FLEMOSI

Tools for ex ante evaluation of socio-economic policies in Flanders

DISCUSSION PAPER 25

THE IMPACT OF DEMOGRAPHIC CHANGE ON POLICY INDICATORS AND REFORMS

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The Impact of Demographic Change on Policy Indicators and Reforms

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Abstract

In this paper, we project demographic changes for the next twenty years, by means of multi-state population projections (Lipro-projections) by age, sex and household position on the one hand and by age, sex and educational attainment on the other. On the basis of these projections we obtain forecasted household weights by calibration. The future population is approximated by static re-weighting of the EU-SILC 2008 dataset, which is a representative sample of the population in the base year. We assume a modest real growth rate of 1%. We investigate the budgetary and distributional effects of the obtained demographic and economic evolution. The importance of demographic change is further illustrated by its influence on the effects of some policy reforms.

1 Introduction

In this paper, we investigate the expected evolution of Flanders´ income distribution over the next twenty years. While such evolution was traditionally mainly attributed to economic variables, such as wages, income, consumption, and wealth (Heathcote et al., 2010), in this paper we focus on the role of population change. Recently, the importance of a clear understanding of demographic change in relation to inequality has repeatedly been stressed (Blank, 1995, 2011; Burtless, 1999; Western et al., 2008; Chen and Föster, 2011). The increase of single-headed households and especially single parenting, and the rise of female educational attainment and labour market participation undoubtedly have contributed to this shift in research focus (Peichl et al., 2012; Burtless, 1999). Less able to pool income resources, a rise in the prevalence of single headed households is often found to trigger an increase in inequality (Kollmeyer, 2012). The rise in educational attainment and female labour force participation is also found to increase inequality as double-income households are concentrated at the top of the income distribution (Esping-Andersen, 2007).

In addition, this paper investigates interactions between demographic evolution and changes in the tax-benefit system. First, we look at the effects of population and economic change on the public revenues and expenditures. The ageing of the population raises concern about the sustainability of our social security system as it alters the population's dependency ratio.

Parallel to ageing, however, also the household structure and education of the population is modified. The effects of the latter processes are much less known. Secondly, by means of a simulation of a child benefit reform proposal, recently advanced by different political parties, we analyse the influence of population change on the potential long term policy outcomes. In contrast to static simulation models that estimate the immediate effect of policy measures, we show the influence under changing demographic and economic conditions.

We thus join a strand of recent research aiming at quantifying the role of demographic change on the increase in inequality (Peichl et al., 2012), breaking down changes in inequality and poverty indices into changes in tax-benefit system, gross wage change contributions and shifts in demographic composition (Bargain and Callan, 2010). Furthermore, to disentangle the impact of population on the one hand and economic change on the other, we use decomposition methods. For a discrete co-variate, two different methods can be used (Handcock and Morris, 1999; Peichl et al., 2012). The first is an exact decomposition of the distributional change by co-variate subgroups (Shorrocks, 1980, 1984), comparing two (income) distributions (at two points in time, t_0 and t_1, say) separately for, for example, each educational level. The second method, which is also valid for continuous co-variates such as age, involves the construction of a counter-factual distribution or index. This involves reweighting the sample at t_0 such that the distribution of education levels (or ages) becomes identical to the sample at t_1. Comparison of the counter-factual with the distribution at t_0 reveals the effect of changing education, while the difference between counter-factual and the distribution at t_1 is a residual effect. Applied to the mean of a distribution, the second method is known as the Blinder-Oaxaca decomposition. In the context of distributional analysis it has been applied by DiNardo et al. (1996), Hyslop and Maré (2005), Handcock and Morris (1998), to name but a few. In this paper, we will mainly apply the second method.

In contrast to former studies, we make this decomposition *prospectively*. From a policy point of view, this is important. For social policy aiming at guiding societal evolution to go beyond ad hoc answers to structural changes, it needs to be informed how future population characteristics affect inequality. In addition, this prospective view can re-mediate some of the difficulties faced by retrospective research due to differences in contextual factors such as the time period and the welfare systems (Esping-Andersen, 2007). Building on hypothetical scenarios about economic growth and population forecasts, we isolate our analysis from temporal and contextual influences and gain at least partial control over interactions with non observed variables.

The prospective nature of our endeavour firmly roots it in the *micro-simulation* tradition. A microsimulation model (*MSM*) is a computer program that simulates aggregate and distributional effects of a policy, by implementing its provisions on a representative sample of individuals and families, subsequently adding up the results across individual units using population weights (Martini and Trivellato, 1997; Bourguignon and Spadaro, 2006). *MSM*s are essentially *forecasting* devices needing a baseline simulation to predict the 'no policy change' situation (Merz, 1991). This property of the model and using state-of-the art population projections, will allow us to forecast the income distribution, and government incomes and expenditure under the current policy context. The simulation property consists of the evaluation of the consequences of some change in the economic environment, often induced by a policy reform, on each individual's income. This will allow us to simulate the child benefit reforms, not only under current *but* also under forecasted economic and demographic conditions. The results in this paper were obtained using the microsimulation model Mefisto[1].

In section 2 we describe the different steps of our methodology. Section 3 presents the results of the population projections. Section 4 describes the forcasted inequality evolution and its relation to demographic and economic change. Section budgetary effects and long term outcomes of child benefit reforms. Section 5, finally, investigates how demographic change influences the impact of a policy reform.

2 Methodology

In order to obtain the desired results, we proceed with a number of distinct steps:

1. We first make multi-state demographic projections at five-year intervals, for the next twenty years (from 2011 up to 2031), by age, sex and household position and by age, sex and educational attainment. The procedure is described in subsection 2.1.

2. We calibrate the *EU-SILC* 2008 data to the distribution of the different population subgroups obtained by the demographic projections. In other words, we reweigh the *EU-SILC* 2008 in such a way that the income data match the population forecast obtained in (1). This procedure is called static ageing (subsection 2.2).

3. We choose a realistic scenario for economic growth to update the income data in *EU-SILC* 2008 for each five-year interval from 2011 to 2031 (subsection 2.3).

4. Finally, based on the re-weighted and uprated income data obtained from (2) and (3), we estimate inequality and poverty indices for each five-year interval (subsection 2.4).

2.1 Multistate population projections

To evaluate the impact of demographic change on the income distribution, classical projections by age and sex only are not satisfactory. In addition to these two covariates, two major evolutions affecting income are identified in the literature: the rise in educational attainment and a shift in household composition (Blank, 1995; Burtless, 1999; Esping-Andersen, 2007; Kollmeyer, 2012). Using the Lipro (Lifestyle Projection) Method (Van Imhoff and Keilman, 1991), two projections for Flanders were made up to the year 2031; the first one by age, sex and household position and the second one by age, sex and educational attainment.

Lipro-projections estimate population structures prospectively by multiplying the density of the initially observed population state vector (baseline vector) with a transition matrix to

[1] Mefisto is a tax-benefit simulator based on the Euromod architecture, incorporating indirect taxes and specific Flemish policy responsibilities.

obtain the density of the state vector in the next period. This way the population is recursively projected one period ahead. The transition rate matrix indicates the probability to transit from one household position (educational level) to another. The matrix also includes death and emigration rates *from* each household position (educational level) as well as births and immigration *to* each household position (educational level). The initial transition rate matrix is estimated from externally observed data. Rate matrices for consecutive projection periods are forecasted according to plausible scenarios about the evolution of fertility, mortality, migration, household formation processes and educational behaviour.

The population as found in the 2001 Census data served as the baseline state vector for both projections. For the projection by household position, the population is broken down by age and sex and 12 "Lipro household positions": children of married and unmarried couples, children in lone parent households, married and unmarried couples with or without children, single households, lone parents, non-related family members, members of collective households and a residual category[2]. For the projection by educational attainment level, the state vector comprised age, sex and nine educational levels: individuals can be still in school or have finished school with a diploma of primary education, lower secondary education (general, technical and professional), higher secondary education (general, technical and professional) and higher education. Initial sets of transition rates between household positions and between educational attainment levels were estimated on the basis of linked 2001 census and Register Data. Also birth, death and emigration rates and immigration figures were extracted from the same data sources[3].

For each consecutive five year period up to 2026-2031, the transition rates are adapted using scenarios based on recent prognoses about the evolution of fertility, mortality and migration (Studiedienst Vlaamse Regering, 2011). We assume that the recent revival of fertility in Flanders will continue up to the period 2016-2021 to go down again afterwards (Schockaert and Surkyn, 2012). Life expectancy will continue to increase, a little faster for men than for women and we assume international immigration to increase up to the 2016-2021 period. Emigration increases linearly with about 20 % over the whole projection period. These hypotheses are summarized in Table 1. Note that we assume that the household formation processes will remain identical during the complete projection horizon. This means that the forecasted population structure and its impact on inequality and expenditures are the result of the ageing and the projection of household formation processes of the current population. In the case of the educational projection, we assume a slight rise in educational retention.

The Lipro-projection model presents some clear advantages with respect to classical projections by age and sex only. First, the results are much richer. Secondly, Lipro is a fully dynamic model where vital events and migration are differentiated by, and interact with household formation or educational processes. If for example, fertility is lower among higher educated

[2]The application of the Lipro-household typology to the Census and register data was discussed intensively by Lesthaeghe et al. (1997) and will be omitted in the current paper.

[3]A detailed description of the projection by household position can be found in Schockaert and Surkyn (2012).

Period			2006 – ’ 10	2011 – ’ 15	2016 – ’ 20	2021 – ’ 25	2026 – ’ 30
Fertility	$\frac{\text{births}}{\text{woman}}$		1.73	1.82	1.76	1.72	1.70
Life expectancy	age (years)	Female	82.7	83.2	83.8	84.4	85.0
		Male	76.9	77.7	78.7	79.6	80.7
External migration	$\frac{\text{rate}}{\text{rate in baseline period}}$		1	1.2	1.4	1.2	1
Educational retention	$\frac{\text{rate}}{\text{rate in baseline period}}$		1	1.065	1.13	1.195	1.25

Table 1: Projection scenarios

women, than a rise in the population's educational levels will temper total fertility rates, even though for all educational levels alike, we considered a relative fertility increase comparable to the one predicted by Studiedienst Vlaamse Regering (2011). In other words, important compositional population changes mitigate the evolution of fertility, mortality and migration, and consequently impose constraints on future population trends. Thirdly, modification in one household position also imposes constraints on the adjustments in other household positions. For example, if for the purpose of population projections we accept the number of same sex couple formation to be negligible, the number of men that transit to the state of "married couple without children" should be equal to the number of women entering this state (and vice versa). In other words, Lipro calibrates the theoretically linked transitions. The constraints included in the household projection are explained by Schockaert and Surkyn (2013). For the educational projection, no constraints were used. The above properties of Lipro projections enhance the reliability of the results by ensuring coherence in population trends.

2.2 Static ageing and calibration to obtain household weights

A conventional view on microsimulation may be summarized as follows. All microsimulation models lie on a continuum between static tax-benefit models on the one end, and dynamic microsimulation models on the other. The former examine the immediate impact of policy changes and do not attempt to incorporate behavioural change; the latter are concerned with incorporating behavioural responses as well as simulating the policy environment (Zaidi and Rake, 2001). While this characterization looks nice at first glance, it does not hold up in practice. First of all, it comprises two dimensions: the incorporation of behavioural responses on the one hand, and the way the future is modelled on the other. Along the latter dimension, we distinguish between:

1. static ageing, which involves re-weighting of a base dataset such that it corresponds with some externally generated predictions (Cai et al., 2006), and
2. dynamic ageing, which involves simulating all relevant attributes of each individual, based on the information from the previous period (O'Donoghue, 2001; Harding, 2007).

Let us clarify both approaches. Suppose we want to predict post-tax inequality next year. When performing static ageing, we reweigh the current year's sample, such that the fraction of workers equals the projected labour market participation of next year. Information on next year's labour force participation is obtained from an *external* source. On the basis of these new weights, we now compute the post-tax inequality. Dynamic ageing in contrast, involves recursively updating the *internal* state vector of the sample.While for age, this exercise is trivial, for other background variables such as marital status, number of children, etc... it involves simulating new values. This is done on the basis of assumptions on fertility, migration, education, etc. ..... Using the predicted or simulated background variables (and possibly lagged outcomes), labour market outcomes are then simulated[4], and finally, post-tax inequality can

[4]Note that such a prediction hinges on estimations using data from the base-year.

be estimated.

While acknowledging that a fully dynamic approach is absolutely necessary if one wants to model short term transitory effects, the focus in this paper is on the outcomes of long term structural changes, that are well captured by a static reweighting procedure. Moreover, our external data are produced by *dynamic* demographic projections of part of the important background variables - age, sex, household position and education (see section 2.1). . For non-demographic variables, most importantly labour market participation, we implicitly assume that their correlation with the projected, demographic variables remains constant over time, i.e. as manifested in the observed sample in the base year. Given that the set of variables on which the projections are based, is deemed to be rich enough, the latter assumption seems not too unrealistic and our approach seems much less depending on assumptions compared to dynamic ageing.

