have an income pension amounting between 0 and ca. 45% of the average wage (this threshold has been set on the basis of the 2008 system). Those who have an income pension equal to zero (i.e. no income pension at all), will be entitled to the maximum amount of guarantee pension, currently fixed at ca. 33% of the average wage. For those with an income pension above zero, yet below the maximum pension income threshold, more precisely up to 1.26 basic amounts (1.12 for couples)[6], the income pension amount is withdrawn from the maximum guarantee pension amount by 100% (so in practice the total pension income of these people will be equal to the maximum guarantee pension, albeit the composition will be split between income and guarantee pension). For those with an income pension between 1.26 and 2.7 basic amounts (1.12 and 2.72 for couples), the maximum amount of guarantee pension will be tapered away at a rate of 48% for every additional unit of income pension.

Beside the public pension, we also let people with an income above 7.5 basic amounts (i.e. average earners and above) contribute into a DB occupational pension which on average pays in retirement around 65% of last earnings (above 7.5 basic amounts, 10% below). The contributions

[6] A basic amount is an accounting device used in the calculation of several benefits and corresponding to ca. 40,000 Swedish Crowns in 2008.

to the occupational pensions vary to keep the system balanced every year, and they increase with age.

2.4 The Automatic Balance Mechanism

One of the most important innovations in the "new" Swedish pension system has been the introduction of an automatic balance mechanism meant to preserve both financial balance and inter-generational fairness[7] within the PAYG component of the public pension (the income pension). The automatic balance mechanism allows keeping a fixed contribution rate while also preserving the long term financial sustainability of the PAYG system, essentially by reducing the pension liability when needed.

By default, the income pension and the notional pension accounts are indexed to the growth rate of average income. This indexation will be interrupted whenever the automatic balancing mechanism is triggered, and an alternative indexation will kick in, at the system's internal rate of return.

The automatic balancing mechanism is triggered when the system's liabilities exceed its assets. The actuarial method of what should be counted as assets and liability is the key factor. The PAYG system in fact counts as Contribution Assets not only the flow of current contributions into it, but also the discounted value of the future expected contributions; this is based on how many years of "sustainable" contributions the state can count on, given current income and mortality patterns, what is known as the expected turnover duration. This is the sum of the expected pay-in and pay-out duration, in steady state, or, in other words, the number of years which, multiplied to the current annual contribution flow, would perfectly match the system's PAYG liability prevailing at the time of measurement. The expected duration is currently set at

[7] See O. Settergren, NFT 2/2003

33 years (but is regularly recalculated), based on the average age at which contributions are paid and pensions disbursed. Additionally, the accounting of the system's assets include the so called buffer fund, which collects any surplus from the yearly contributions flow to the PAYG system and invests it in the capital markets (thus making the PAYG system effectively mixed or partly funded).

The system's Pension Liabilities are accounted as the flow of expected future discounted pension payments given the present demographic structure, i.e. the total pension liability to those who are alive today and who have not yet started to draw their pension (based on the current value of their notional account) plus the remaining liability towards those who are already drawing their pension, based on current life expectancy by age (no projections are used).

The automatic balance mechanism therefore is calculated by the following Balance Ratio and Balance Index:

$$(3) \quad \text{Balance Ratio} = \frac{ContributionAssets + BufferFund}{PensionLiability}$$

$$(4) \quad \text{Balance Index} = BalanceRatio * IncomeIndex \qquad \text{if Balance Ratio} < 1$$

When the balance ratio exceeds one, the system has a surplus i.e. it has sufficient assets to insure against the liabilities. If the ratio goes below one instead, it means that the assets are not enough to cover the liabilities and that the system is financially unbalanced. If this was to persist, the buffer fund would be depleted. This situation is indeed possible since liabilities and assets are likely to grow at different rates.

The balance index—obtained by multiplying the income index by the balance ratio when this is below 1—is the rate at which the pension liability must be indexed to ensure that assets and liabilities are equal, or in other words the system's internal rate of return. The system's internal

rate of return is a function of (i) the growth in the contribution base (e.g. population aging would imply lower growth in the contribution base), of the change in age-related income and mortality patterns (i.e. changes to the expected turnover duration), and of returns to the buffer funds (e.g. a financial crisis), all of which would affect the growth of the assets side, and of (ii) changes to the life expectancy which will affect the growth of the liability side. Unequal changes to the growth of assets against the growth of liabilities will require the balance index to work as a levelling mechanism, by lowering the liabilities so that balance will be eventually restored and income indexation resumed.

In practice, the triggering of the balance index will mean that all notional pension accounts as well as income pensions being paid out will be indexed by the system's internal rate of return rather than the rate of growth in average incomes. As the balance index is lower, the liabilities will start decreasing; at some point, as the liabilities decrease and the balance ratio increases again, the balance index will reach the income index levels and normal indexing can resume.

It is important to notice one effect of using the balance index (also commonly known as the "brake"). When the brake is on, both workers' notional accounts and pensioners' income pension will be subject to balance indexing. However, for most workers this will only represent a nominal loss compared to average income indexation, which they hypothetically could compensate by raising labour supply; pensioners instead will experience a real loss as their pension benefit will fall relative to what was initially "promised" to them on the basis of their accumulated savings and life expectancy. In other words they will experience a lower return to their pension savings when the brake is on compared to what they would have got if the system had remained balanced. Therefore, the on-set of the automatic balancing may threaten the inter-generational fairness achieved when both notional pension capital and pension benefits are indexed by average income growth. The system would, without balancing, produce a rather stable cohort benefit/contribution ratio and stable average pension to average income ratio across cohorts (see Settergren, NFT 2/2003, page 104).

3 Key Interactions

It is useful at this point to draw attention to those micro-macro interactions which characterise the IFSIM model. Figure 1 in the Technical Appendix summarises the main feedbacks taking place between most variables of interest at any simulation time t. Here we try to spell them out and to hypothesise some of the feedbacks which sharing the parental leave might trigger.

The main interactions in the baseline model involve educational and labour supply choices, wage and disposable income formation, the tax and benefit system and fertility. The red line in the story goes approximately as follows: the economy is driven by human capital accumulation and population growth (i.e. no physical or financial capital in the model). People choose their educational level on the basis of the observed wage difference between skilled and unskilled labour: when the wedge is greater more people want to become highly educated (while at the same time, as an effect of the supply increase, more educated people will push down their wage relative to the unskilled wage, so that a constant alternation in wage dynamics is produced). A more educated workforce results in any case in higher output and higher average incomes. Individuals, who are interacting agents and constantly learn from their environment, use their knowledge e.g. about average incomes to form their aspirations (e.g. aspired consumption) and their expectations (e.g. projected incomes). When the average wage increases, also the aspired consumption of an individual is going to increase, and most likely also her propensity to work (as the opportunity cost of not working becomes higher[8]). If the return to work increases, fertility is also likely to be lower (again, the opportunity cost of having a child becomes higher). If the effect on fertility is large enough, at the aggregate level this might result in an aging or even declining population in time (especially if we include social pressure effects, i.e. lower nativity rate in one´ s own network, then we can see the emergence of a fertility trap); this in turn might

[8] N.B. Childcare costs however will also increase (since they are a fraction of average income) so the labour supply effect is uncertain.

off-set the positive output gains we originally had from a more educated workforce, reducing output growth but also provoking imbalances in the tax and benefit system (e.g. it might endanger the PAYG component of the pension system and lead to the striking of the automatic balancing mechanism). In sum, the net effects of all these micro-macro interactions are too complex to be solved analytically and that is why we rely on a model such as IFSIM to simulate them instead.

What micro-macro feedbacks could be triggered by sharing the parental leave between the parents. The main implication is that married women will be able to free one more year (per child) when they will be able to choose to study[9], to work full or part time, or to be home. This will entail a likely increase in their labour market participation in fertile ages, which (for any educational level) will then entail a greater accumulation of work experience, hence steeper wage profile and greater accumulation of pension rights. At the same time, it is also possible that some women will reduce their labour supply in older ages since the increase in work experience obtained in earlier years might mean that they can reach the aspired consumption level by working less later on. The net effect of the Reform on life-cycle labour supply thus becomes uncertain from the theoretical point of view (plus it also depends on how the man´ s wage and experience profile is affected, as the labour supply choice is based on incomes from both spouses). Furthermore, working more in fertile ages might also imply a lower amount of children by age 40, as the cost of additional children becomes higher once wage growth steepens up in those years (in the long run). Lower fertility might contribute to more sluggish output growth. At the same time, men will now have to work one year less (1 year of parental leave for every child), which will result in e.g. possibly lower wage increases for them; this might have a negative impact on total output (since men occupy a bigger share of the labour force, plus it will create a disincentive to get higher education and accumulate skills for younger men). Lower

[9] In the model individuals are allowed into University until age 32.

output will in turn translate into a number of further feedbacks, e.g. in education (less people might get educated), or lower aspired consumption (possibly lowering even more the labour supply response of women).

If a macro feedback on output should be triggered from the Reform, it is not unlikely that women will also be affected negatively, so that their initial gains might be counterbalanced by some losses coming from these very macro feedbacks (e.g. lower growth which in turn might imply lower wages, lower benefits etc.), which eventually might lead to an undesired outcome: lower welfare in old age despite having worked more.

The performance of the pension system will also be affected by this Reform. This is both indirectly (as the Reform might affect total output and output growth, which in turn affects the parameters of the system, e.g. the income index growth) and directly, as e.g. any labour supply response associated to the Reform will affect the balance of the pension system.

We will now look at our simulation results to see how these mechanisms function in practice and to see whether some of our hypotheses indeed gets confirmed by the model.

