
Esa Karonen¹ * and Mikko Niemelä¹
¹University of Turku, Faculty of Social Sciences, Sociology, 20014, Finland

*Corresponding author: Email: eokaro@utu.fi

Research paper draft for RC28 conference

Abstract

The paper utilizes static counterfactual microsimulation model to assess the effects of demographic and policy changes on income distribution during period of 1990-2015. Measurement periods are 1990-2002 and 2003-2015. Our empirical analyses are based on the Finnish Income Distribution Statistics (IDS), which is optimized for SISU-microsimulation model. Income data are collected from tax and other registers and the data is harmonized to be a representative sample of the Finnish population containing 820,880 observations. Our very preliminary results indicate that traditional inequality measures such as Gini-index are insufficient to draw clear sociopolitical conclusions on how demographic shift influences on income transfer system. Findings suggest that demography has a clear effect on income distribution on the level of absolute disposable income but also in at-risk-of-poverty groups and income transfers. Disposable income and at-risk-of-poverty level rises when demographic calibration is taken account. Thus, the demography indeed plays a role on income distribution, although more in depth analysis is required. From the perspective of two measurement periods, we can state that structural effects have more impact on the period of 1990-2003 while stagnation period seems to be more affected by social policy effects.
Introduction

Policy makers usually aim to forecast whether actual tax-benefit reforms have achieved their objectives in terms of income redistribution. Historical data and analysis suggest that using progressive taxation and spending as a poverty-reducing instrument has been successful to reduce or slow down levels of inequality (Alverdo et al. 2013; Doerrenberg and Peichl 2014). Thus, increasing attention has risen on simulation models to analyze redistributive impact of such measures. In large body of literature, analysts have usually identified the impact of policy changes on income distribution by decomposing inequality indices by income components and tracking what is the role of taxes or social transfers (see eg. Shorrocks 1982, 1999; Brady 2005; Cantillon et al. 2003; Fuest et al. 2010; Jäntti and Danziger 2000; Bargain 2012; Hills et. al. 2014). This assessment is usually repeated over time to capture changes in distribution before and after reforms. Tax-benefit microsimulation models are used to detangle the actual direct effect of policy change from the environmental factors, however, these simulations may be sensitive to various long-term changes in society. For example, contrafactual models do not usually take account certain structural changes in given society, which vary over time. Such major variables are demographic measures ranging from age distribution of population and employment status during economic fluctuations. Although this interaction of these two dimensions are obvious and noted on previous research, only little attention has been contributed to separate actual policy effects and demographic impact (see eg. Kangas and Ritakallio 1998; Immervoll et. al. 2005; Bargain and Callan 2007; Avram et. al. 2012; Ilmakunnas 2014).

This paper contributes to the large body of social policy research focusing on “policy vs. structure” discussion. The aim of the study is to capture the effects of income redistribution system and demographic factors on income distribution in Finland. This article contributes by answering two primary research questions:

- What role the *demographic factors* do play on the income distribution when the structural changes during 1990-2002 and 2003-2014 are attached to year 2015?
- What role *policy changes* in income redistribution system do play on the income distribution when the legislative changes during 1990-2002 and 2003-2014 are attached to year 2015?
In Europe, many economically advanced nations face the crisis of labor supply problem, which can lead a broad spectrum of adverse social and economic effects. For example, direct effect of this is major decline in fertility rates over recent decades. Implications for the welfare state are most obviously in a massive impetus to population ageing over the next century, economic shocks and migration. To frame this dilemma on more appropriate scale, it has been estimated that if current trend remains stagnant, Germany will have populations - and hence economies - only about a quarter of the size they are today during next century (see McDonald, 2000; Castles, 2004). These shifts in the demography and economic fluctuations create a need for policy changes that are bound to change income distribution amongst households, which can lead to increase or decrease of income inequality. Fiscal cost on social policy systems are bound to these externalities, which can adjusted by doing legislative changes in the income transfer system. The trial for policymaking is to distinguish how much of future demographic change itself plays a factor, and how much is effectively unpredictable, and how much can be seriously influenced through social policy. In order to understand better these individual effects, we focus on both structural and policy changes.