An overview of weighting methods can be found in Kalton and Flores-Cervantes (2003), keeping in mind that most of these methods are conceived to re-mediate survey non-response (Holt and Elliot, 1991). Reweighting by a simple reweighting of cells (Kalton and Flores-Cervantes, 2003) however, is ruled out for two reasons. First, due to data limitations, we use two sets of demographic projections. Since these are made independently from each other, they possibly result in conflicting reweighting factors. Although a simple solution seems to be available by calibrating the conflicting individual weights, a second more fundamental problem remains. In the described demographic projections, the unit of observation is the individual, while for our distributional analysis, we prefer the household as unit of observation, since it is the cornerstone for equivalising income. In order to marry the individual-based demographic projections with the household-based inequality and poverty analysis, we calibrate the base year sample using household weights, to the individual-based totals implied by the demographic projections (Deville and Sarndal, 1992). Such a calibration procedure finds new weights as close as possible to the old ones, such that the individual-based demographically projected totals are respected.

The practical implementation encompasses following elements:

1. Each member, i, of household, f, is uniquely identified by the pair (f, i) and (s)he represents w_{f,i,t_0} individuals in the population observed at time $t = t_0$. Observation (i, f) is a member of exactly one particular cell c_h according to the projections by age, sex and household position and of exactly one specific cell c_e due to the projections by age, sex and educational attainment. Denote the number of cells c_p, by C_p, where p can denote either h or e. In addition, denote the *set of individual observations in the sample* contained in class c_p by $S^{p;c_p}$ and the number of observations contained in this set by $N^{p;c_p}$, $p = h, e$.

2. Using the aforementioned weights w_{f,i,t_0}, the number of individuals belonging to cell c_p *in the population at the moment of observation* t_0, is given by

$$T_{t_0}^{p;c_p} = \sum_{(f,i)\in S^{p;c_p}} w_{f,i,t_0}.$$

3. At each point in time, t, two weights are generated for each individual by a simple reweighting of cells

$$\begin{aligned} w_{f,i,t}^{h;c_h} &= \frac{T_t^{h;c_h}}{T_{t_0}^{h;c_h}} \cdot w_{f,i,t_0} \\ w_{f,i,t}^{e;c_e} &= \frac{T_t^{e;c_e}}{T_{t_0}^{e;c_e}} \cdot w_{f,i,t_0} \end{aligned}$$

where $T_t^{p;c_p}$ is equal to the projected population number of individuals contained in class c_p according to the particular projection $p = h, e$ concerned, at time t. As before, the number of individuals belonging to cell c_p *according to projection* p *at time* t*,* will be given by

$$\begin{aligned} T_t^{p;c_p} &= \sum_{(f,i)\in S^{p;c_p}} w_{f,i,t}^{p;c_p} \\ &= \sum_{(f,i)\in S^{p;c_p}} \frac{T_t^{p;c_p}}{T_{t_0}^{p;c_p}} \cdot w_{f,i,t_0}. \end{aligned}$$

Note that for a household f with N_f members, we obtain a set of $2 \cdot N_f$ potentially conflicting new weights at each time t, even if we start with weights that are constant within each household.

4. At each point in time, t, a starting value for one unique household weight is constructed as the weighted average of all applicable individual weights by taking them into account inversely proportional to the number of individuals belonging to the particular class

$$w_{f,t}^0 = \frac{\sum_{i=1}^{N_f} \left(\left(N^{h;c_h} \right)^{-1} w_{f,i,t}^{h;c_h} + \left(N^{e;c_e} \right)^{-1} w_{f,i,t}^{e;c_e} \right)}{\sum_{i=1}^{N_f} \left(\left(N^{h;c_h} \right)^{-1} + \left(N^{e;c_e} \right)^{-1} \right)}.$$

We use this particular weighting scheme because cells with few observations have few degrees of freedom to adjust to the $2 \cdot N_f$ potentially conflicting totals. By giving more weight to such potentially problematic cells in the construction of the initial family weight, we hope to avoid convergence problems as much as possible.

5. We calibrate[5] a set of unique household weights, which is done by numerically solving the problem

$$\begin{aligned} w_{f,t} &= \arg\min_{x_{f,t}} \sum_{f=1}^{H} d\left(x_{f,t}, w_{f,t}^0\right), \text{ subject to} \qquad (1) \\ T_t^{h;c_h} &= \sum_{(f,i)\in S^{h;c_h}} x_{f,t}, \quad c_h = 1, \ldots, C_h \\ T_t^{e;c_e} &= \sum_{(f,i)\in S^{e;c_e}} x_{f,t}, \quad c_e = 1, \ldots, C_e, \end{aligned}$$

[5]The calibration was performed using the `reweight` command from Stata, contributed by Daniele Pacifico.

year	total	converged	non-converged	wrong projections
	#	#	# (% of total)	% of total projected population
2006	249	243	6 (2.47%)	1.10
2008	249	243	6 (2.47%)	1.07
2011	249	242	7 (2.89%)	1.12
2016	249	243	6 (2.47%)	0.86
2021	249	243	6 (2.47%)	0.84
2026	249	242	7 (2.89%)	1.16
2031	249	241	8 (3.32%)	1.07

Table 2: Number of demographic cells and their (non)convergence

with H the number of households in the sample. That is, we look for the set of household weights, as close as possible to the original weights $w^0_{f,t}$, but still respecting all population totals. In practice, this is a hard to solve problem, which explains our particular construction of the starting weights $w^0_{f,t}$. Each projection p class c_p, contains exactly $N^{p;c_p}$ individuals in the observed database. In other words, there are $N^{p;c_p}$ degrees of freedom available to fulfil the corresponding constraint

$$T^{p;c_p}_t \quad = \sum_{(f,i)\in S^{p;c_p}} x_{f,t}.$$

Constraints with a smaller number of individuals will thus be harder to fulfil, which is why we favour them during the construction of the starting weights $w^0_{f,t}$, by constructing the latter as a weighted sum of individual weights $w^{p;c_p}_{f,i,t}$, with weights inversely proportional to the number $N^{p;c_p}$ of observations in the sample contained in the class c_p.

In practice, the full optimization problem (1) never converged, but we found a solution to this difficulty by iteratively adding more constraints, and taking the previous solution as starting value for the next problem. If a restriction results in non-convergence, it is discarded. Upon inspection of the non-converged restrictions, we decided to aggregate certain neighbouring classes c_h, and, likewise some neighbouring classes c_e. For example, the population projections based on age, sex and household positions, discerned between married and unmarried couples. We made the assumption that merging both categories, would bear little influence on the variables of interest in this study. In addition, while classes/restrictions c_h and c_e with zero observations for all projection years can readily be discarded, we merge classes for which no observations were present in the base dataset but for which a positive number of cases were predicted in the future, with neighbouring cells.

This merging of neighbouring classes finally resulted in the situation depicted in Table 2. The calibration procedure successfully reconciles the two sets of demographic restrictions and results in an error of only 1% of the projected population.

2.3 Economic growth

In order to obtain a realistic impression of future (equivalized) income distributions and concepts derived thereof, such as inequality and poverty, not only demographic changes need to be taken into account, but we need to make some assumptions concerning economic growth as well.

Clearly, economic growth is not independent of demographic changes. Indeed, if we consider economic growth[6], we can split it up into two components:

1. a *demographic* (or, in this context of demographic projections, endogenous) growth component, caused by a changing distribution of individual and household characteristics over time (considering the projections we use, the main source of this component is an increase in educational attainment)[7]. Whenever a (projected) population stabilizes, this component tends to zero.

2. an *efficiency* growth component, induced by the fact that people with identical individual and household characteristics produce ever more.

Since the first component is completely determined by the demographic projections, we can only vary productivity growth, conditional on the demographic assumptions, which we termed *efficiency growth*. In the remainder of this paper we assume that the *efficiency growth* amounts to a yearly real-term increase of 1%.

In addition, the following assumptions are made:

- economic growth is proportionally shared among the factors of production, which entails that (self-)employment income and income from capital have the same growth rate.

- benefits grow according to the assumptions described in Dekkers et al. (2013): the minimum income will grow at an annual rate of 1% in real terms, all other benefits at 0.5%.

To ensure that we do not overestimate inequality, we allow pensions to grow with the efficiency growth rate. Let us justify the pension growth rate by providing an example. Consider a pensioner in the observed sample who retired five years prior to observation at time t_0. In the philosophy of the reweighting methodology, this observation will represent a number of pensioners at time t_1, who will have retired in $t_1 - 5$. Exact calculation of their pension would involve calculating the observations last wage at $t_0 - 5$, applying the observed real wage growth between $t_0 - 5$ and t_0, applying the hypothesized real wage growth between t_0 and $t_1 - 5$, and finally, applying an hypothesized real pension growth between $t_1 - 5$ and t_1. Simply uprating pensions by the hypothesized real wage growth rate will produce accurate results if

1. real pension growth rates between $t_1 - 5$ and t_1 are identical to those between $t_0 - 5$ and t_0.

[6]Making abstraction of phenomena like job title erosion, etc.

[7]Assuming the increasingly educated are fully absorbed by the labour market, i.e. there is no involuntary unemployment among the higher educated

2. the real wage growth rate between $t_0 - 5$ and t_0 was close to the hypothesised real wage growth rate.

It seems reasonable to make assumptions concerning incomes in terms of the efficiency growth rate, since collective wage agreements pertain to individual increases in wages. Assuming the educational attainment of one firm, or even a whole sector of the economy, remains quite stable over time, wage increases will be accorded conditional on age and education of employees. Likewise, an increase in benefits is stated as a percentage increase of the individual's benefit. Consequently, wage and benefit rises seem not directly connected with any demographic evolution. The demographic growth component is not observed by individual firms, but only appears ex-post at the aggregate level.

The resulting factors by which incomes and pensions are uprated are given in Table 3. As

year	factor
2011	1.030
2016	1.083
2021	1.138
2026	1.196
2031	1.257

Table 3: Uprate factors

mentioned above, this represents only the *efficiency growth* component of the total economic growth, the second component arising from the fact that increasingly educated cohorts grow older. The combined effect of efficiency growth and growth induced by demographic change is depicted in Figure 1. It is obtained by calculating the growth rate of aggregated primary income per capita, under the combined demographic and economic assumptions, which should be a close proxy to projected per capita economic growth. The total growth rate gradually decreases to the annual *efficiency growth* rate of 1%. Although this boundary is not fully reached, the projected evolution is consistent with what we theoretically expect: once we reach a stable population (keeping boundary conditions on fertility, migration, ... constant), economic growth will settle at the level of what we termed the *efficiency* growth component.

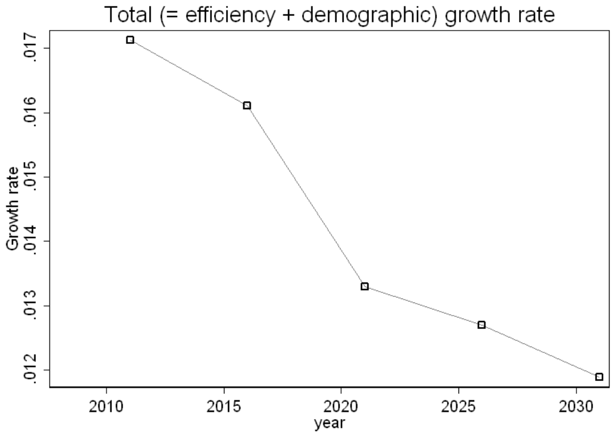


Figure 1: The macro-economic growth rate resulting from both *efficiency* and *demographic* growth.

2.4 Measuring inequality and poverty

2.4.1 Inequality indexes

We calculate two inequality indices: the Gini coefficient and the Theil index. For some continuous (income) distribution F with mean μ_F, the Gini coefficient is formally defined by

$$\mathcal{G}_F = -1 + 2\int_0^\infty \frac{xF(x)\,dF(x)}{\mu_F}, \tag{2}$$

where the variable x represents equivalized net income of individual i. The equivalized income is obtained by dividing total net household income by an equivalence scale, which takes into account differences in household size. It could be considered as the amount of income a single person household would have to earn to obtain a comparable welfare level. In this paper, we use the *OECD* equivalence scale, which gives full weight to the first household member, 0.5 to subsequent adults and 0.3 to each child. The value of the Gini coefficient ranges from 0 at complete income equality (everybody earns the same amount) to 1 when inequality is maximal (only one individual earns total income). If we only have a sample at our disposal, the Gini coefficient can be estimated by

$$\hat{\mathcal{G}}_F = \frac{1}{N(N-1)}\sum_{i=1}^{N}\sum_{j=i+1}^{N}\frac{\|x_i - x_j\|}{\mu},$$

with x_i representing a realisation of x.

The Theil index[8] is a competing inequality measure. It is given by

$$T_F = \int_0^\infty \frac{x}{\mu_F}\ln\left(\frac{x}{\mu_F}\right)dF(x). \tag{3}$$

It ranges from 0 at complete income equality (everybody earns the same amount) to $\ln N$, when

[8]It is a member of the class of generalized entropy measures.

inequality is maximal (only one individual earns total income). It is measured by

$$\hat{T}_F = N^{-1}\sum_{i=1}^{N} \frac{x_i}{\bar{x}} \ln\left(\frac{x_i}{\bar{x}}\right).$$

The Gini index is a popular measure used in many inequality studies, in the first place for its clear interpretation. One main advantage of the Theil index is its sub-group decomposability, i.e.

$$T_F = T_B + \sum_{g=1}^{G} q_g \cdot T_{F_g}, \tag{4}$$

where $g = 1, \ldots, G$ constitutes a partition of the population[9], q_g is the equivalized income *share* of subgroup g, T_{F_g} is the Theil index of sub-group g and T_B is the between group Theil index. It is calculated by attributing every individual the group-mean equivalized income μ_{F_g}.