4 Simulation Results

In the next sections we will present several different results to demonstrate the following main ideas:

- The risk of poverty in old age is a function of the labour supply choices made before retirement. In so far as sharing the parental leave (the "Reform") affects the consequent labour supply choice of women, there is going to be a direct effect on their poverty levels in old age. Furthermore, indirect effects will depend on macro economic feedbacks (e.g. lower growth, lower aspired consumption) which might be triggered by the Reform, and which could affect the value of pension income (e.g. through lower indexation). Another important macro feedback is given by the striking of the automatic balance mechanism (regulating the

financial sustainability of the *inkomstpension* system) which can also be affected by the Reform and also matters for the poverty outcome.

- The gender inequality outcome of the Reform (in terms of both the poverty as well as the pension income ratios by sex) varies also with the striking of the automatic balance. More generally the macro feedbacks generated from the Reform in terms of output growth and changes to the income distribution are useful to cast light on these mechanisms.

Our main finding is that variations to the public pension, generated by the Reform and by related behavioural and macro effects (e.g. changes in labour supply, resulting in different pension entitlements), can explain changes in pensioners' poverty and gender inequality in old age, given the current pension system design. The latter is in fact based on a balancing mechanism sensitive to growth and to changes in other demographic and financial conditions (on-set by the Reform). At the same time the balancing mechanism plays a role in determining the Reform outcome also since it can spur behavioural responses in the labour supply of older women.

The rest of the paper is divided in two sections: first we will analyse our results for one specific cohort, in a life-cycle perspective. Then we will look at the cross-sectional evidence (over 150 model years), which will highlight how the current pension design plays a role in shaping the outcome of our labour market reform.

4.1 Results for one cohort

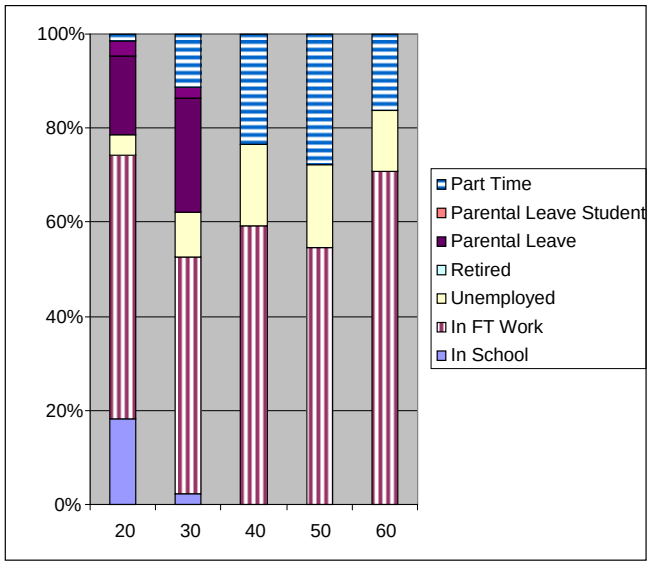
We first want to study the effects of sharing equally the parental leave and compare the outcome of this Reform against the Baseline scenario where women take out the entire duration of the leave (2 years). To this end, we want to follow one particular cohort throughout its lifetime so as to compare individuals who are comparable in all characteristics and in the macro environment surrounding them apart from the change in parental leave years and the related labour supply responses (both simultaneous to the parental leave years and life-long). We take a cohort which

is entirely born in the model, and for which we have simulated an entire lifecycle[10]. We identify it as cohort 2075 since it is born in that artificial year (we must recall here that the model years are fictitious although the year of the survey inputted in the model is 1996).

The first comparison we need to make is about the change in labour market status for women (since men can only work full time in the model), by age. In other words we map what proportions of women in that cohort in a certain age group work, study, are on parental leave or are voluntarily unemployed or "home makers".

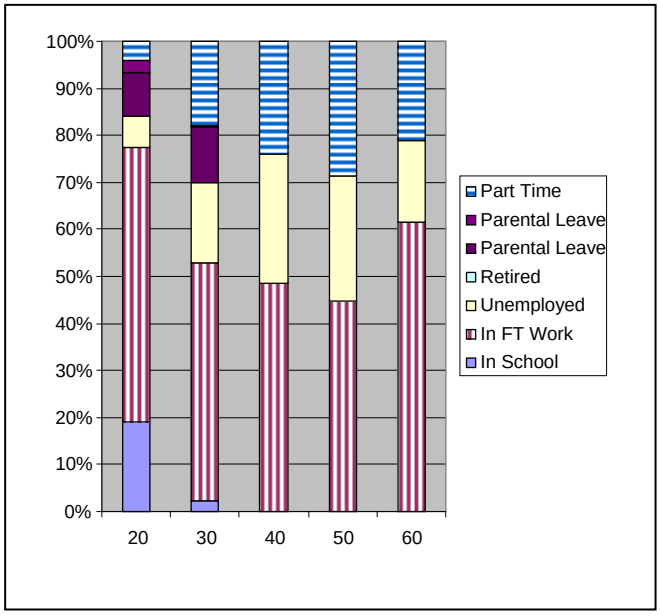
Figure 1 Simulated Labour Supply of Married Women by Age (Cohort 2075)

Baseline (a)



[10] Recall that currently our model outputs data only from model year 2070 to 2150.

Reform (b)



Focusing on the baseline first (Figure 1a), we see that about 15-20% of women between 20 and 40 are on parental leave (dark purple column column), and the rest shares their time between studying (light blue), full time work (red vertical stripes), part time work (blue horizontal stripes) or voluntary unemployment (white). The proportion in part time or voluntary unemployment increases with age, possibly because as people get older, wages increase (including the husbands') and the children grow (i.e. children costs decrease), so they can afford to work less to achieve the aspired consumption. However by age 60 we see again in increase in full time work, possibly due to the fact that, on the one hand, children are older, and on the other agents start to factor in retirement income in their decision (hence they need to work more again to reach their aspired consumption).

If we move to the Reform scenario (Figure 1b), we first of all see expectedly a reduction in the time spent on parental leave among the 20-40 age group, and simultaneously an increase (for the same age group) of the time in part time employment, but also of voluntary unemployment. Over the later years we still see an even stronger trend in increased part time work and also greater voluntary unemployment at the expense of full time work (at least between 40 and 60 years old).

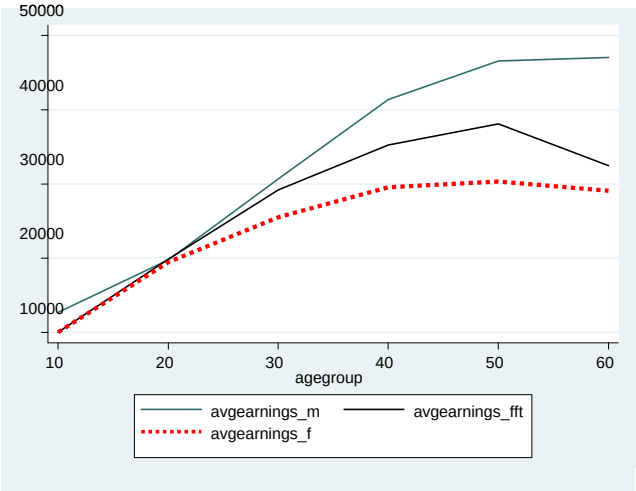
This can be explained by the fact that some women can now reach their aspired consumption earlier due to e.g. higher human capital accumulation in earlier years and higher incomes in years they would have otherwise been on parental leave.

We can thus conclude that for, this cohort at least, the Reform spurs a net substitution effect with women trading parental leave for full time or part time while very young (i.e. between 20 and 30), although later on in life there seems to be for some women an even greater income effect i.e. a reduction of full time work. At the same time we see that just before retirement (between 60 and 64) some women go back to work full time. Over the life cycle in any case it appears that the income effect prevails (i.e. the Reform has reduced the total amount of labour supplied over the life cycle).

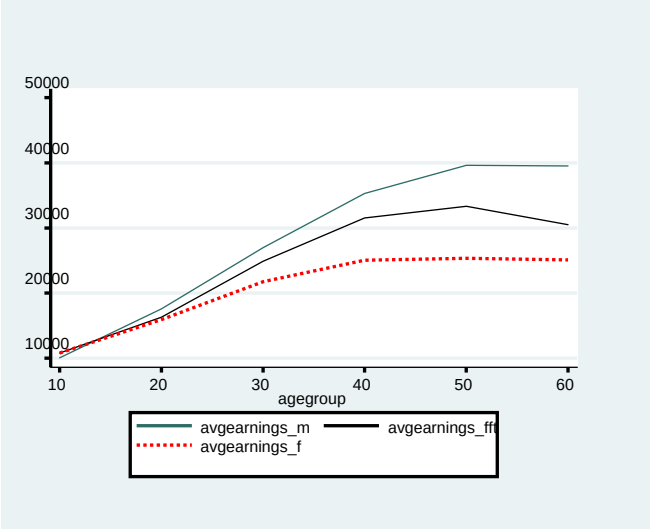
We now show the effect that such a labour supply effect has on wage profiles for men and women of cohort 2075.