In the context of analysing the influence of change in the population composition on the income distribution, this property of the Theil is helpful. We use it to analyse the contribution of specific changes in the prevalence of population categories, for example, the increase of single headed households or individuals with higher education, to the forecasted changes in inequality. This contribution can be derived from the second part of the formula $\sum_{g=1}^{G} q_g \cdot T_{F_g}$, since the income share is related to the sub-group population share.

2.4.2 Poverty

(Foster et al., 1984) introduced the family of poverty indices

$$P^{FGT}(F \mid z, \alpha) = \int_0^{\infty} \left[\max\left(1 - \frac{x}{z}, 0\right)\right]^{\alpha} f(x)\, dx,$$

known as the Foster-Greer-Thorbecke class of poverty measures, where, as before, the variable x represents equivalized net household income, $f(x)$ its density function and with z the poverty line or poverty threshold. In this paper, we use a relative poverty line, defined as 60% of the median equivalized income of the *Flemish* population. Note that the poverty line varies over time. $P^{FGT}(F \mid z, 1)$ is the normalized poverty gap[10]. The (non-normalized) poverty gap per poor person is equal to the difference between the individual's income and the poverty line divided by the poverty rate. It is an indicator of the severity of poverty.

A key advantage of the FGT class of poverty indices is its subgroup decomposability, i.e.

$$P^{FGT}(F \mid z, \alpha) = \sum_{k=1}^{K} p_k P^{FGT}(F_k \mid z, \alpha),$$

with p_k the fraction of the population belonging to subgroup k and F_k the income distribution within subgroup k. As in the case of the Theil decomposition, we will use the poverty

[9] Under a partition, every individual belongs to *exactly one* subgroup.
[10] The poverty gap is also known as the poverty deficit.

decomposition to gain insight in the impact of specific shifts in the population composition on poverty.

The EU-2020 "At Risk Of Poverty or social Exclusion" (*AROPE*) indicator (Antuofermo and Di Meglio, 2012) is a composite indicator defined as the share of the population for which *at least one* of the following conditions holds:

1. being at *risk of poverty*;
2. living in a situation of *severe material deprivation*;
3. living in a household characterised by a *very low work intensity*.

Being at risk of poverty means that the equivalized net income of the household falls below the poverty threshold, as defined above. A household is severely materially deprived if it cannot afford four or more out of the nine following items: (1) timely payment of mortgage or rent, utility bills, hire purchase instalments or other types of loans; (2) one week's annual holiday away from home; (3) a meal with meat, chicken, fish (or vegetarian equivalent) every second day; (4) unexpected financial expenses; (5) a telephone (including mobile phone); (6) a colour TV; (7) a washing machine; (8) a car; (9) heating to keep the home adequately warm.

A person is defined to be of working age if he is aged between 18 and 59 years, excluding students between 18 and 24 years old. For each household the number of full-time equivalent months worked by all persons of working age is divided by total number of months that could theoretically have been worked by the same household members.If the obtained number falls below 20%, the households is considered to have a very low work intensity.

3 Demographic trends

During the second half of the last century, intense modifications in family formation and dissolution were observed (Lesthaeghe et al., 1997): a postponement of first marriage, a reduction of marriage intensity and an increment in divorce rates. These evolutions in combination with the endurance of fertility decline and the increase of life expectancy, will induce a profound change in Flanders´ demographic structure over the next twenty years.

Figure 2 shows the population distribution by age and sex in 2011 and the projection result for 2031. As the baby-boom generations at working and reproductive age in 2011 grow older, the bottom of the pyramid shrinks and the top becomes heavier. Parallel, this ageing process gives rise to changes in the population's household composition as the younger generations of 2011 grow older and their family formation behaviour is reflected in successive age groups in each subsequent projection year. This is demonstrated in Figure 3.

Figure 3 depicts the proportional distribution of household positions by age for each five year projection period between 2011 and 2031. On the x-axes are represented the five-year age groups and on the y-axes the proportion of individuals from each age group in single headed households and in couples with and without children. Each curve, from light to dark grey, than

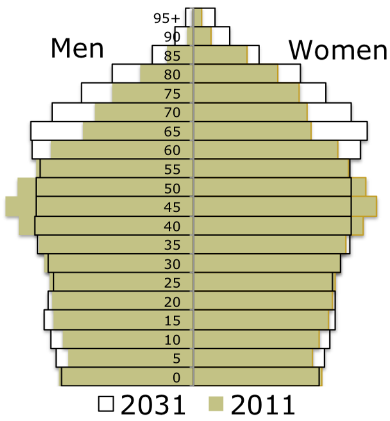
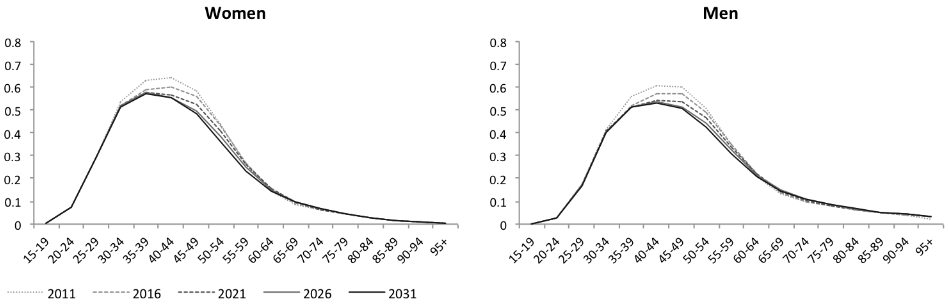


Figure 2: Population pyramid 2011 - 2031

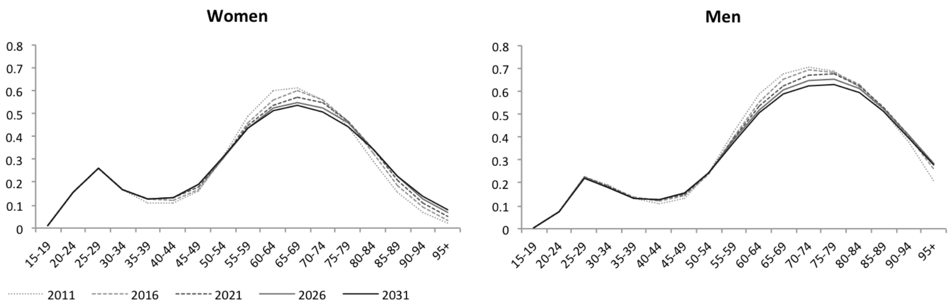
represents a consecutive projection year. Panel (a) and panel (b) correspond to women and men respectively. A first important evolution is the decrease of the share of individuals that live in couples with children and a concentration of parenthood around younger ages. These evolutions are related to the decrease and postponement of couple formation and to fertility decline leading to a shorter total time span that children are present at their parent's household. Higher divorce rates add to this evolution and also explain the decreasing prevalence of couples without children at more advanced adult age. However, among the elderly population, above the age of 75 for women and 85 for men, the prevalence of individuals living in a couple increases in time. This is easily understood as the result of growing partner's survival rates since we projected women's and especially men's life expectancy to grow. The decrease over time of couples results in the rise of single-headed households, most eminent between the age of 40 and 70[11].

Figure 4 depicts the proportional distribution by age of individuals with only primary education or less, lower and higher secondary education and higher education for each five year projection period between 2011 and 2031. Panel (a) and panel (b) represent the distribution for women and men respectively. The Figure shows that parallel to ageing and changes in household position, for all age groups and the two sexes, we foresee a considerable advancement in educational attainment. That is, for each age group the share of the population with higher secondary and higher education becomes larger in time. This process is almost entirely due to the ageing of the population as from each projection year to the next, the educational profile of the younger generations is progressively spread to all ages. Therefore, in the first part of the projection period, especially the $40-64$-age group's educational attainment increases; in the second half of the projection period, the 65+ educational attainment rises most while below 60, practically no change is observed any more. Within the population under the age of 35, practically no change is observed since we assumed only minor adaptations in educational

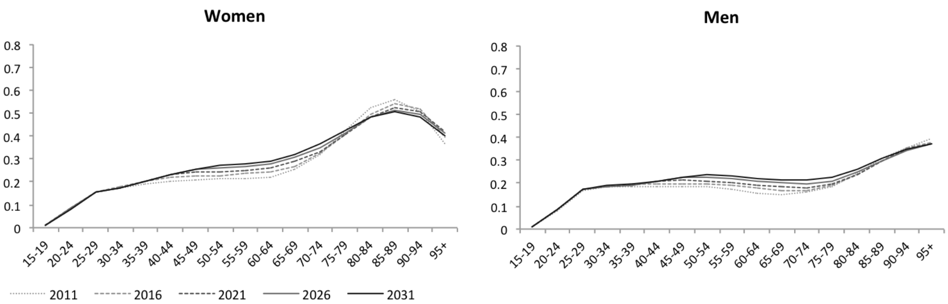
[11]Note that, by age and for each projection year, the prevalence of female single headed households progressively outgrows the prevalence of male single headed households. The sex differences in life expectancy and the fact that women on average are younger than their partner, leads to a higher proportion of female than male headed households. At the end of the life course, the proportion of single headed households decreases, as people move to a collective household.



(a) Couples with children



(b) Couples without children



(c) Single headed households

Figure 3: Population by age, sex and Lipro position

behaviour (cf. Table 1). Consequently, in the long run, an equalizing tendency between generations and gender is observed. The following comparison demonstrates this tendency: in 2011, the part of the population having at least a higher secondary degree below the age of 40 was about 80% while this was only the case for about 22% of the group above 65. In 2031 80% of the whole population under 65 will have a higher secondary degree, and this is also the case for almost 60% of the +65 group. Furthermore, in 2011, the younger generations of women had already suppurated the level of the men; in 2031 this will be the case for all age groups, except the most advanced ones.

4 Inequality and poverty effects

4.1 Demographic and efficiency growth effects on inequality and poverty evolutions

In this section we depict the forecasted change in income distribution, using the Gini and Theil indexes (Figure 5) for describing the overall inequality changes. In addition, the poverty rate, poverty gap, and the AROPE indicators (Figures 6 and 7) focus on the evolution of the lower tail of the income distribution. The curve called "total predicted effect" traces the evolution of each indicator when we carry out projections as described in section 2. Note that the main interpretation of such a curve should be comparative to the year 2008, represented by a horizontal grey line.

We decompose this projection into its constituent components, following the Blinder-Oaxaca decomposition method (see section 1). The "efficiency growth effect" is obtained by keeping the population identical to its 2008 distribution, but attributing every individual an income increase as described in subsection 2.3. The "demographic effect" results from the projected evolution in population composition, but keeping *real* incomes constant at their 2008 level. Note that the total effect is not always the sum of the two partial effects, but a sometimes quite important interaction effect induces some degree of non-linearity.

Both the temporal evolution and the decomposition into a demographic and an efficiency growth effect of the Gini and the Theil indices are similar (see Figure 5). The overall inequality change is mainly driven by the demographic component with a rather small efficiency growth effect added to it.

Inequality peaks around 2021 and reaches a level comparable to 2008 in 2031. Note however that the predicted change is quiet small. At its peak in 2021, the Gini coefficient has only increased 0.007 points in absolute terms (which corresponds with roughly 3%) above its initial level of 0.211. Of this change, about 86% is due to demographic changes and only 14% to the efficiency growth effect. However, in 2031, the Gini coefficient is only 0.002 points (1%) above its initial level, with 100% of the increase explained by the efficiency growth effect[12]. The Theil index follows a similar pattern, with a maximal increase of 0.008 points (9%). While

[12] Compare this with the results of Blank (2011, ch.4, p.94), who only attributes a mere 15% of the 1979 – 2007 rise in the US Gini coefficient for total income to demographic changes.