Figure 2. Simulated Wage profile for men, women and women only working full time (cohort 2075)

Baseline(a)



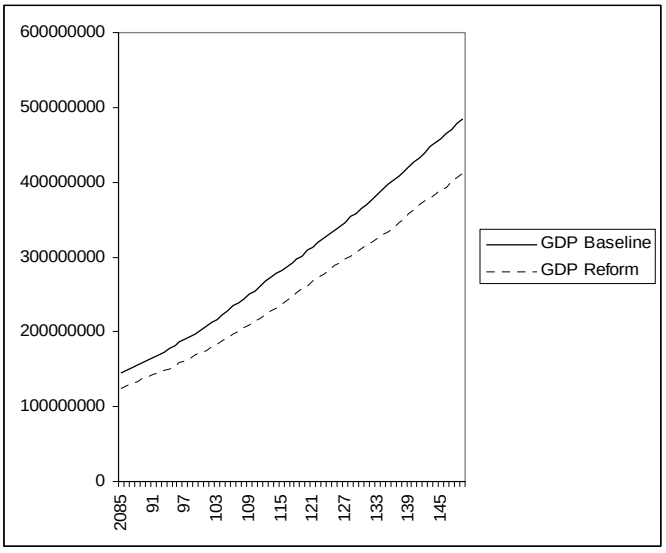
Reform(b)



The most noteworthy result on the wage profile is that the main change from the Reform affects men: as a result of sharing parental leave, both men and women on average see a slower wage progression over time. By age 40, men in the baseline would have earned ca. 40,000 units (Figure 2a) while in the reform scenario (Figure 2b) they earn less than 35,000 (top green line). This implies a less steep wage progression and likely an increase in the time needed for a man to reach the household's aspired consumption. This will have impacts on the labour supply choice of the woman. Women in general (red dotted line) also see a significant decrease in the steepness of their wage; by age 40 in the baseline they would earn ca. 30,000 units while in the Reform scenario they reach ca. 25,000. Since they work more in fertile ages compared to the baseline, this decline must be due to a macro feedback which lowers wages per capita. After age 40, due to the large income effect which pushes them to work less we see that they remain on the same wage level as at 40 i.e. no wage progression. Among the sub-set of women who work full time (black middle line) we also see a slight decrease in their final wage possibly due to the overall slowing down of the economy caused by lower male participation, partly due also to some skill depreciation taking place after age 50. Overall we see that they are also affected by slower growth in the Reform scenario, albeit less than men.

Our model is able to quantify the macro effect that such a decrease in men's wages have on output growth[11]. Since men represent the larger share of workers, the decrease in their wages due to staying some years at home to care for children, as well as their consequent decrease in human capital accumulation, results in a lower overall growth rate of the economy[12], as shown in Figure 3.

Figure 3. Simulated Output Growth by Model Years (100 = 2100)



Interestingly we see that as a result of keeping men more at home the economy in the Reform scenario grows at an average yearly rate that is 0.3% lower than in the baseline. Over time this cumulates to show an increasingly lower output as shown in Figure 3. We must consider at this point the effects that a lower output will have on women also, particularly on their pension accumulation since this will be negatively affected by lower growth and indexation.

One effect of lower output, stemming from the construction of our labour supply function is that, everything else being the same, women´ s aspired consumption (which is a proportion of the

[11] Recall that in our model output is only a function of human capital. A decrease in the average wage of the skilled in one period will result in lower supply of skilled workers in the next period. This will in turn lower aggregate output.

[12] Let´s recall that in our model output is only a function of skilled and unskilled human capital. In Figure 3, values on the y axis represent fictional units of output.

average equivalised income) will be lower. This will make it more likely that women who are not on parental leave (including older women) will need to work less. Moreover, those women who have worked more in fertile years will have accumulated a higher human capital than what they would have had in the baseline, which together with a lower aspired consumption ensures the reduced need to work.

The negative effects of the Reform on women´ s life-cycle accumulation of pension savings thus become evident. In relative terms, in old age women end up being slightly worse off from the Reform: at age 64, as they have worked overall less than in the baseline, they have on average accumulated lower pension rights relative to men (accounted here as the size of their public pension accounts only, i.e. income and premium pension accounts). More precisely the average pension accounts of a woman have gone from 59 to 55% that of a man (even though men have also decreased their pension entitlements by working less).

Consequently, if we compare the size of the average pension of a woman above 65, we will see that in absolute levels her pension will have decreased due both to working less and to the lower growth: her (smaller) contributions to the pension system, particularly to the state notional defined contribution (NDC) system will have yielded less. By the time she retires, her income pension will now be 87% of its value in the baseline scenario. That of a man will also be lower in the reform (85% of the value in the baseline). In relative terms she will be slightly better off, reaching an average public pension which is nearly 66% that of a man from 64% in the baseline.

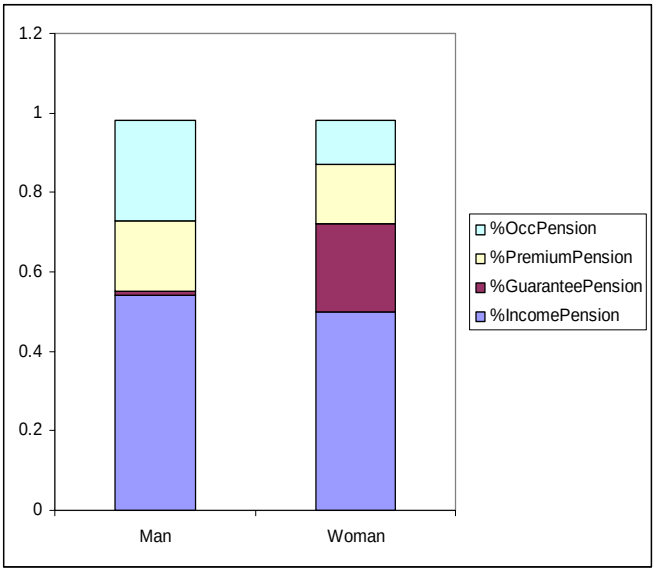
A useful result to understand poverty dynamics is to show how both female and male total pension incomes as a result of the Reform will change in terms of reliance on the guarantee pension. The guarantee pension is the minimum pension meant to bring everyone to a minimum level of income (roughly 33% of the average wage), and being gradually withdrawn for every additional income pension amount that the individual receives (below a ceiling of an income pension corresponding to 45% of the average wage). As we will soon show, there is a strong

correlation between having some guarantee pension as part of one's pension income and being poor.

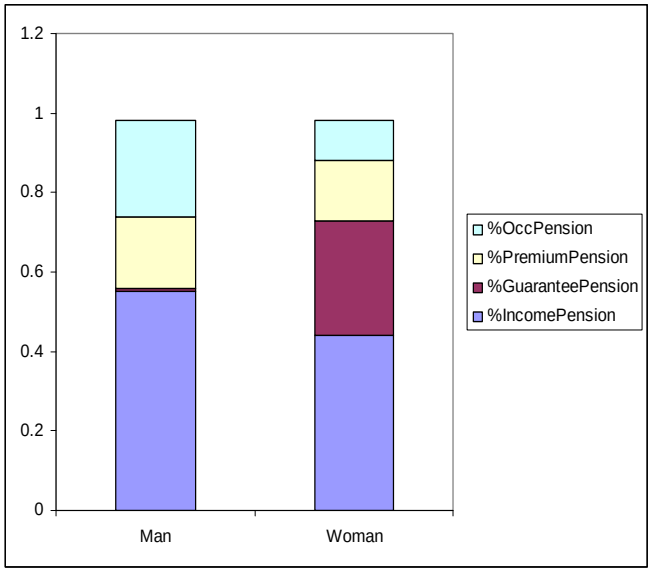
If we look at the composition of the average pension income for someone born in 2075, in terms of which proportion of pensioner income comes from which source, we see that in general (i) the man relies more on the income pension than the woman and much less on the guarantee pension (Figure 4a) (ii) after the Reform (see Figure 4b), the average elderly woman relies a bit more on the guarantee pension and less on the income pension as her average income pension has decreased in absolute value due to lower growth in the economy, plus she has worked less over her life time (iii) after the Reform, the man does not experience any substantial change to his pension composition, on average.

Figure 4. Simulated Pension Income Composition by Sex (cohort 2075)

Baseline (a)



Reform (b)



In other words, we see that in the Reform, the hypothesised benefits from sharing the parental leave might not translate in more gains in old age, particularly for women, if we look at incomes and poverty rates in general, where instead the Reform seems to make women poorer.

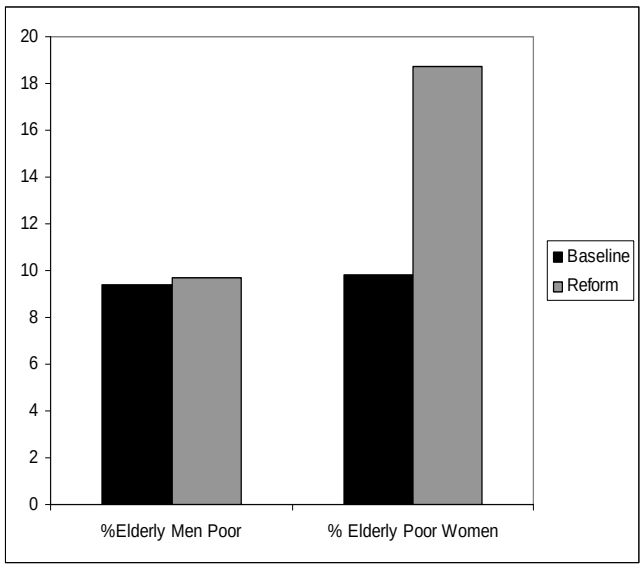
This result is confirmed when we output poverty rates by sex under the two scenarios.

Figure 5 shows that poverty rates for women have doubled at retirement, from 10% of the over 65 being poor to ca. 18%[13]. This effect, due to the lower labour supply, is even more noteworthy since it exists despite that lower growth has also decreased the poverty line (here set at 60% of median household equivalised income).

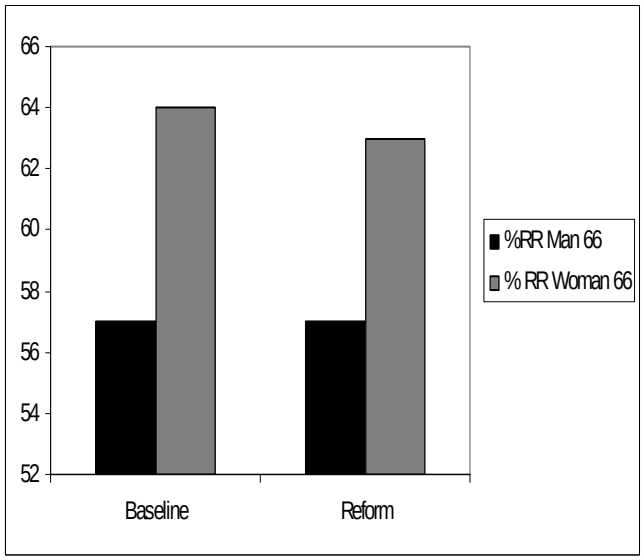
[13] Poverty here is measured on household equivalized income rather than individual. Let´s remember than a household in our model corresponds to a basic family unit. Clearly those who are poor are more likely to be single individuals and widows/widower, i.e. those for whom only one income counts.

Figure 5. Simulated Elderly Poverty rates and Replacement Ratios by sex at retirement year 2140 (cohort 2075)

Poverty (5a)



Replacement Ratio (5b)

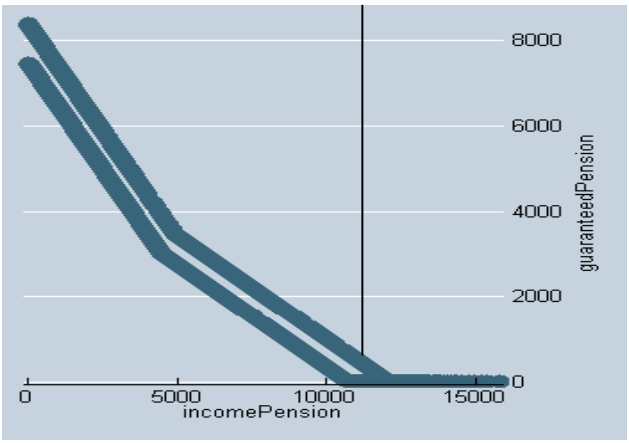


As women earn fewer rights to an income related pension, and rely more on the guarantee pension, it is understandable that they should become poorer in old age after this Reform (or

rather after the labour supply effects that the Reform spurs). The fact that elderly men are not as affected can be explained by the fact that, although they also work and earn less as a result of now going on parental leave, thus accumulating lower pension rights, their average loss is not enough for them to have to rely so much more on the guarantee pension.

To understand this dynamics better, it is useful to see in general who is poor in the baseline purely based on the guarantee and income pension mix (since those who receive a premium and occupational pensions will most likely not be poor). In Figure 6 we see that most people born in 2075 with some guarantee pension in their total would classify as poor at retirement (i.e. all those with an income composition to the left of the black line). Here it is clear how some people on the left of the line who have almost no guarantee pension still do not have enough income pension to move above the poverty line.

Figure 6. Public pension Composition and Poverty Line for year 2140 (cohort 2075)[14]

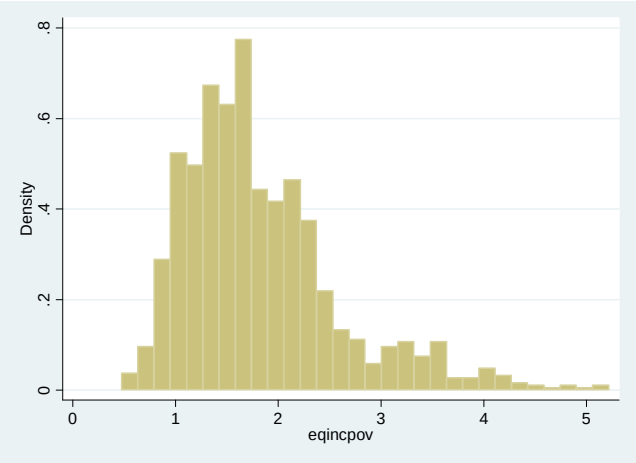


[14] N.B. The two lines refer to single and couples since they have different thresholds against which the guarantee pension is withdrawn.

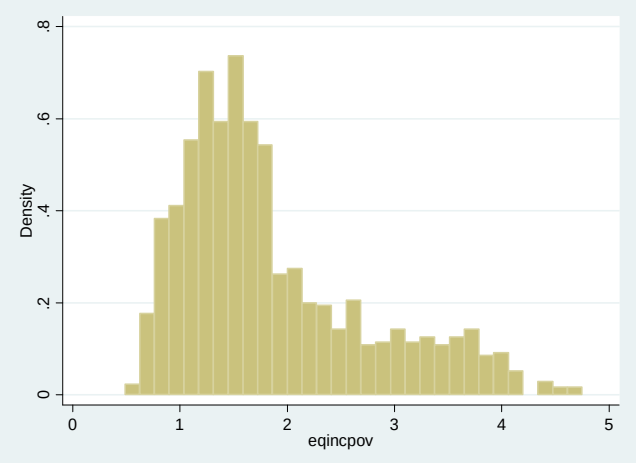
In terms of the income distribution of elderly people for cohort 2075, it is interesting to see that, while lower life-time female participation and lower male wages have brought about a more left-sided and wider distribution around the mean (see Figure 7b), more people in the Reform now lie from just above the poverty line to just below. Hence the proportion of poor increases, as shown in Figure 5, despite the considerable lowering of the poverty line due to lower growth.

Figure 7. Simulated Income Distribution for retirees (cohort 2075)- Equivalized Income as a share of the 60% Poverty Line

Baseline(a)



Reform (b)



4.2 Results for All cohorts

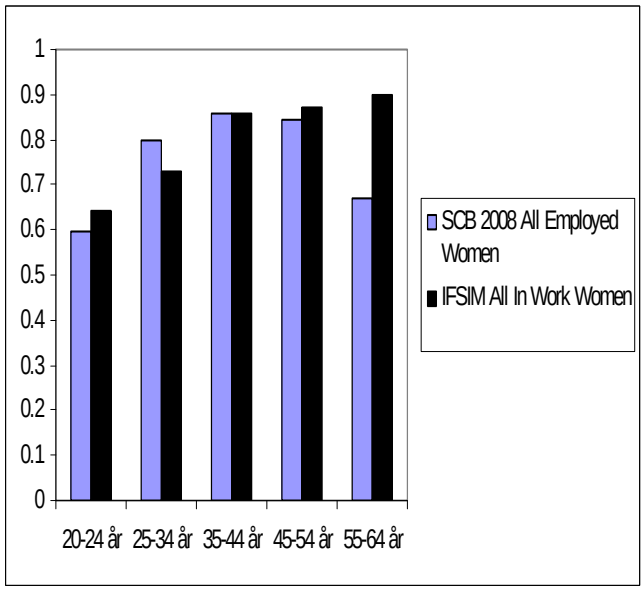
When we look at all cohorts, we see a more nuanced picture than for cohort 2075, in particular we see that the poverty outcome of the Reform can also be positive i.e. sharing the parental leave for some cohorts might actually result in lower poverty rates for both men and women. The key differences in poverty results depend mainly on the features of the pension system (those related to the striking of the brake) and any related labour supply effect. Cohort-level and cross-sectional analysis might hide differences in this respect which in turn explain differences in poverty and gender outcomes between the two scenarios.

We summarise our main elderly poverty findings in Figure 9, by model year. First however we start by giving the cross-sectional labour market impact for the over 65 in the two scenarios (Figure 8a), as well as some baseline results compared to real 2008 labour market statistics for Sweden (Figure 8b).

Figure 8. Full Time and Part Time Female Labour Supply in Baseline and Reform, by model year (a), and Total Women in Employment by Age simulated against real SCB 2008 data (b)

(a)

(b)



Overall, the model output from our labour supply module tends to reproduce quite well the age distribution of women in employment in 2008, with the exception of older women (55-64) where the model over-predicts employment (Figure 8b). This is expected since in the model retirement is fixed at 65 i.e. we do not model early exit from the labour market e.g. through disability or occupational pensions.

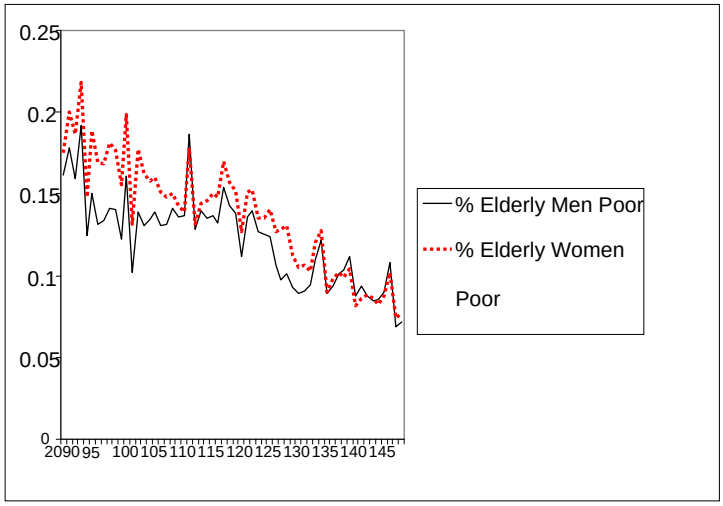
At the cross-sectional level, we see that over time women in general tend to work less full time in the Reform than in the baseline, i.e. the growth in the number of women (of all ages) working full time in any given year is lower (Figure 8a, top black lines). As in the one cohort analysis, the reason lies in the fact that in the Reform, working full time pays less (due to lower output growth) and also that aspired consumption does not grow as much (due also to lower output growth). This output drop might be only partially compensated by a slightly larger number of women working part time in the Reform scenario (Figure 8a, grey dotted lines). Overall, at a cross-sectional level fewer women are in work at any given time in the Reform scenario. This result is compatible with what we saw was happening in a life-cycle perspective for cohort 2075.