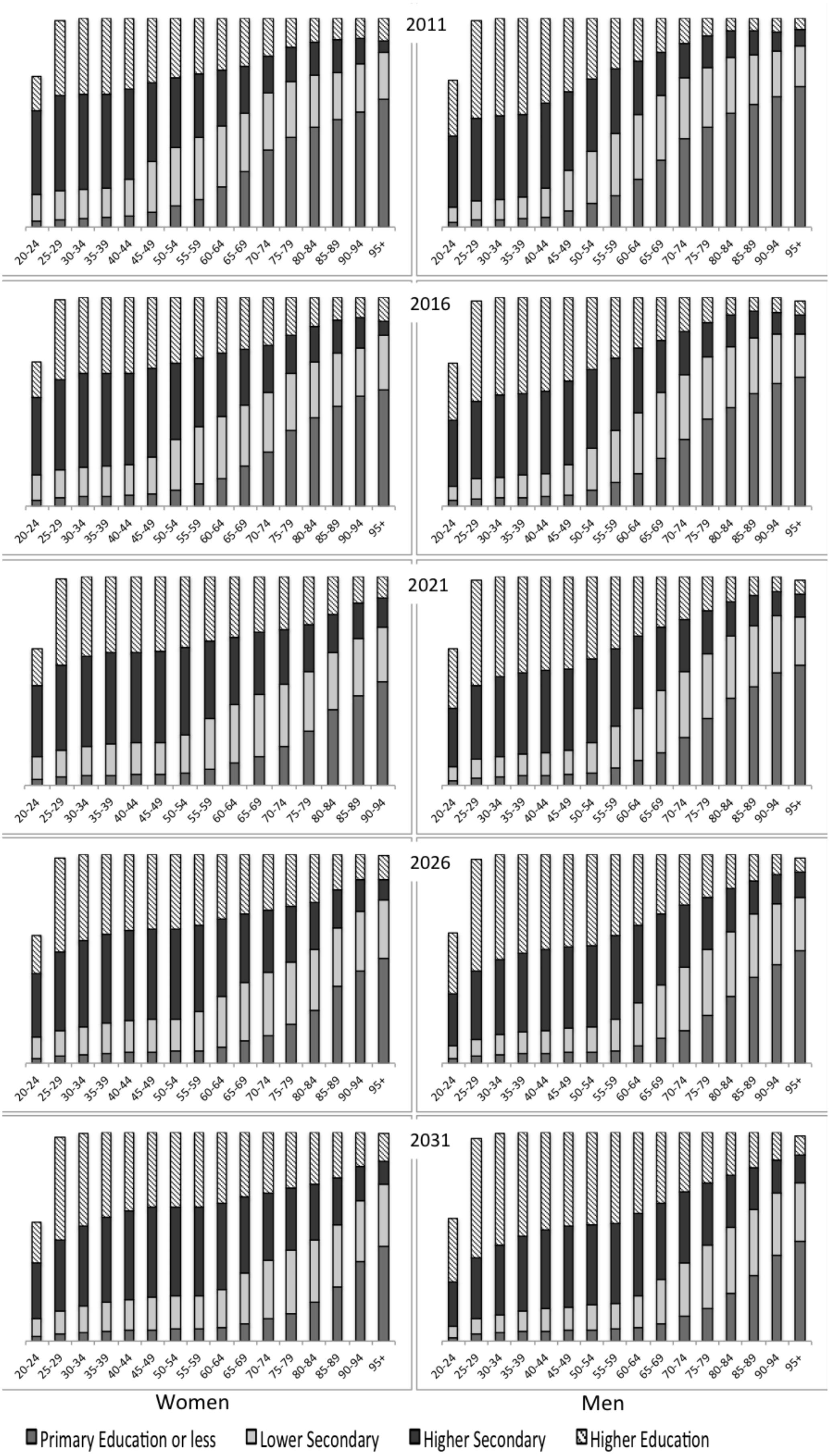
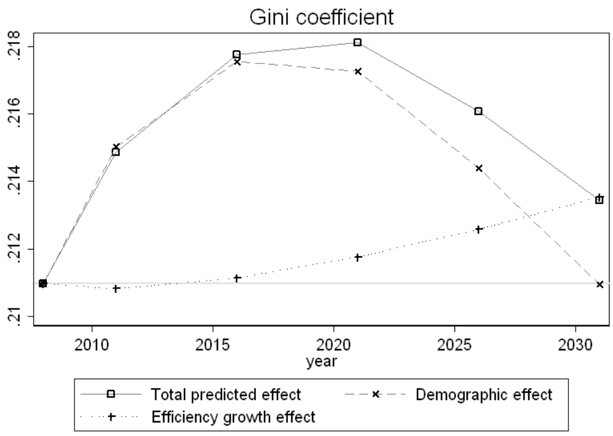
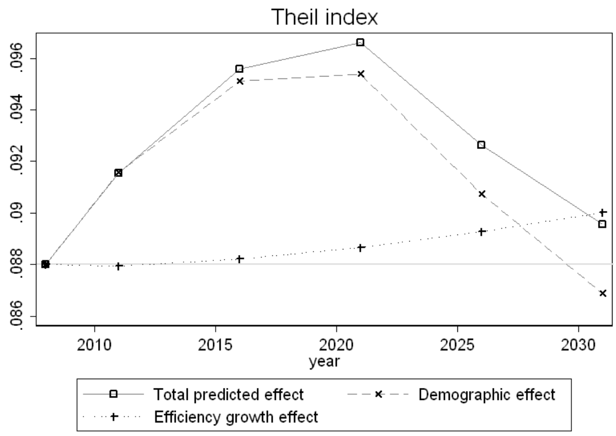


Figure 4: population and educational attainment by age and sex

the efficiency growth effect increases inequality due to the different growth rates between gross wages and the different types of benefits, we refer to refer to sub section 4.2 for a detailed analysis of the effect of demographic changes on inequality.



(a) Gini coefficient



(b) Theil index

Figure 5: Inequality indices

The projection of the poverty rate and the *AROPE* indicators are depicted in Figures 6a and 7. From 2011 onwards, both indicators steadily decrease from a maximum of about 13.5% and 10% to 11.5% and 7.3% respectively. The number of people in poverty (Figure 6b) follows a similar pattern. This is the result of a efficiency growth effect, reinforced after 2016 by a demographic effect[13]. In contrast with the poverty rate, the average poverty gap (Figure 8a) systematically *increases* from 300 € to about 340 €. In other words, despite the decrease in poverty risk, for those in poverty, the situation becomes more severe. The aggregate poverty gap, which represents the cost to eradicate poverty in Flanders, shows the pattern of the poverty rate: an initial increase followed by a decrease (Figure 8b).

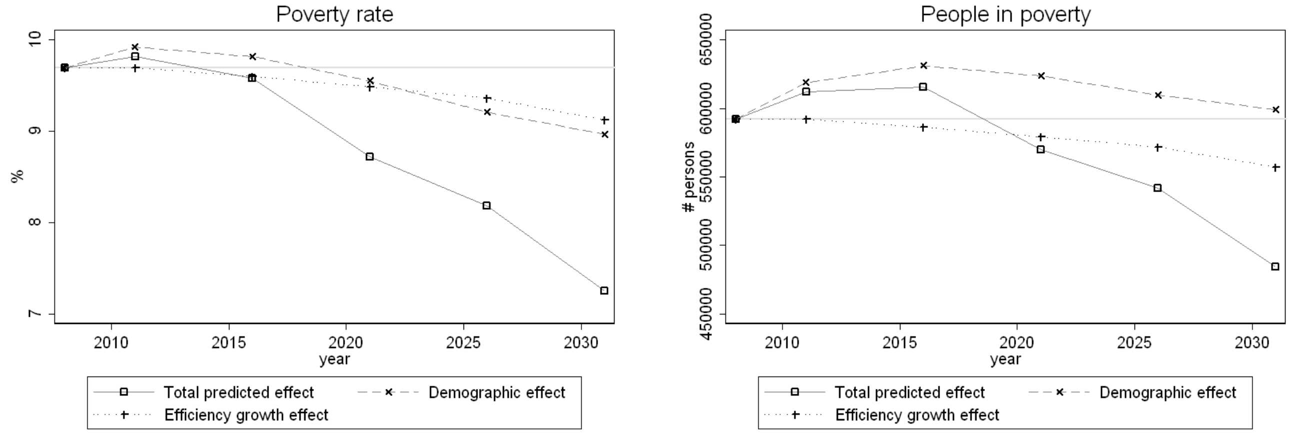
Finally, the child poverty rate and the number of children in poverty appear in Figure 9. We observe an almost constant efficiency growth effect that, combined with a monotonously increasing population-effect, results in an total predicted effect that peaks in 2016 at 8% and 83000 poor children. Afterwards, both indicators decline.

In short, inequality rises during the first decade of the projection period and decreases afterwards. Poverty as well witnesses an increase, but for a shorter period of time. Furthermore, overall inequality changes seem mostly driven by demographic factors, while the poverty evolution in addition strongly depends on the forecasted economic factors.

4.2 Understanding the effect of population change

Up till now, we established the effect of the joint forecasted population changes as compared to efficiency growth effects. In this section, we break down the population effect in order to gain

[13]Note that the joint effect is larger than the sum of the demographic and efficiency growth effect, indicating an important interaction between both evolutions



(a) Relative poverty rate (b) People in poverty

Figure 6: Overall poverty

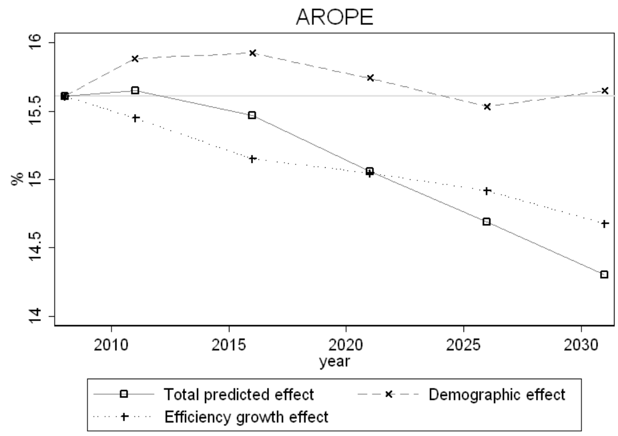
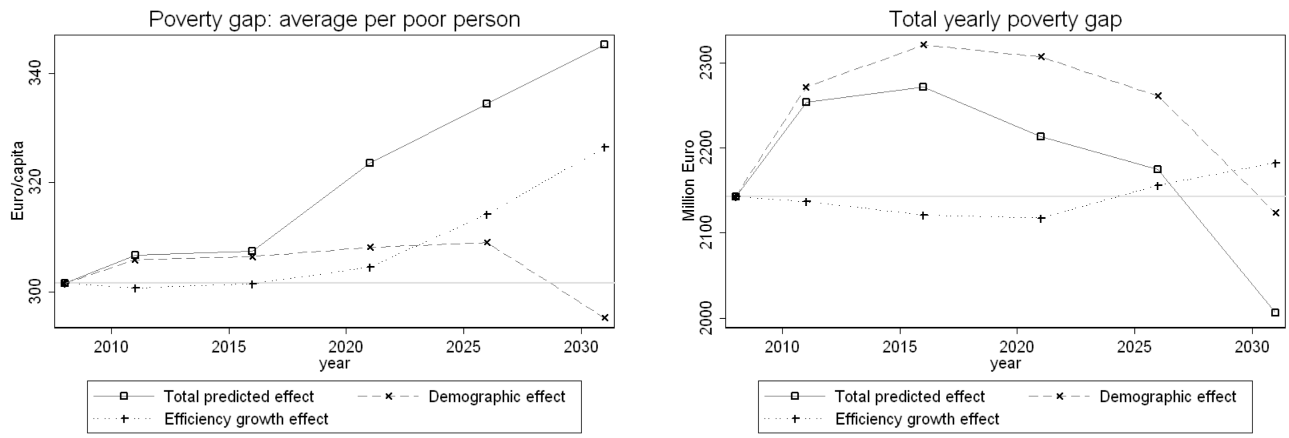
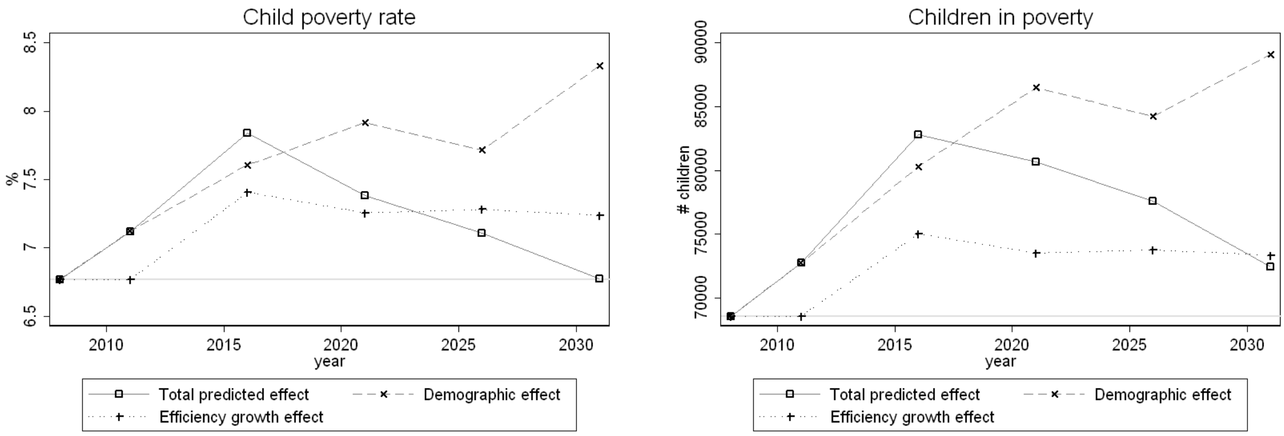


Figure 7: Percentage of the population at risk of poverty or social exclusion



(a) Monthly poverty gap per poor household (b) Total yearly poverty gap

Figure 8: Poverty gap



(a) Child poverty rate

(b) Children in poverty

Figure 9: Child poverty

insight into the way population change affects inequality. Some shifts in the prevalence of particular sub-groups described in Section 3 give some suggestions, but evolutions are intertwined and/or imply contradictory effects, rendering simple inference difficult.

Let's take first the example of ageing. On the one hand, ageing implies an increase of the population above the age of 65, frequently pensioners at the bottom of the income distribution. On the other hand, ageing also implies an increase in life expectancy, and couples´ longer survival has a positive effect on household income: in 2031, women will depend less on a widower's pension and also, with the increase in education and female labour force participation, households will often have two pensions or combine a pension with (the younger woman's) income from wages. Consequently, the effect of ageing on the income distribution is far from clear.

The same counts for the growth in educational attainment, leading in the first place to higher wages and labour force participation. Consequently, combined with assortative mating, income disparity between highly educated working couples on the one hand, and lowly educated couples with low work intensity or single headed households on the other, increases (Esping-Andersen, 2007). However, the larger the group of educated and the lower educational disparity, the smaller the role this factor will play in the determination of income inequality. In the long run, we well might expect the rise in educational attainment to temper inequality.

Figures 10-11 show the decomposition of the population effect on the evolution of the Theil index (cf. Figure 5b) by age and educational attainment (Figure 10) and by age and household position (Figure 11). This decomposition method was explained in Equation (4) of Subsection 2.4. Note that students are not included in this analysis and we also exclude the age groups below 25, over-represented among students. The left side of the figures analyses the overall inequality reduction between the beginning and the end of the projection period (2011 versus 2031) observed on Figure 5b. The right side of the figures is restricted to the period of temporal inequality increase between 2011 and 2021.

The first bar at the left depicts the change in the between-groups Theil. The other bars

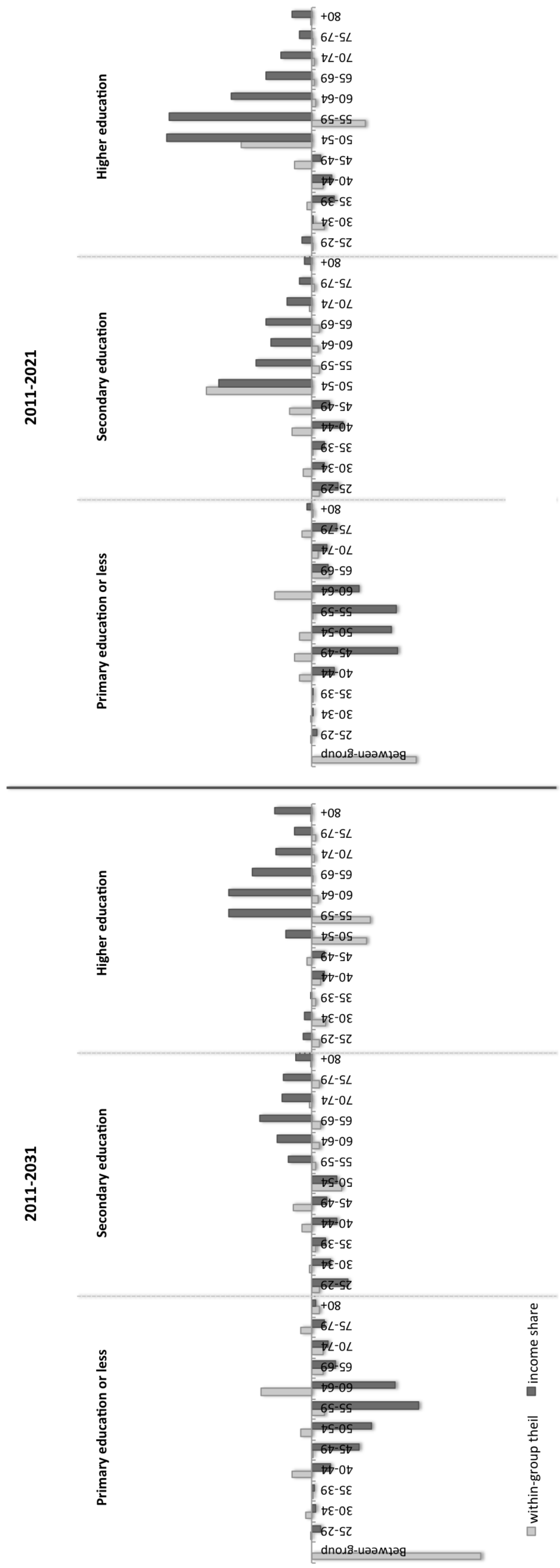


Figure 10: Decomposition of the change in Theil index by age and educational attainment

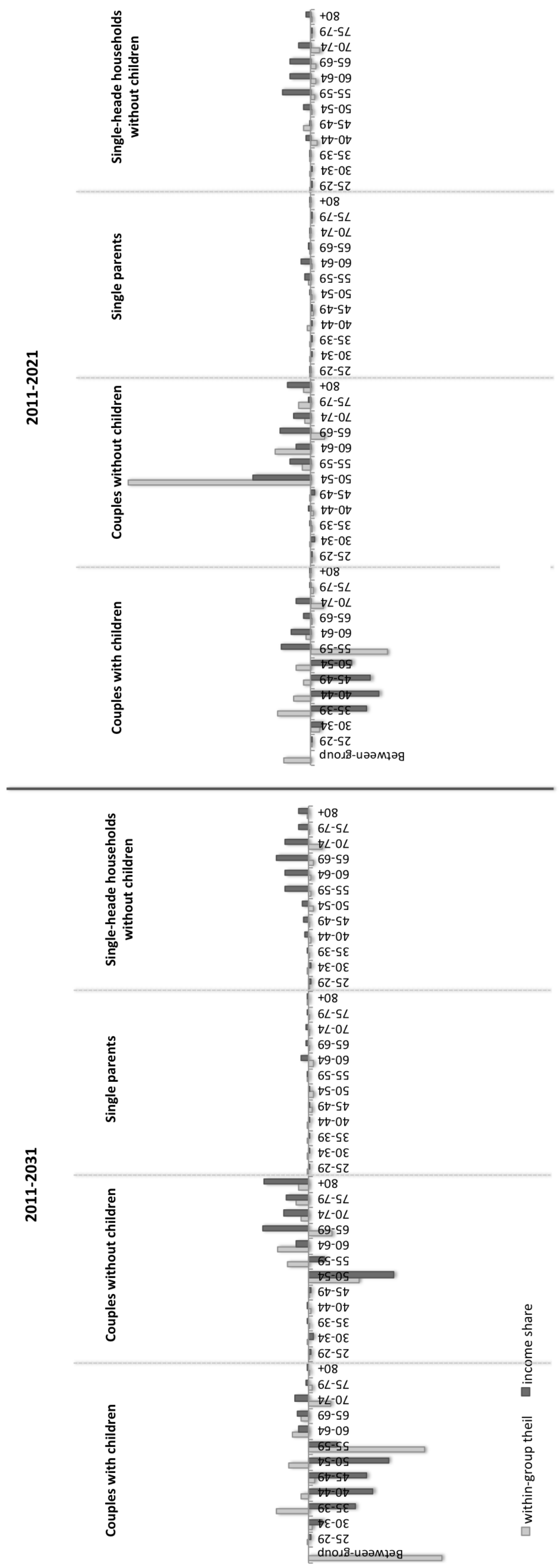


Figure 11: Decomposition of the change in Theil index by age and household position

indicate each population group's contribution to the overall inequality change. This contribution depends on the *inequality* evolution *within* each group and the group's *share* of the total population's *income,* represented in light and dark grey bars respectively (cf. Equation (4)). The size of the bar indicates the size of contribution to inequality change; upward means a positive impact, downward a negative one. Note that the income share of each group plays the most important role, while within-group shifts have mostly only modest effects. Since we work under the assumption of "no economic change", the within-group inequality change is only due to modifications in the unobserved variable composition (and the sex composition) related to the forecasted population change. Under the same assumption, it is clear that changes in the income share are largely driven by changes in the population; a change in the prevalence of a population category provokes an income share change in the same direction. This way we can directly link the results with the population change described in Section 3.

The left side of Figure 10 indicates that the overall decrease in inequality between 2011 and 2031 is due to a reduction of between-group inequality and to the decrease in income share of the population with no or only primary education. The latter process is related to the general increase in educational attainment depicted in Figure 4 in subsection 3. The reduction of between-group inequality can easily be understood through the attenuation of generational differences in education. In contrast, Figure 10 also shows that the increase of the income share of individuals over 55 with secondary or higher education, increases inequality. In other words, ageing and the subsequent growth of the elderly population increases inequality, despite their higher educational attainment. This effect is however not enough to offset the impact of the reduction in the lowest educational levels combined with the decrease in between-group inequality. The right side of Figure 10, focussing on the first part of the projection period showing a short-term increase of inequality, reveals similar subgroup influences. Nevertheless, the impact on inequality of ageing outgrows that of educational attainment growth and between-group inequality reduction. Consequently, Figure 5b showed an increase of inequality between 2011 and 2021.

Figure 11 decomposing the Theil by age and household position also reveals that the growth of the elderly population's income share positively contributes to the Theil, weather living in a couple or in single-headed households. The decrease of the adult population younger than 55 living in couples with children, has a negative impact on inequality. Note that the within-group inequality among many couples of the same age group increases, as well as the between-group inequality between 2011 and 2021. This can be understood by the fact that educational growth, especially at the beginning of the projection period, increasingly differentiates among individuals in similar household positions. This process is more evident in couples than single headed households due to larger effect of education on the income growth of double-income households. Over the total observation period, the direction of the contribution of each group's within group inequality change remains the same as during the period prior to 2021, but the impact of couples without children and single headed households is not large enough any more to counteract the effect of the changes in couples with children and the between-group inequality decrease.

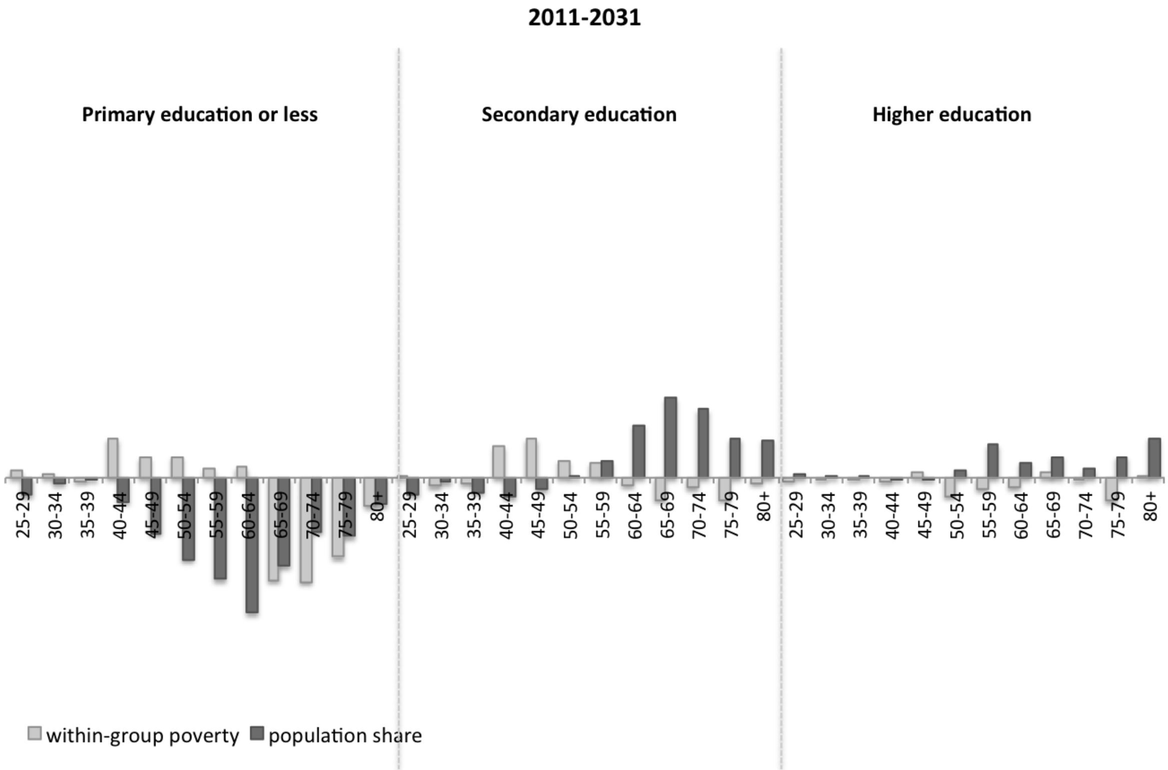


Figure 12: Decomposition of poverty change by age and educational attainment

Figures 12-13 show the decomposition of the declining poverty trend between 2011 and 2031 (cf. Figure 6a). Figure 12 refers to the decomposition by age and educational attainment; Figure 13 to the decomposition by household position. The bars indicate each population group's contribution to the overall poverty change, depending on the within-group poverty and the population share of each group, represented in light and dark grey bars respectively (cf. Equation (4)). The size of the bar indicates the size of contribution to inequality change; upward means a positive impact, downward a negative one. Note that the student population and the population below the age of 25 were excluded.