When focusing on elderly poverty, the first cross-sectional trend to notice is that in the baseline (Figure 9a), poverty tends to decrease over time for both older men (black line) and women (red line). Generally, women have slightly higher poverty rates than men, apart from the last years of simulation where we actually see the reverse and more men than women become poor. For women, this decrease might well be the effect of younger cohorts who retire having worked more full-time compared to earlier ones (as shown in Figure 10, black thin line). Indeed over time we also see a (cross-sectional) increase in the average income pension of both men and women which is likely to be driving the reduction in the poverty rate (i.e. this increase is greater than the yearly increase in the poverty line). Also, the reduction in the poverty rate among men can be ascribed to a general improvement in the position of the elderly in the income distribution due to e.g. an increase in labour supply among younger cohorts (by women, see Figure 8a, which

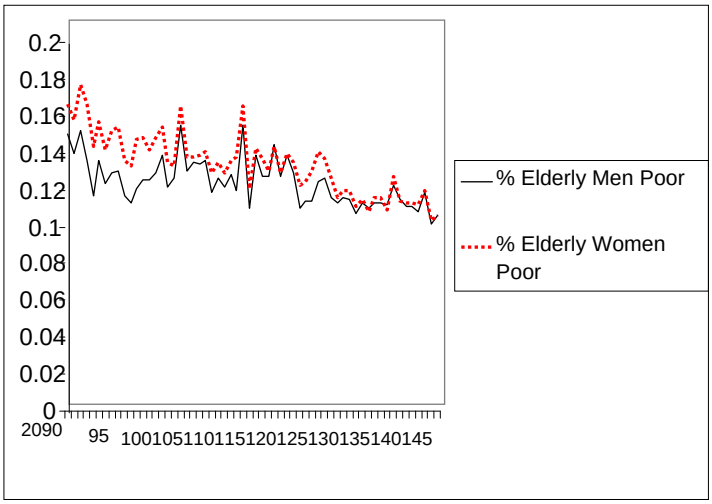
still has an impact on household income) and higher coverage of the occupational pension among the retirees (from ca. 72% in 2080 to 78% in 2145)[15].

Figure 9. Simulated Elderly Poverty Rate by Sex and Model Year

Baseline (a)



Reform (b)



[15] Let us recall also that the poverty rate is calculated on equivalized household income hence it picks up changes to the household composition and income over time.

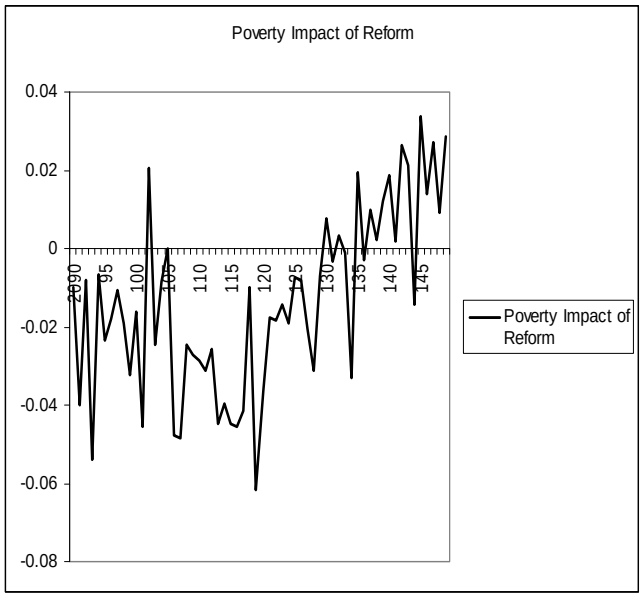
In the Reform scenario (Figure 9b), we see a slightly different picture, whereby poverty rates (by sex) are lower in the beginning compared to the baseline (14-17% instead of 18-20%) but then the poverty rate decreases much less over time, remaining above what it would have been in the baseline by the final years of simulation. So in essence it goes from being lower to being higher than in the baseline over time. We need to understand how any difference in poverty trends between the two scenarios might be linked to sharing the parental leave, either directly or indirectly (i.e. through secondary effects on either output, fertility or labour supply).

The direct effects that sharing the parental leave has on elderly poverty rates (Figure 9b) can be attributed to the same labour supply mechanisms which we saw for cohort 2075, and that are confirmed in Figure 8a, namely a reduction in the life time supply of labour by women compared to the baseline, and the consequent diminishing of their pension claims by the time they retires. By working less over their lifetime, women end up relying more on the guarantee pension, which is strongly associated to being poor.

The indirect effects of the Reform have to do with the macro feedbacks which follow from sharing the parental leave. We have already seen for cohort 2075 how lower male participation and human capital accumulation result in lower output growth. We will now look closer at those feedback effects which can be responsible for a higher poverty rate in old age (compared to the baseline).

To shed light on this question, we output the impact of the Reform on poverty over the years (Figure 10); so we see that up until ca. 2135 the Reform has a positive effect on elderly poverty, i.e. poverty is lower compared to the baseline, while after that year the poverty rate is higher than in the baseline hence the effect is negative (like for cohort 2075). Figure 10 summarises the effect of the Reform on elderly poverty and shows how it goes progressively from positive (in the graph below zero) to negative (in the graph above zero).

Figure 10. Simulated Poverty Impact of the Reform on the Elderly, by model year

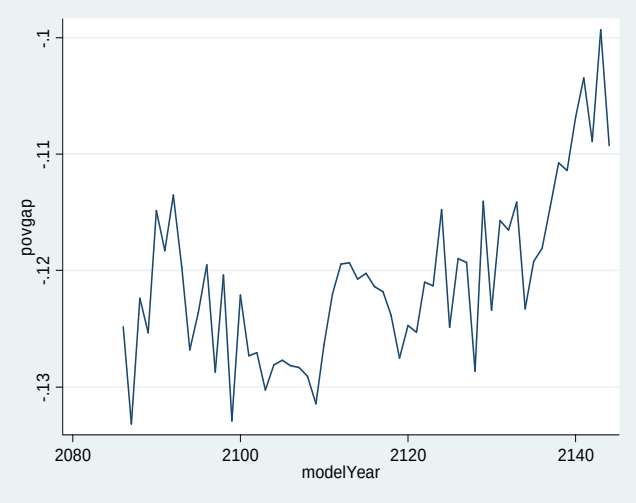


It appears that something happens around 2135 that is able to shift the results from positive to negative. In a similar fashion, from 2135 we observe a reduction in the average "depth" of poverty among the elderly in the baseline scenario, as measured by the so called poverty gap ratio[16] (Figure 11a), which is not present in the Reform (Figure 11b).

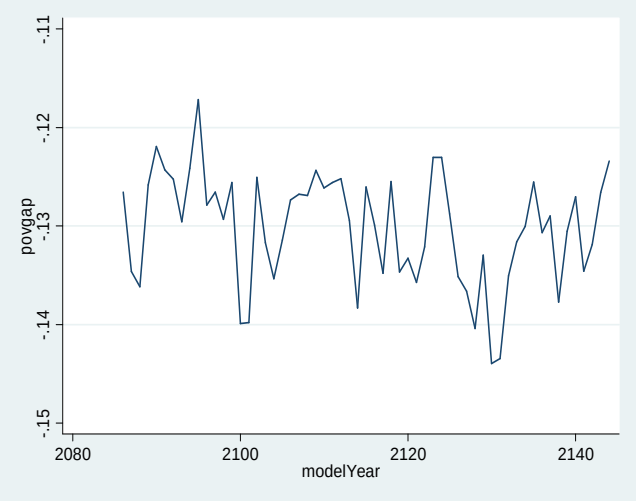
[16] The average gap ratio measures the average distance of the poor from the poverty line as a percentage of the poverty line itself.

Figure 11. Poverty Gap Ratio by model year

Baseline(a)



Reform (b)



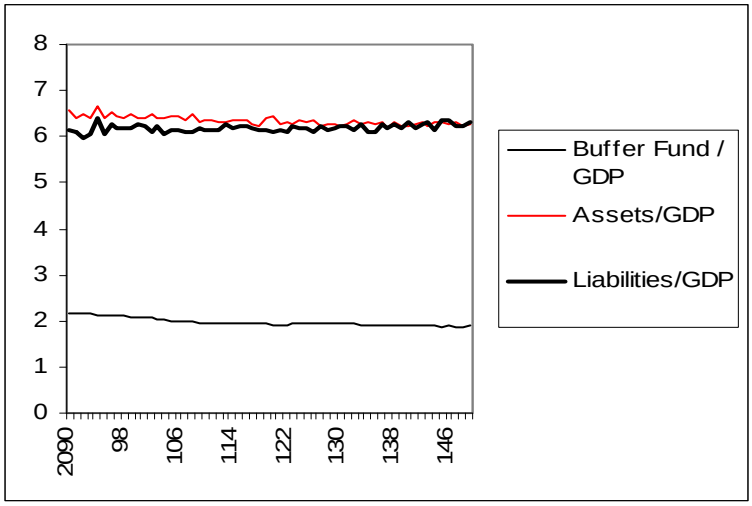
In order to understand better what other forces are at play here we must recall from section 2 how the Swedish pension system is designed, in particular the feature which concerns the automatic balancing mechanism present in the *inkomstpension*. This mechanism was introduced

to strike only occasionally, when the system long term balance would be in danger due to e.g. demographic change. The system's balance is calculated by comparing the actuarial long term liabilities (namely how much the Swedish state owes in pensions today if it was to pay them out to all contributors) with the long term assets (namely how much the State can receive as intake from the current and future contributors, assuming an average contribution period). When the liabilities should overtake the assets e.g. due to the rate of population aging the system's balance is temporarily restored by lowering the growth of the income pension going to current pensioners.