Figure 12 shows that the poverty reduction observed in Figure 6a is closely related with educational changes. The decrease of the population share with only or less than primary education contributes to a large extent to the poverty decrease witnessed between 2011 and 2031. Among the lowly educated of more advanced age, the population share change is smaller due to the ageing of the population. We observe however a prominent reduction in their poverty levels, leading to an important overall contribution to poverty reduction. At higher educational levels (secondary and higher education), ageing increases poverty, despite the decrease of poverty levels within the elderly population. Note that among younger age groups, the within-group poverty increases, except among individuals with higher education. Figure 13 shows that the reduction of poverty within the elderly population is most pronounced among couples without children, but is also witnessed among single headed households. The increase of poverty among the younger population concentrates within couples with children. The de-

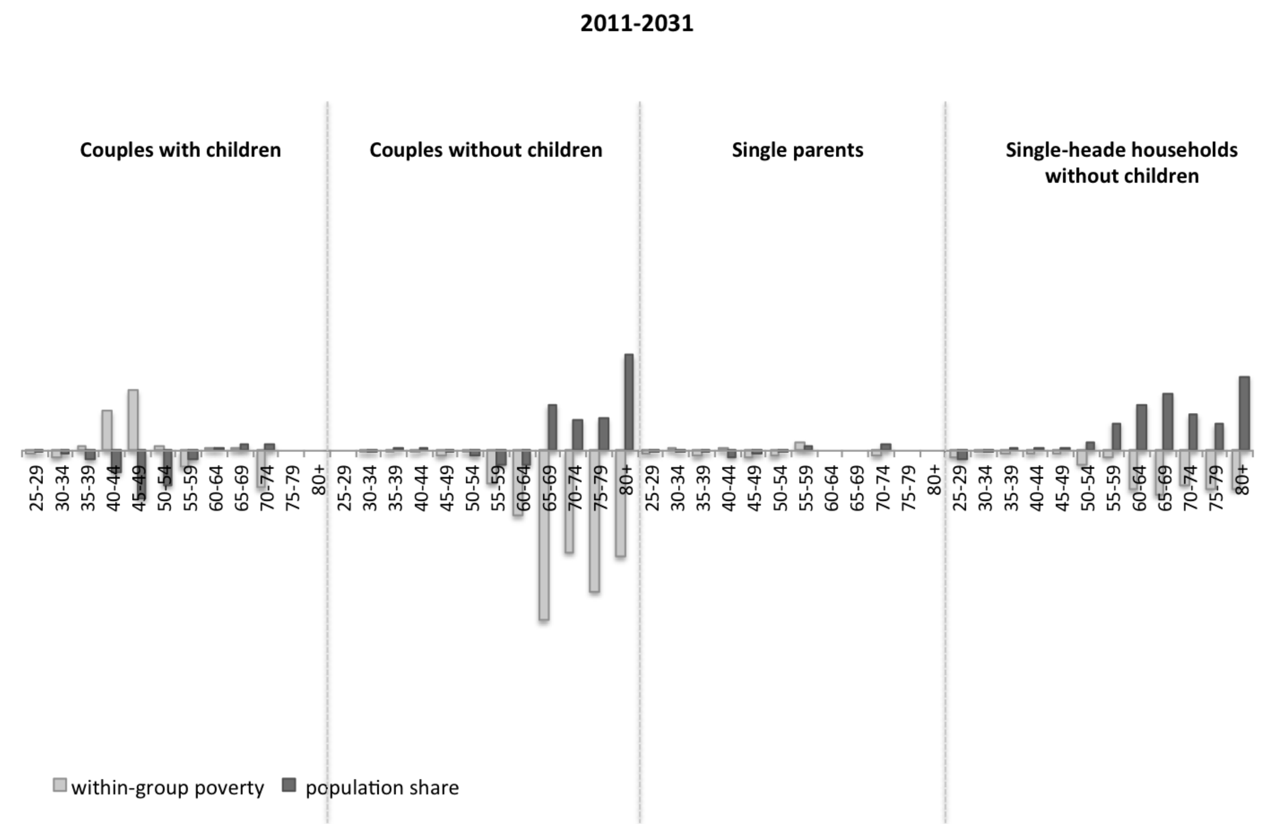


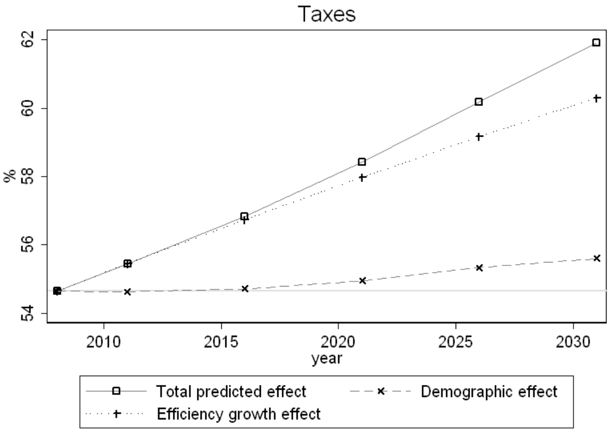
Figure 13: Decomposition of poverty change by age and household position

crease of couples without children (cf. Figure 3) counterbalances this tendency, leading to a rather modest joint effect on poverty change. Being single headed households among the lower income groups and couples without children among the higher ones, the increasing share of the former and decreasing share of the latter, also counteracts the negative evolution of the total poverty rate.

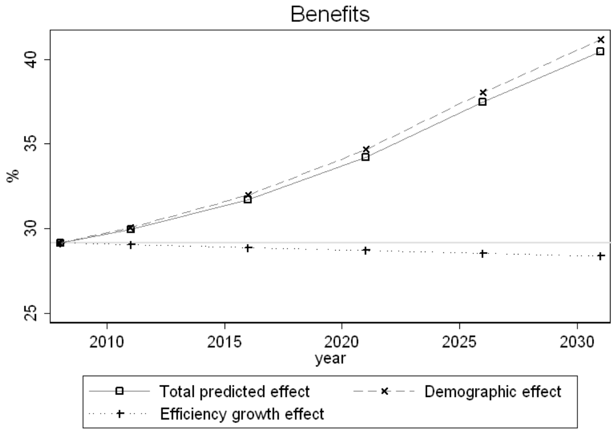
4.3 Budgetary effects

In Figure 14 we present the projected evolution of payments made *to all levels of government* and benefits received *from all levels of government* by Flemish households, expressed as a percentage of aggregated gross incomes. These numbers are generated by the *MSM* Mefisto, which models the Belgian tax-benefit system. We decompose the "total predicted effect" into an "efficiency growth effect", by increasing each individual's income, keeping the population structure identical to the 2008 structure, and a "population effect", by changing the population structure to match the population forecasts, but keeping constant individuals' income in real terms (cf. section 4).

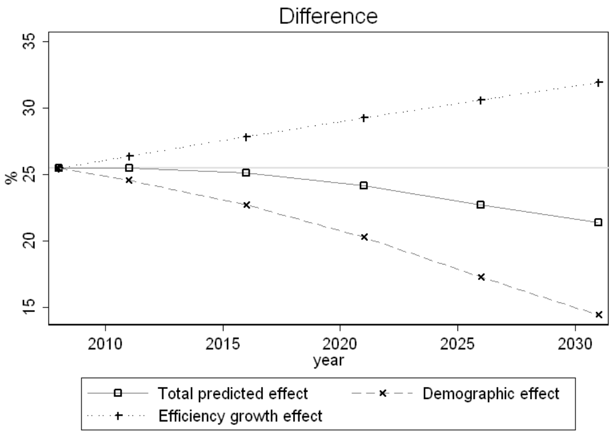
Figure 14a depicts the total tax burden, which consists of total income taxes and social security contributions. Demographic changes have only a moderate effect on the tax burden, increasing it by around 1% – frome 54.5% to 55.5% – between 2008 and 2031, again in percentage of total gross income. In contrast, the efficiency growth effect induces an almost linear increase in taxes from 54.5% in 2008 to 62% in 2031. This tax increase is mainly caused by increasing



(a) Evolution of income taxes and social security contributions as a percentage of total income



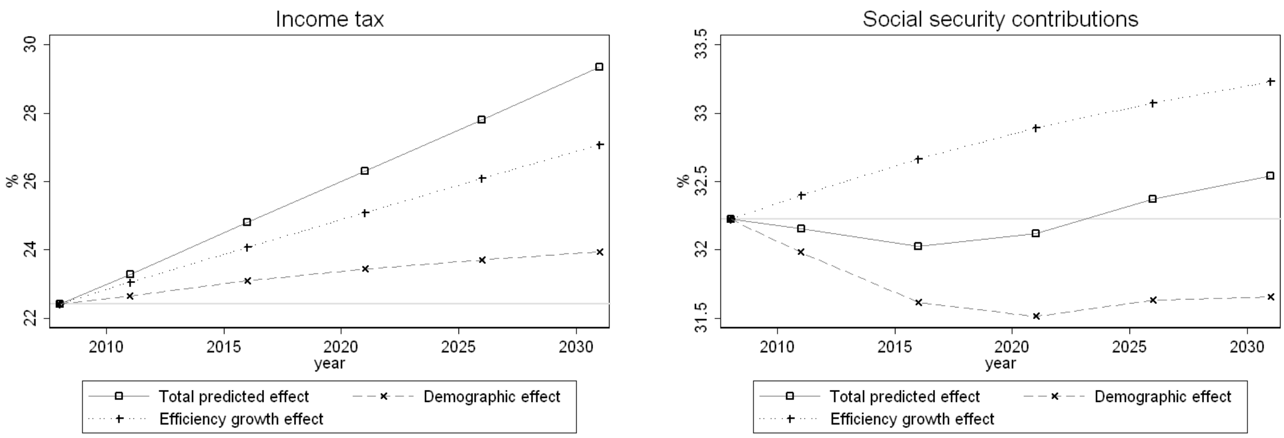
(b) Evolution of all social security payments received as a percentage of total income



(c) Net yearly payments made

Figure 14: Budgetary effects of demographic evolution and assumed growth rate.

real wages which are faced with a tax system assumed to be constant in real terms, resulting in increasing real tax rates. The evolution of the total predicted effect climbs slightly above the efficiency growth effect. Note that, in general, the total effect, measured as the difference at a certain point in time with the year 2008, is not always the sum of the two partial effects, measured similarly, but a sometimes quiet important interaction effect induces some degree of non-linearity. For example, the difference between the total predicted effect on taxes in 2031 and the horizontal line marking the level of taxes in 2008, is larger than the sum of the demographic and the efficiency growth effects in Figure 14a.



(a) Income tax

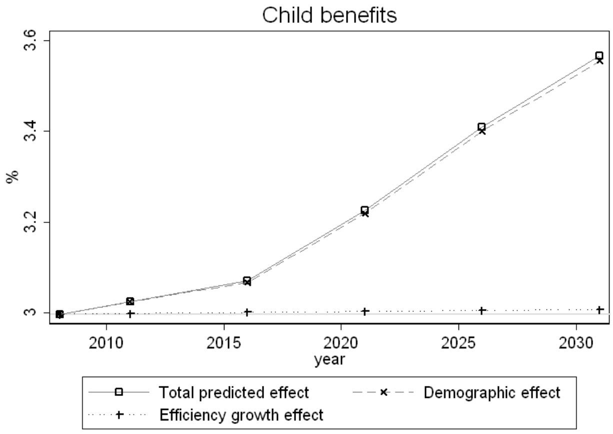
(b) Social security contributions

Figure 15: Evolution of income taxes and social security contributions

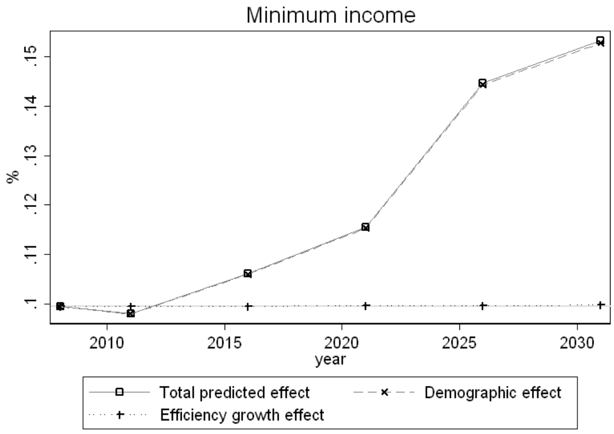
Figure 15 breaks down the total tax burden into its constituent components income tax (Figure 15a) and social security contributions (Figure 15b). Income tax is predicted to rise almost linearly from 22.5% of total gross income in 2008 to 29% in 2031. About two thirds is induced by the efficiency growth effect, while the remaining increase of one third follows mainly from the endogenous growth due to increasing educational levels. Social security contributions fall below their initial level of 32.2% of total gross income until 2021, but climb to 32.5% in 2031. This last evolution is the combined effect of a linearly increasing efficiency growth effect with a negative demographic effect, which stabilizes around −0.7% after 2021.

In Figure 14b, the dependent variable is the sum of child benefits, minimum guaranteed income, unemployment benefits and pensions (again expressed as a percentage of aggregated gross incomes). While the efficiency growth effect on total received benefits decreases with about 1%, the total increase from 29% to 40% is mainly driven by the demographic effect. Breaking down all benefits received into their four components (Figure 16), the bulk (80% of total benefits) consists of pensions, with the remainder about equally divided between child (10.3%) and unemployment benefits (9.4%) in 2008. In 2031, however, the share of pensions has increased to 85% of total benefits at the expense of the unemployment benefits (6%), and with child benefits slightly decreasing to 9% of total benefits.

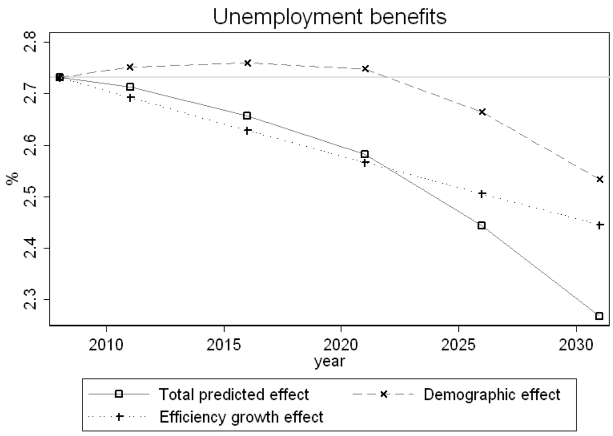
The difference between figures 14a and 14b, is given in sub-figure 14c. It could be considered as a measure of the size of government *pur sang,* i.e. that part of revenues which is not



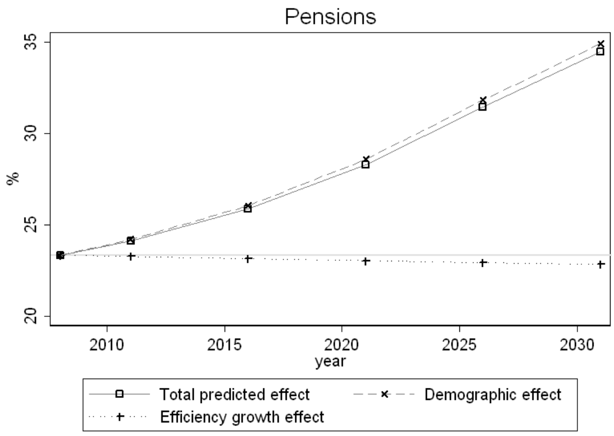
(a) Child support



(b) Minimum income



(c) Unemployment benefits



(d) Pensions

Figure 16: Evolution of different types of benefits received

redistributed right away. Here the two partial effects oppose each other, resulting in a steady decrease of the total effect from 25% to 20%. Remarkably, the total predicted size of government expenses, expressed per capita (instead of relating it to total gross income) is roughly the same in 2031 as in 2008. This means that the non-redistributive tasks of the aggregated government, such as law enforcement, infrastructure, education and health care, for example, can remain at their 2008 level, *in real terms, per capita*. In other words, under the assumed growth scenario and keeping the tax-benefit system constant *in real terms*, in twenty years time the aggregated collective sector governing the *Flemish population* will be able to provide the same level of services and collective goods per capita as today, *despite the increasing share of pensions in total income* from 23% in 2008 to 34% in 2031 (see Figure 16d).

Note that when we would consider the social security system separately, and compare benefits received (Figure 14b) with contributions made (Figure 15b), we can not help but notice that the surplus of about 3% (32.25% contributions paid by households obtained from Figure 15b minus 29.25% benefits received by households obtained from Figure 14b) in 2008, is turned into a deficit of 6.5% (32.5% contributions paid minus 39% benefits received) in 2031 (all quantities measured as percentage of aggregate gross income). This in turn could have lead us raise alarmist warnings about the sustainability of pensions. Indeed, in a *steady state*, i.e. without any demographical or other transition, any system can only be sustainable, if it complies to a budget constraint. In this respect, two remarks are in order:

1. The ageing of the population is a *transitory effect*, hence any ceteris paribus steady state reasoning seems a priori overly simplistic.

2. Notice the use of the word system, without the "social security" qualifier.
   Indeed, when considering the complete collective sector, our exercise shows that the increased income taxes ensuing from only a moderate growth will pay for the increased volume of pensions, while at the same time leaving everyone better off *in real terms*, compared to the present situation. As the population approaches a new steady state, the fraction of taxes needed to subsidize the social security system can be brought down again.

5 Changing the child benefits

Recently, some political parties started to formulate reservations regarding the actual distribution of benefits among the population. In the present child benefit system, the marginal allowance increases with the child's rank, thus encouraging more strongly larger families. This principle has been called into question and a flat rate has been advocated. In addition, some proposals increase the extra allowance given to parents with a sufficiently low income to be eligible for social assistance.

We will now not only simulate such a reform, investigating its distributional effects, but we will also evaluate the impact that the demographic evolution can have on the effects of such a policy change.

5.1 Reform

The actual reform we simulate consists of two parts:

1. A fixed base allowance of 143.5 € per child, which replaces the current age and rank-dependent allowance. This base allowance constitutes 90% of the budget for child allowances.

2. An extra allowance of 70 € per child, accorded to single parents and parents with a sufficiently low income to be eligible for social assistance.

The amounts are chosen such that the extra allowance for parents with a sufficiently low income is about 50% of the base allowance and such that the reform is *budget neutral*: the total amount spent on child benefits post-reform remains identical to the amount spent pre-reform.

5.2 Results

Figure 17 reports the fraction of winners and losers (Figure 17a) and the average net amount gained, both in absolute and relative terms (Figure 17b), per decile of the equivalized baseline income. In general, the number of winners decreases with time and the number of losers increases or stays constant. The highest fractions of losers are situated in decile 4 and 5, while the highest fraction of winners lie in deciles 6 to 8. Losers outnumber winners only in decile 4. The average net gain is close to zero or negative across the income distribution. It stays constant or decreases over time, except in decile 6. The average net gain is lowest in deciles $4-5$ and $7-8$.

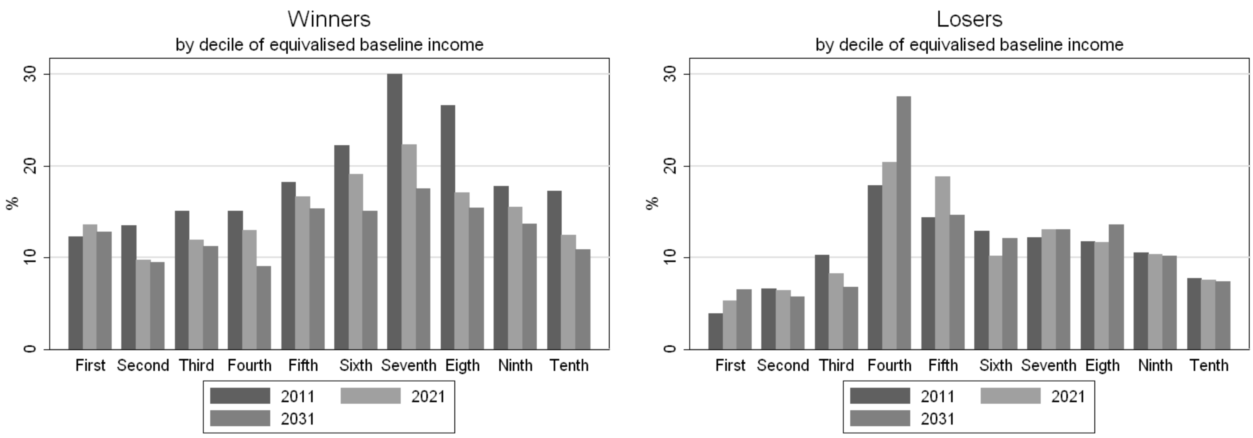
Figure 18 depicts the projected evolution of the child poverty rate and the number of children in poverty. Without policy reform, the child poverty rate would steadily decline to 6.8% in 2031, after reaching a peak of about 7.8% in 2016. The simulated reform, however, while initially causing a slight increase of the child poverty rate, has a favourable effect up to about 2020. Afterwards, the child poverty rates of baseline and reform are very close, but in 2031 the child poverty rate lies about 1% above the baseline. The evolution of the absolute number of children in poverty is similar.

Figure 19 shows the small but consistently positive effect of the policy reform on income inequality, represented by the Gini coefficient.

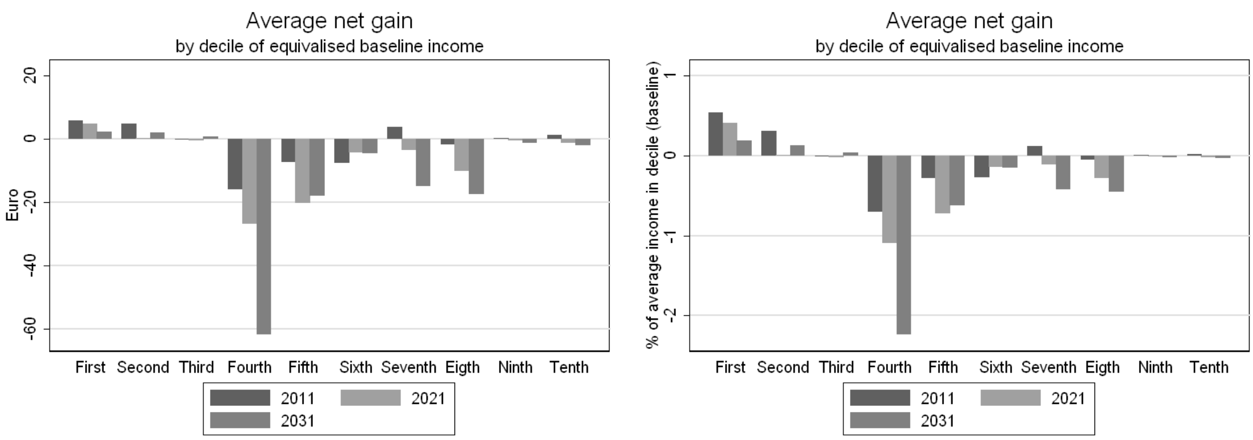
Figure (20) traces the budgetary effect of both the baseline and the reform over time. Whereas in the base-year 2008, the reform was budget-neutral by construction, it will constitute savings of about 500 million€ by 2031. This is of course another look at the same information contained in Figure 17: on average people lose by this reform.

6 Conclusions

Under the assumptions of our projections, inequality exhibits a non-monotonous pattern over time, reaching a maximum around 2020. Poverty steadily declines after 2011. Demographics

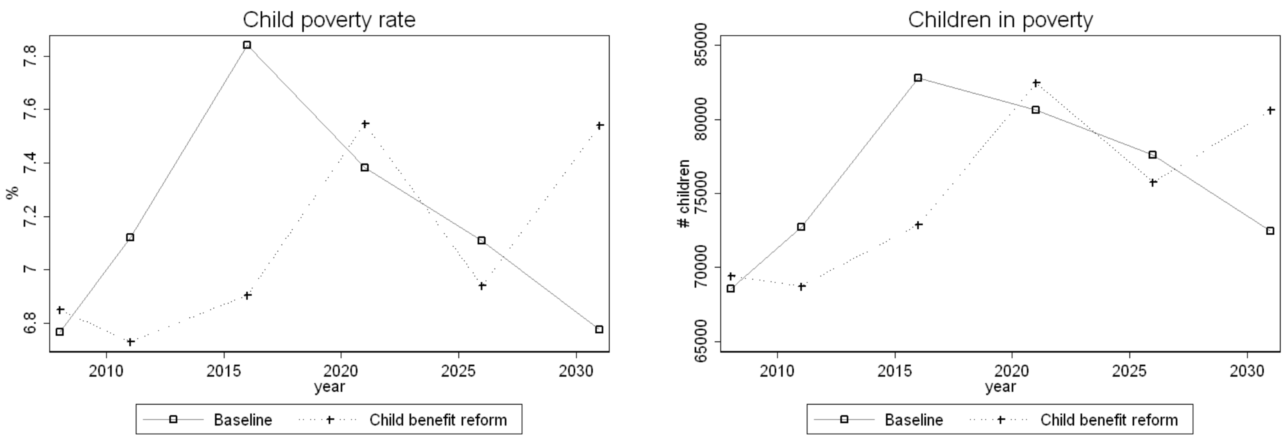


(a) The percentage of winners and losers within each income decile



(b) The average net gain per decile both in absolute terms and as a percentage of the average disposable income per decile

Figure 17: Situation of the gains and losses in the income distribution.



(a) Fraction of children $\leq 14y$ at risk of poverty. (b) Absolute number of children $\leq 14y$ at risk of poverty.

Figure 18: Projected evolution of child poverty measures.

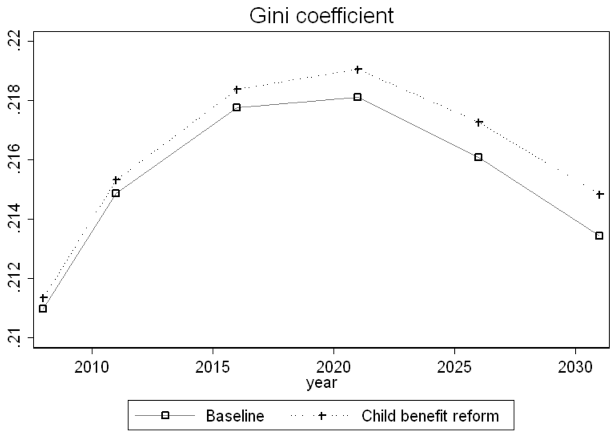


Figure 19: Projected evolution of inequality.