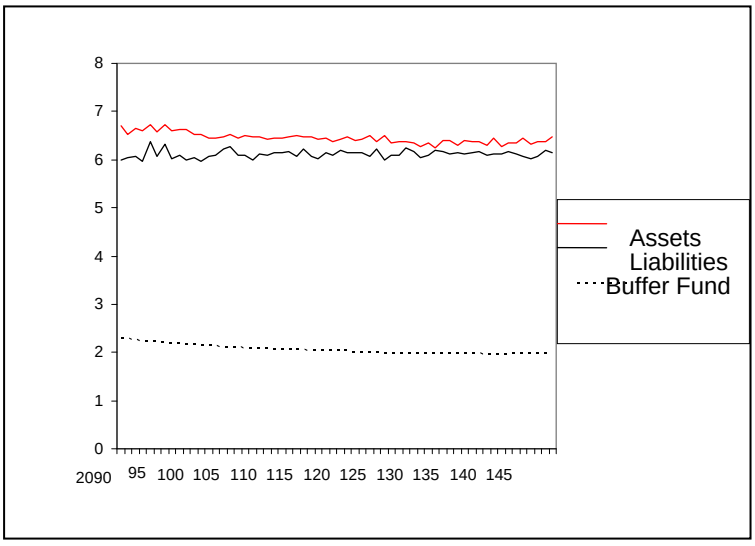
In our model, the balance strikes in the baseline scenario more or less uninterruptedly from around year 2135 (Figure 12a) to year 2150. In the Reform scenario instead, the brake does not strike at all (figure 12b). Why this difference? On the one hand, a lower labour supply participation in the Reform scenario lowers the system´ liability, so that the brake does not need to strike as early as in the baseline. This effect, together with lower growth rate, is indeed what makes the pension liability (black line in Figure 11) grow more slowly hence avoids (or at least delays) the striking of the brake in the Reform scenario.

Figure 12. Total Projected Assets and Liabilities plus Buffer Fund as a proportion of GDP, by model year

(a) Baseline



(b) Reform



In light of the above, we need to explain again (i) why the poverty rate and poverty gap decrease even though the brake is on in the baseline scenario (i.e. Figure 9a and 11a) and conversely (ii) why in the Reform, (Figure 9b and 11b) poverty and poverty gap end up higher although the brake is always off. This is allegedly against intuition (since the loss incurred by pensioners with lower indexing of the income pension would suggest higher and not lower poverty when the

brake is on). Something else must be happening in our model while the brake strikes, possibly a behavioural response which might help explain this.

We pursue the hypothesis of a direct effect of the brake on poverty which could be due to (i) a behavioural response by older women once the brake is on, since they suddenly realise they need to work more just before retiring if they want to reach their aspired consumption (ii) the brake having also an impact on the income distribution e.g. it lowers the median income so that less people appear to be poor and the depth of poverty also decreases.

We investigate hypothesis (i) and (ii) in the baseline and the Reform results, putting them now in relation to the striking of the automatic balancing.

Looking at hypothesis (i) first, we want to investigate further whether the brake is associated to a labour supply response of older workers in particular. Indeed, as we saw for cohort 2075, it is possible that those older women who make their labour supply decision when the brake has striken will end up increasing their labour supply just before retirement[17] in response to the brake. The striking of the brake, which normally entails a reduction in the growth rate of the income pension benefit and account, is in fact going to reduce the projected household disposable incomes of those who are making the decision, thus raising the probability that they will have to increase their labour supply in order to reach their aspired consumption, at least temporarily[18]. If they do so, they will end up accumulating larger pension credits right in their final years of work (when they have also reached their highest lifetime wage), both for the state, premium and occupational pensions. This means that when they actually retire, and the brake is

[17] Recall that the woman´s projection is based on an income regression done on a sample of women who are 10 years older and with 10 years more work experience (10 more precisely for full time income projections; 5 for part time). For women who are above 56, this includes a sample of women who are already retired at the moment of the projection. If the brake is on in the regression year, its effects will be included in these women´ s projection of their future income. This is so even if the brake is actually no longer striking when they will retire. In this sense, women´s forecasting is imperfect. They do not account for the fact that e.g. their increased labour supply will end up affecting the probability of the brake striking again or not (most likely, it will delay it).

[18] By model construction, this period should last around 10 years.

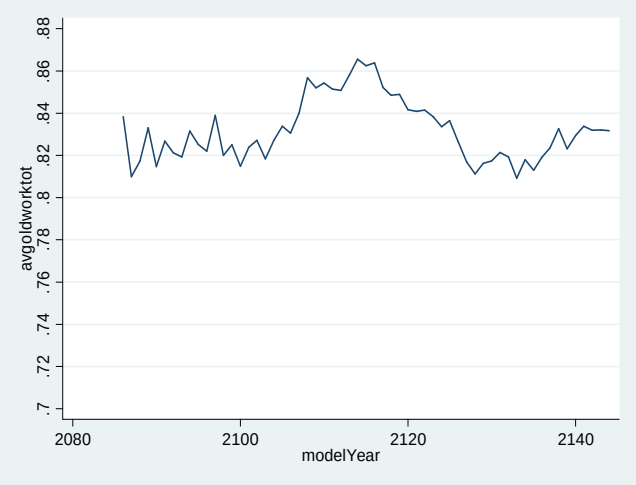
still on, they might nevertheless experience a higher average income pension (or total pension) compared to those earlier cohorts who retired when the brake was off and worked less in their latter years since they had not needed to adjust their behaviour.

This hypothesis seems to be confirmed albeit weakly by our data[19]. If we look specifically at the proportion of over 56 women who are in work in the baseline (Figure 13a), we see a slight increase starting exactly around 2135 (of ca. 2% points); however the behaviour of older women shows fluctuations over time so that it is hard to attribute this particular increase in labour supply specifically to the brake. At the same time in Figure 13(b), i.e. the Reform scenario where the brake does not strike, labour supply of older women in the same years is generally lower. Around those years when the brake would be on in the baseline (and here is not) we in fact see a reduction in older labour supply from ca. 2140, which might well be correlated to the lack of the brake as an incentive to work more.

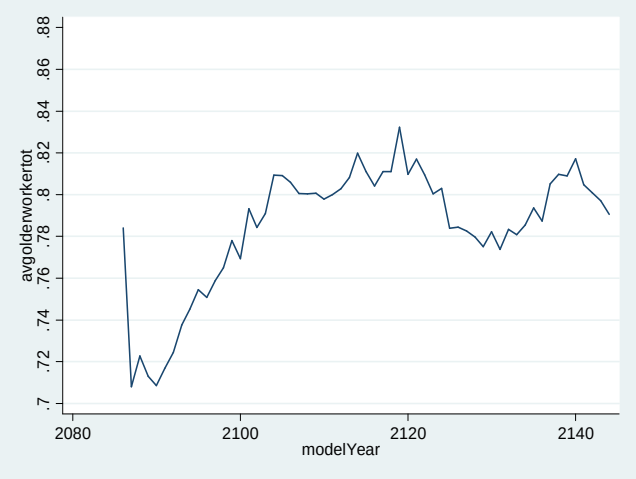
[19] N.B. Our evidence is not able to show a causal relationship between the striking of the brake and the increase in labour supply of older women, which might also be due to other factors such as higher aspired consumption levels in those years; however it shows some degree of correlation between the two events which might need further study.

Figure 13 : Proportion of 56-64 years old women working full time or part time

(a) Baseline



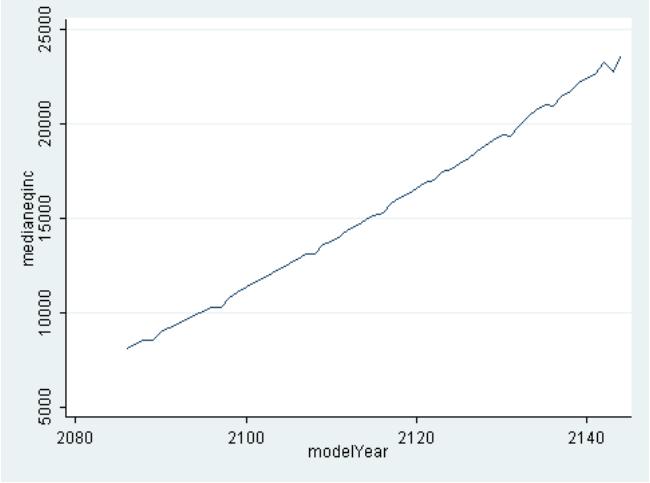
(b) Reform



Moving on to hypothesis (ii), we look at changes in the median income over the years to compare differences in the baseline and the Reform which might be caused by the brake. To do this, we track the evolution of the median income in both.

Figure 14. Median Equivalised Income by model year

(a) Baseline



(b) Reform

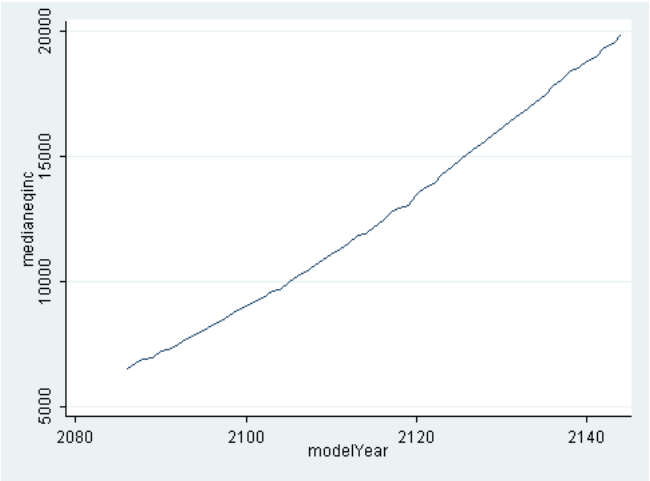


Figure 14 shows the evolution of median income in absolute levels. In the baseline a downward spike is present around year 2140 which might well be due to the cumulative effect of a few years of the brake striking. No such dropping of the median is visible in the Reform around the same years. This also supports the evidence of overall a lower poverty rate in the baseline than in the Reform, as the poverty line will be also proportionately lower once the brake strikes.

In figure 15 below, where we report the poverty rate of the elderly in the baseline first and then for the Reform, for a year before the brake strikes (2110) and for a year while the brake is on (2140). In the baseline clearly we see that the poverty rate has changed with the income of the

elderly growing faster than the poverty line, so that fewer lie to the left of the line in 2140 (from 14% to 9% ca.).

Figure 15 Poverty Rates of Elderly, year 2110 and 2140

	Baseline	Reform
Year 2110	13.6%	13.5%
Year 2140	8.7%	11.3%

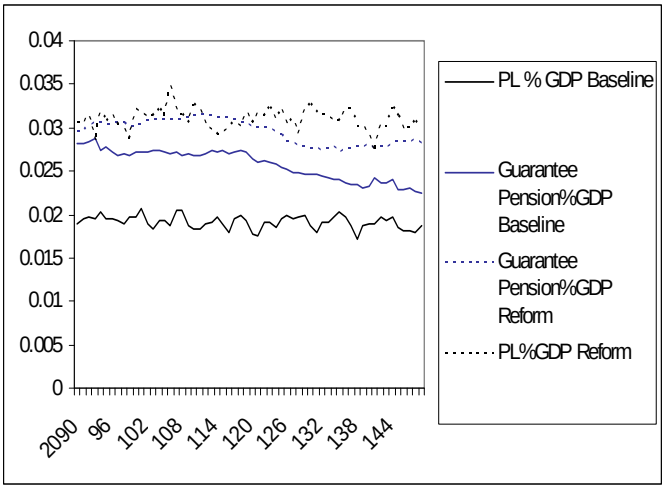
If we look at the poverty rate for the same two years in the Reform scenario, we can notice that by 2140 the poverty rate of the elderly remains very similar to that of 2110, compared to the baseline, due to much less change to the underlying income distribution.

This effect can be also attributed also to the fact that both men and women work less than in the baseline. Let us recall that, beside the brake, there are also more positive changes in the income distribution under the baseline scenario than the Reform, as an effect of higher and increasing female labour supply (cross-sectionally, See Figure 8), which benefit all households where a woman lives (since the distribution measure is household-based).

A last observation concerns the effects that the Reform has on the financial costs of the system. Figure 16 below shows the trend in tax financed public expenditure as a percentage of GDP, under both scenarios. Interestingly, the Reform generates higher costs, since it produces on the one hand higher poverty, which translates in higher coverage of guarantee pension, and on the other hand higher parental leave costs, since financing this benefit for men is more expensive (the benefit in fact replaces 80% of previous earnings and men have higher earnings than women). The increase in tax required to meet a yearly rise in public expenditures of ca. 2% points of GDP is likely to generate a series of other negative feedbacks e.g. lower investment in

education, lower fertility, which in turn over time would affect also poverty statistics (but which we do not assess here).

Figure 16. Public expenditures on Guaranteed Pension and Parental Leave Benefit as a percentage of GDP, by model year



5 Conclusions

Our paper has conducted a theoretical experiment using our agent based model IFSIM. Our aim has been to study the dynamics of poverty in old age, particularly from a gender perspective, when changing conditions in the labour market should lead to higher women's participation in the labour market, and consequently, higher accumulation of pension rights in retirement as well as lower poverty and inequality.

In particular, we have chosen to see the effects of sharing the parental leave equally between a man and a woman upon the birth of their child (for a period of one year each), against a baseline scenario when women take the full amount of parental leave instead.

We have simulated a labour supply choice for women comprising the possibility to choose between full time, part time and voluntary house work. Men can instead only work full time in our baseline model. The labour supply choice involves a trade off between working more and earning more in order to satisfy one's aspired consumption level (varying with education and

parental upbringing), or staying at home to look after children (while also saving on childcare costs). While it is impossible to infer a priori whether the Reform creates incentives (e.g. by increasing the wage profile of women) to substitute leisure with more work, or rather the opposite (e.g. to promote earlier exit from the labour market as e.g. higher wages allow women to reach their aspired consumption earlier), still we do observe that sharing the parental leave on average is traded with a simultaneous increase in part time or full time work, i.e. a positive substitution effect for most women. However, forcing men also to stay home negatively affects their wage development and thus has an unexpected negative macro feedback on economic growth (since men are the higher share of the workforce in the model) and on fertility (since the opportunity cost of having a child increases for women), which in turn feeds back negatively on growth also. For our show-case cohort 2075, this macro effect can eventually result in a lower accumulation of pension rights for women also (since a large part of the public pension, the income pension, grows at the rate of incomes), thus reducing the return from working (by reducing the absolute gain in terms of pension accumulation). Thus our model allows us to take into account macro feedbacks within the individual labour supply choice, and to show that long term consequences might not be in line with expectations, as the Reform might even bring about higher poverty rates for women although they have worked more in fertile ages.

Another contribution of the paper is to have identified a correlation between the striking of the automatic balancing mechanism (a crucial feature of the design of the Swedish income pension) and the poverty effect of the Reform, as well as its gender impact.

Our model has in fact been able to capture another important behavioural feedback, namely an increase in labour supply of older women when the brake strikes (only in the baseline). This effect counterbalances the otherwise negative impact of the brake on pensioners´ incomes and poverty rates, by rising women´ s pension entitlements at retirement (from both occupational and state sources) and consequently rising the (equivalised) income of many elderly households (at least those which are married or single women households). Sharing the parental leave sets on a

series of macro-feedbacks which delay the brake: lower growth and lower fertility entail also lower income pension growth, and lower predicted pension liabilities in the system, while higher female labour market participation in fertile ages can be accompanied by lower labour supply in older ages (when the brake is off), which also entails a lower pension liability at the aggregate level. As the brake is not set on in the Reform scenario, also its positive effects on older labour supply and pension income composition are delayed, and so are the consequent gains in lowering elderly poverty and improving gender equality.

We therefore conclude that the effects of sharing the parental leave on pensioners' poverty are not straightforward, and there is no single answer as to whether sharing the parental leave is good or bad from the point of view of pensioners´ welfare. The outcome depends on a number of concurring events including macro and behavioural feedbacks, which our model IFSIM can suitably handle. An even more meaningful conclusion is to have shown that the effects of a labour market reform on poverty and gender equality can be substantially affected by the design of the current pension system; in particular including the behavioural responses associated to the striking of the pension brake in the analysis might be crucial to assess the impact of any reform.

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Technical Appendix

Sensitivity Tests of the Labour Supply Module

The labour supply Module makes a number of assumptions about the way married women choose how much to work. These assumptions are based on the idea that women will work the minimum amount necessary to reach a certain aspired consumption, once childcare costs are also accounted for. The decisional algorithm is calibrated on a number of hard-coded parameters. In order to test the extent to which results might depend on the choice of these parameters, we have tested the following as shown in the table below. More details can be available upon request.

Parameter	Baseline	Baseline Test 1	Baseline Test 2
N. of Years in Projected Income Formula	10	5 Outcomes: Raise in Full Time Labour Supply slightly less steep Brake strikes earlier (from year 2070 ca.) Decline in Elderly Poverty slightly less steep	20 Outcomes: - Rise in Full Time and Part Time Labour more steep - Brake does not strike as contribution raises more than liability - Decline in Elderly Poverty more steep
Weight of Husband´s Income in Projected Income	0.5	0.2 Outcomes: - Rise in Full Time	1 Outcomes: -Rise in Voluntary

		and Part Time Labour more steep - Brake strikes earlier (from 2070 ca) as income pension liability increases - Decline in Elderly Poverty more steep	Unemployment -Brake strikes earlier (from 2070) - More stable poverty (not declining) -Declining population as more women in voluntary unemployment leads to lower incomes which affect fertility choice
Child Care Costs	7% of average income per capita for child < 5 5% of average income per capita for child > 5	TO DO	TO DO

The sensitivity tests confirm that our model is robust to the choice of parameters since we see no change in the direction of our main statistics (e.g. labour supply totals, pensioners poverty rate), apart from very small variations in the levels reached in any given year (as expected), logically compatible with the parameter change.

Appendix: The IFSIM development environment

The simulation model is developed in a java-environment using the pre-compiled package JAS 1.2. JAS is a JAVA-based object-oriented simulation toolkit, specifically designed for agent based simulation modelling. JAS is developed and distributed (as freeware) by Michele Sonnessa, Dept. of Computer Science, University of Turin, Italy[20].

JAS does not define a domain-specific language: it provides the JAVA programmer a collection of ready to use libraries, widgets and a set of methods to build such kind of simulations. A JAS model is an instantiation of a particular Java class (jas.engine.SimModel), creating a collection of agents and a schedule of discrete events performed over those agents. Our model is itself an instantiation of the JAS class SimModel. Therefore, it can interact with JAS library commands and features.

JAS is a flexible tool which can be easily embedded in the user's own JAVA model. In our case, the JAS library is included in the Eclipse development environment. The JAS User Interface is launched from within the development environment, allowing the programmer to run the simulation, as well as easily follow and analyze its outputs. In other words, the JAS User interface is an application through which the user can execute simulation experiments, loading JAS compatible models and controlling their execution. The main panel of JAS, once PABM has been uploaded but before running it, is shown in Figure 1.