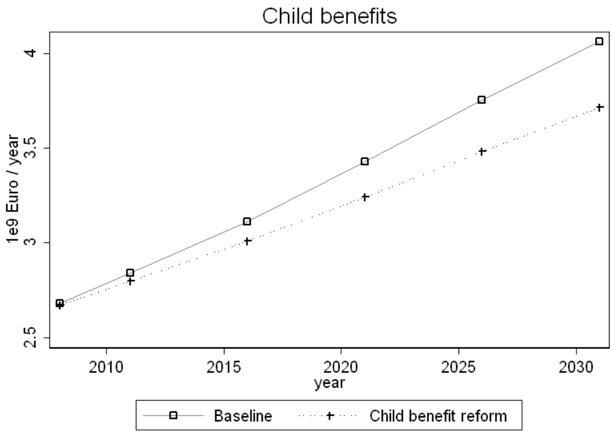


Figure 20: Total amount spent on child benefits per annum

also play a mayor role in the evolution of public finances. On the revenue side, income taxes increase from 22% to almost 30% of gross income earned by all families. This effect is caused by the tax brackets we assumed constant in real terms. On the expense side, pensions increase from 23% to 34% of gross income earned by all families. However, this spectacular increase in pension volume is completely paid by the modest growth we assume and by keeping the tax system constant in real terms. These results are obtained *without altering the retirement age, nor the level of pensions*. Which is not to say that no policy changes will be needed to keep the social security system sustainable. In particular, we made no explicit assumptions about the growth of the health benefit expenses.

Most of the observed phenomena can be understood by studying underlying demographic evolutions. The first and most important evolution, is, without any doubt, the ageing of the population, causing an increasing fraction to become pensioner and at the same time increasing inequality. A second evolution is the increasing educational level of those same ageing baby-boomers, causing incomes and participation rates of each cohort to slightly increase compared to previous ones. In addition, as the population ages, educational levels of all generations increase and the difference between generations attenuates. This effect somewhat counterbalances the ageing effect. The rest of the observed evolutions can be understood mainly in terms of relative shifts between different family types, as was analysed in detail in subsection 4.2.

The rise in inequality during the first part of the projection period is associated with an increase of between group income differences and with the increase of single-headed households to the detriment of couples without children among adults of advanced age (55-75). After 2021, these groups play a smaller role in inequality change. The decrease of couples with children tempers the inequality increase during the first period of the projection and reinforces the inequality decline related to the strong decrease of between group inequality after 2021.

The increase of single-headed households to the detriment of couples without children among adults of advanced age ($55 - 75$) increases inequality; the decrease of the prevalence of couples with children tends to decrease inequality. In section 3, it was shown that as the population ages, educational levels of all generations increase and the difference between generations attenuates. The decrease of low educational levels decreases inequality. Ageing, despite of increased educational levels of the elderly population, increases inequality.

7 Acknowledgements

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Essex. For more information on the project, see www.flemosi.be.

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A A Lipro-typology construction for *EU-SILC*

The first step of the reweighting procedure consists of knowing for each individual, its age, sex and household position. The former two variables are readily available in the *EU-SILC*; household position however is not. In this section we explain how we constructed a Lipro household typology within the *EU-SILC* dataset. The *EU-SILC* questionnaire identifies the relationships of parenthood and partnership between all household members. Figure 21 shows an extract of the Belgian *EU-SILC* questionnaire on the relationships among household members. Based on

											Indien respondent status =1	Indien data status =11	Indien type interview =5			
(1)	(2)	(3)	(RB 210) Act St 20	(RB 220) Father 21	(RB 230) Mother 22	(RB240) 23	24	25a	25b	*(RB 245)* 26	(RB 250) 27	(RB 260) 28	(RB 270) 29	(RB 030) 30	(RB 040) 31	(RB040) 32
HHM ember	Family name	First Name				Spouse	Partner	Tax Mbr	Ten laste	RespSt	DataSt	InterTyp	Proxy	*Uniek persoonnu mmer*		
1	voorgedrukt	voorgedrukt												voorg	voorg	voorg
2	voorgedrukt	voorgedrukt												voorg	voorg	voorg
3	Voorgedrukt	voorgedrukt												voorg	voorg	voorg
4	Voorgedrukt	voorgedrukt												voorge	voorge	voorge
5…20																

Figure 21: The *EU-SILC* questionnaire on relationships among household members
Note: "voorgedrukt" and "voorg" means that the information is taken directly from the National Register. The interviewer only verifies it.

information directly from the National Register, in column 2 and 3, the names of each household member are printed. In column 21 to 24, the interviewer enters the line number (column 1) corresponding to the father, mother, spouse or partner of each individual.

To assign a Lipro household position to each individual in the database, we started with the basic rules presented in Table 4. In the case of nuclear families, the application of the above rules is not problematic. In the case of extended families, additional restrictions become necessary. When the extended family involves grandparents, parents and children, the grandparents are assigned the MAR+ or UNM+ category. This implies that the second generation is classified as CMAR or CUNM and the grandchildren will be OTHR/NFR. The same rule is applied if there is only one grandparent present; the first generation is H1PA, the second C1PA and the grandchildren OTHR/NFR. This choice has implications for the population structure. Most grandparents are married couples, while this is less the case for the second generation among which consensual unions are more accepted. If we had the MAR+ of UNM+ categories to the second generation, more individuals would have been UNM+.

To verify the compatibility of the *EU-SILC* Lipro typology and the Census typology, we compare the population structure by age, sex and household position in *EU-SILC* (2008) and in the results of the population projection. The continuous lines in represent the distribution by age, sex and Lipro-household position for 2008 resulting from the weighted average of the 2006 Register data used in the projection and the projected population for 2011. The dotted lines show the distribution from the *EU-SILC* data, taking into account the original weights. Since both distributions refer to the same population, they should be identical. However, we observe some important discrepancies. In the case of children's household positions, the population distribution by age and sex in *EU-SILC* closely follows the one of the Projection (Figure 22). There are a little less C1PA children of young age and slightly more CUNM children in *EU-SILC*. Also the proportion of singles (SING) and lone parents (H1PA) seems to be slightly underestimated in the *EU-SILC* with respect to the projection, while the part of married men and women with or without children (MAR0 and MAR+) is somewhat higher (Figure 23).

The largest difference however is found among the UNM0 and UNM+ categories for which the *EU-SILC* shows a considerable larger part of the young adult population. Several processes

SING	A person is defined as SING if there is no other individual living in the household
H1PA	A person is defined as H1PA when he is identified as someone's parent and he is without partner
MAR0	A person is defined as MAR0 when he is identified as someone's partner and not as someone's parent, and when both he and his partner are currently married
MAR+	A person is defined as MAR+ when he is identified as someone's partner and as someone's parent, and when both he and his partner are currently married
UNM0	A person is defined as UNM0 when he is identified as someone's partner and not as someone's parent, and when either he or his partner are not currently married
UNM+	A person is defined as UNM+ when he is identified as someone's partner and as someone's parent, and when either he or his partner are not currently married
CMAR	A person is defined as CMAR when he identifies someone as his parent, and when both the parent and his partner are currently married
CUNM	A person is defined as CUNM when he identifies someone as his parent and when and either the parent or his partner are not currently married
C1PA	A person is defined as C1PA when he identifies someone as his parent and the parent has no partner
OTHR or NFR	All other positions
COLL	Collective households are excluded from EU-SILC

Table 4: Rules for creating a Lipro-typology in *EU-SILC*

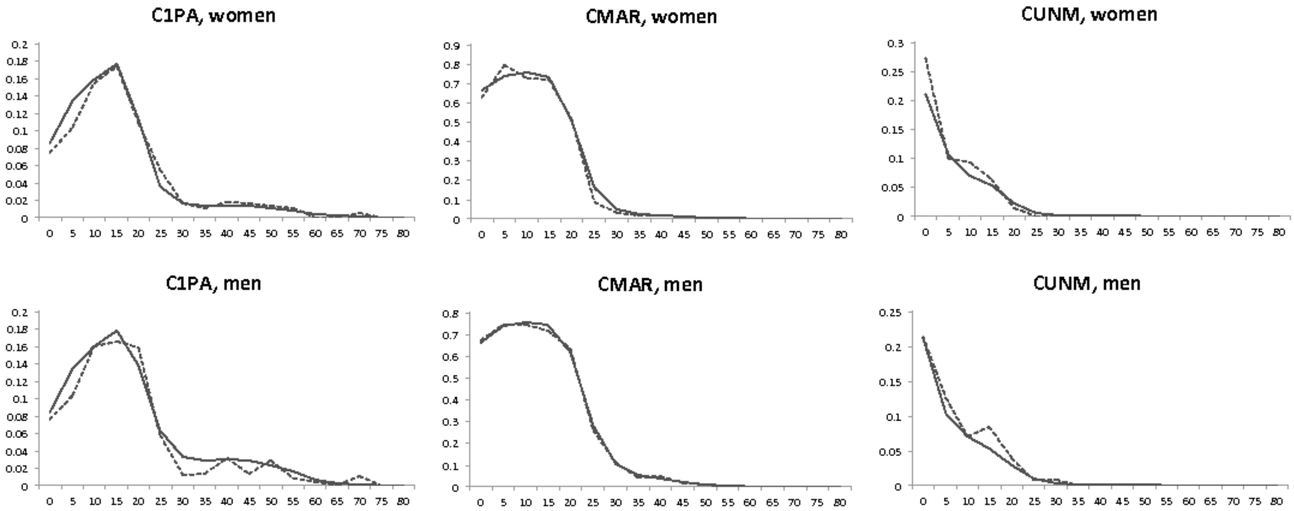

Figure 22: Comparison of the population distribution by age and sex in *EU-SILC* and the projection, SING, MAR0, MAR+.

are at the basis of these divergences. The underestimation of singles, and single parents and their children in the *EU-SILC* most probably reveals a sampling error not entirely corrected by the weights; drop-out and non-response is higher among individuals living alone (or alone with children) than among larger households. The larger proportion of UNM0 and UNM+ in *EU-SILC* than in the Projection Results is more puzzling. In the Census and Register data used for the projections, the Lipro-household position is defined using the relationship of each member with the household head. While in the *EU-SILC* data, the unmarried couple is always defined as UNM0 or UNM+, this is not the case in the Projection Results, where another member can take the role of the household head. More important yet is the absence of a clear manner to identify consensual unions in Census and Register data; when the household head is not married, no relationship is defined. To identify the UNM0 and UNM+ individuals, Deboosere et al. (2009) therefore proposed that individuals of the opposite sex and without family relation to the household head are a potential partner. However, this person should have an age difference of at least 15 years to all other non-family related members. This last restriction may lead to an underestimation of consensual unions.

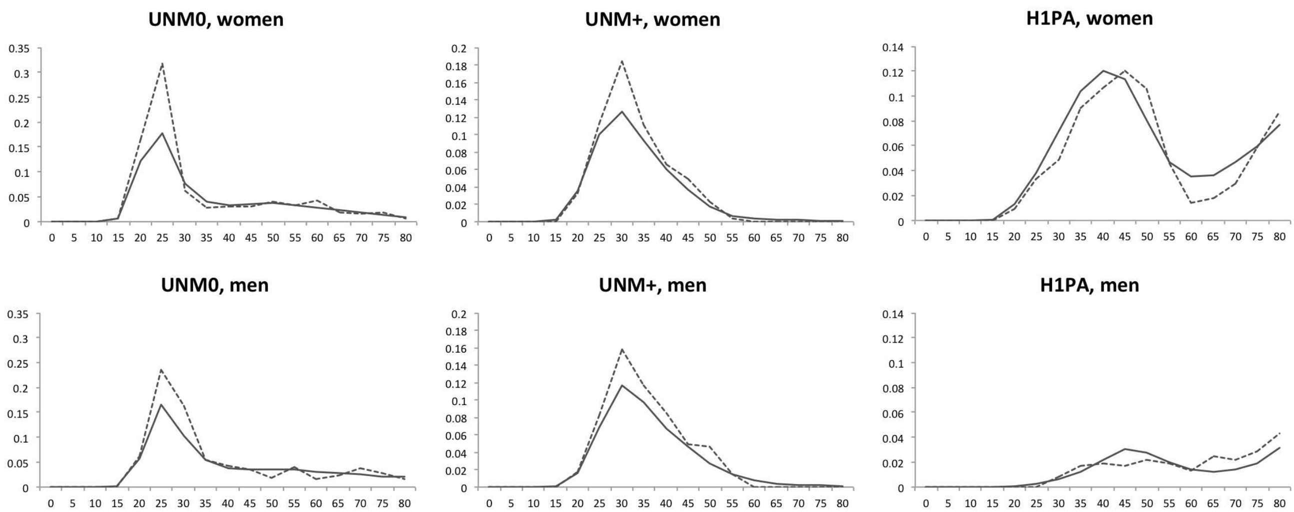

Figure 23: Comparison of the population distribution by age and sex in *EU-SILC* and the projection, UNM0, UNM+, H1PA.