[20] For more information, you can visit: http://jaslibrary.sourceforge.net/

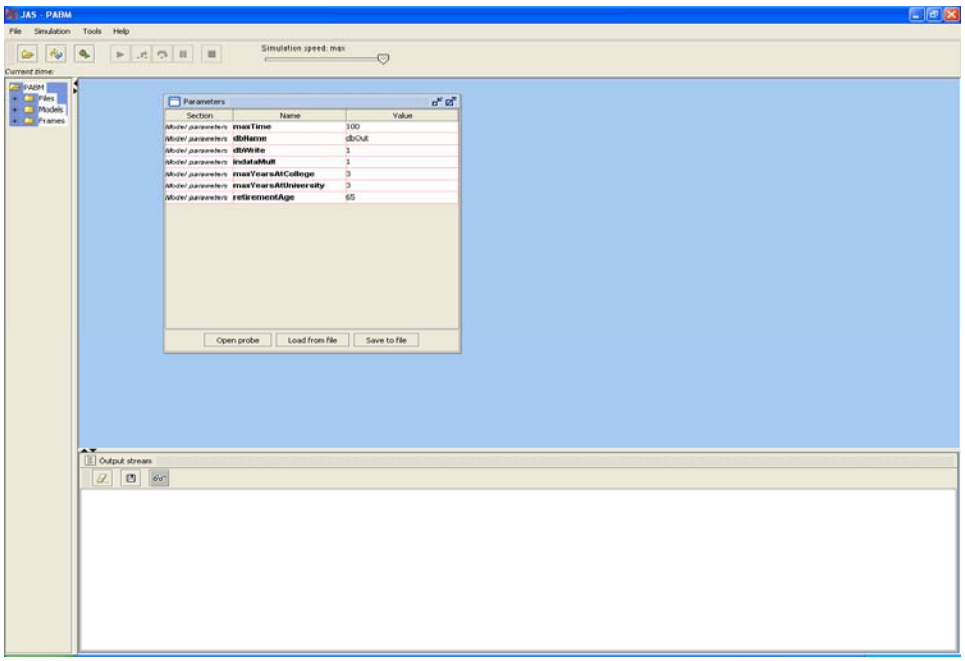


Figure 1 Screen dump of JAS user interface

The Parameters window allows the user to change any model parameters of his or her choice, for instance the simulation times, or some policy related parameters, such as retirement age or schooling years, provided they are previously coded in the relevant "JAS parameter bag". The Parameters window also allows to save the simulation output in an SQL[21] database which can be subsequently accessed and analyzed, provided a name (e.g. dbOut) is specified before running the model. Finally, the Parameters bag allows access to an on-line probe ("Open probe" button on the bottom-left side), which the user can access to follow the history of every agent in the model as it develops.

The running of the model in JAS actually consists of two separate steps: first, the model needs to be initiated. This essentially means that the input dataset (external) needs to be read into JAS and transformed into an output database (the one where new information is stored as the model runs). Only then, the model is actually run. On the top left corner, the user can observe the model

[21] Structured Query Language database

current time and stop the simulation at any point. Otherwise the model will continue running until the number of time periods specified in the Parameters window is elapsed.

From the JAS interface, the user can also view graphical outputs of various variables´ time paths (e.g. total GDP, population growth, average human capital levels etc.). Figure 2 shows an example of the graphical outputs which can be produced after running PABM for 100 years.

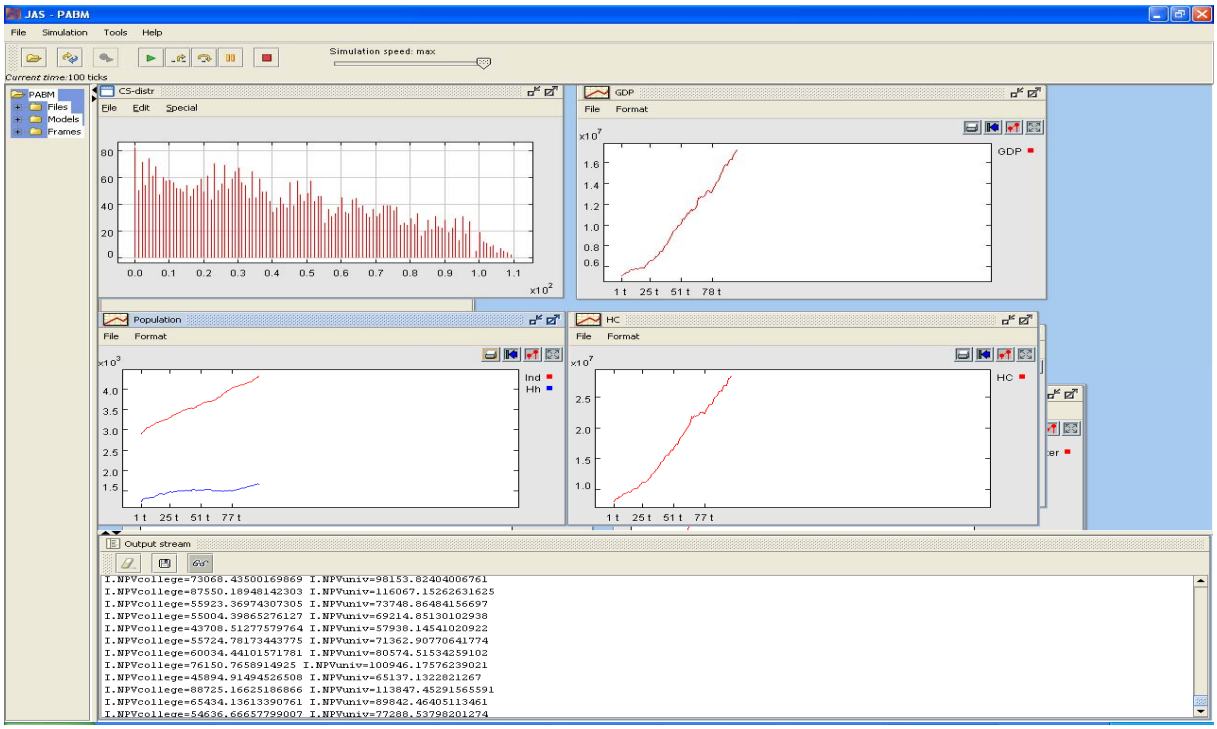
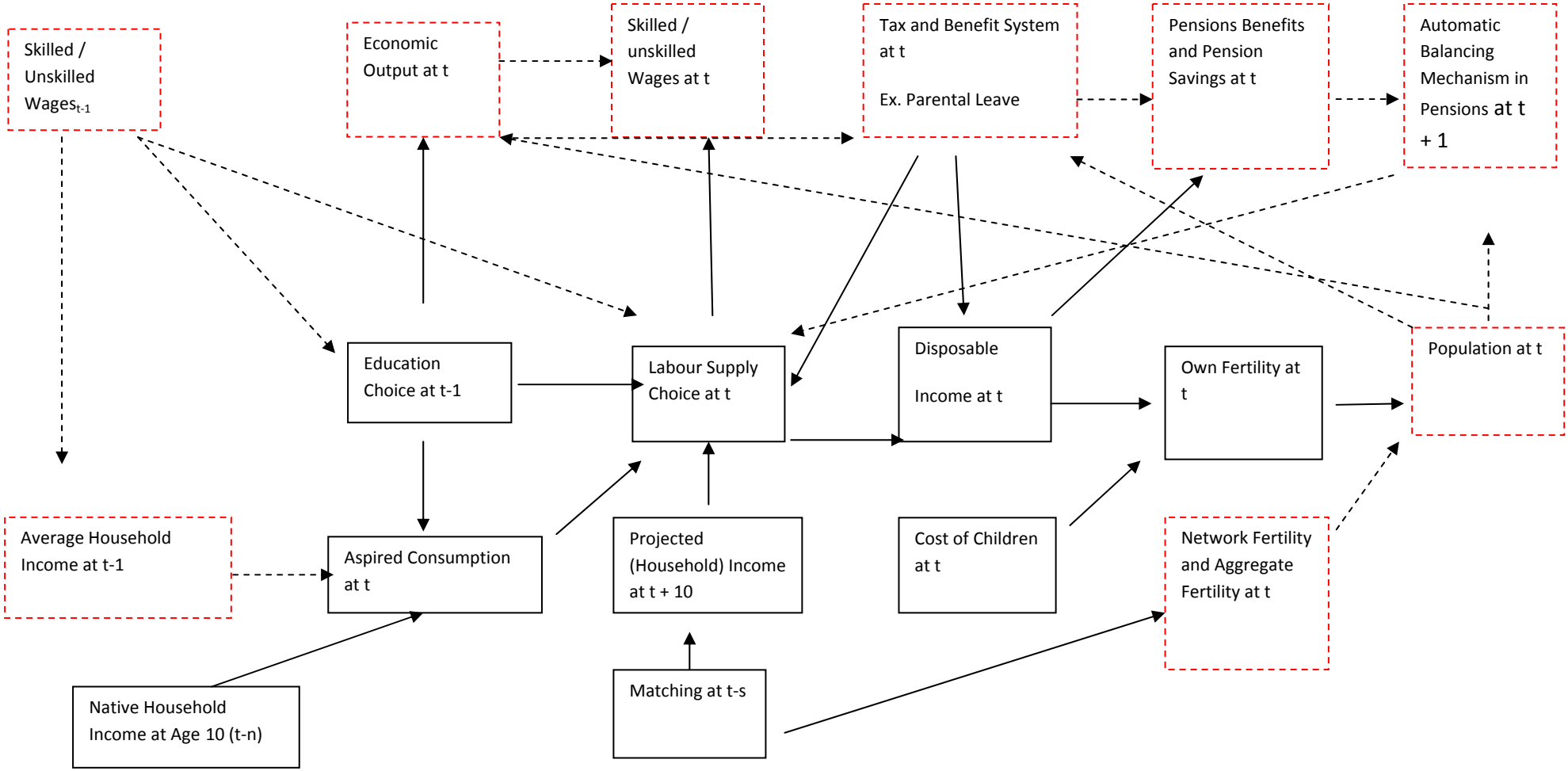


Figure 2 Screen dump of the simulation model running

From the Output Stream window, the user can check any errors occurring in the run as well as print statements specified in the code.

FIGURE 1 - IFSIM – Key Micro – Macro Interactions

Notes: Macro level boxes marked in Dotted Line - Red, Micro level boxes in Black. From Macro to Macro or Micro: Dotted Line. From Micro to Macro: Straight Line



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