This study aims to improve upon previous studies in multiple ways. First, the study will assess how income distribution has developed across periodic economic fluctuations in relation to different age structures. The central interest lies in how the changes in population affect income through cohort structure dynamics. Second, this study utilizes register-based datasets with highly detailed social policy parameters on periodic level. Third, we aim to offer more holistic case by separating three important components of income inequality: demographic structure, economic fluctuations and policy changes. Both demographic and economic changes can bring direct and indirect effects on income inequality. As direct effects, demographic changes are usually seen through changing age distribution among population. Policy changes in the terms of retirement age can be seen as direct effect of policy, while economic fluctuations change the landscape of employment as indirect effect. Finally, this paper separates three concepts of income inequality mentioned above to distinct the effects of each individual factors, but also illustrates on how these affect on higher taxation-cost redistributive system, which offers comparison point on other European countries where such system is more individual oriented.

This paper is organized as follows. Section ‘Research framework and previous research’ discusses theory and historical policy changes as well as provides a brief overview of the
previous studies relevant for the study. Section ‘Data and variables’ presents the data and descriptive facts about variables related on our microsimulations that motivate the specification of the statistical models in Section ‘Description of the simulation model and demographic weighing model. Section ‘Results’ presents the empirical results of our microsimulation models on income distribution in Finland during the period between 1985 and 2015. Analyses provide illustrated graphs and tables of the estimates. Finally, section offers concluding remarks and discussion.

Research framework and previous research

During Finnish economic history, there have been multiple important changes in the economy, socioeconomic and demographic composition. This has molded the welfare state several important ways in the last decades. In addition to case of Finland, similar changes have been observed in other Western countries. Economic growth after the Second World War was quite stable in Finland until the early 1990s (see Figure 1 for GDP per capita in Finland). While Finland was a late in adapting industrial society, it did not develop as a mature industrial economy until the 1970s. One of the characteristics of “late bloomer” –status in urbanization and industrialization is major decline in the labour force of agricultural employment throughout the 20th century. In addition, since the 1980s, share of manufacturing employees has been also declining. The service sector did grown steadily, today accounting for some 60 % of the labour force (Jäntti et al. 2006). While everything did seem to go according to plan, the rapid economic growth during the late 1980s turned into major economic crisis in the early 1990s. The recession of the 1990s had a severe impact on Finnish economy where GDP declined by more than 10 % and the unemployment rate did hike up to almost 20 % (Ilmakunnas 2014). The the economic crisis of the 1990s were more severe in Finland than compared to other OECD countries.
Policy changes can be tracked over time to examining how tax expenditures and the progressivity of various components of income taxation has changed during structural changes and economic shifts. The Finnish evidence suggests that since the 1990s, changes in income inequality have been associated with the economic cycle. The period from 1990 to 1995 was the most significant shock that Finland has ever faced and has largely been considered “the great depression”. Driving forces behind growing income asymmetry are to be found in the overall changes of tax policy over time but especially policy changes made in the year 1993 did play a major contribution. Answer to the economic shock of 1990’s was to implement several cuts to the social benefit system. Even though the evolution of income inequality after 2000’s has not been as dramatic, the at-risk-of-poverty ratio did grow until 2008 (OECD 2011; Riihelä et al., 2008; Blomgren et al., 2012). Between the years 1995 to 2008 the at-risk-of-poverty ratio did grow from 7.9 percent to 14.9 percent according to calculations made from the national register of income distribution statistics. Comparing to other OECD-countries the growth of income inequality was tracked on the growing inequalities in the wages while the overall changes were less severe than in Finland (OECD, 2008).

One central factor that directs social policy planning are economic fluctuations. In Finland, the trend of income inequality since the 1960s can be divided into five periods (Blomgren et al., 2014). First, the era of welfare state expansion in the 1960s and 1970s decreased income
inequality regardless of the income concept. Second, from the mid-1970s to the economic recession of the early 1990s, market income inequality increased but, due to income transfers, gross and disposable income inequality remained constant. Third, the recession of the 1990s increased inequality in market income but not in gross and disposable income. Fourth, whereas market income inequality since the mid-1990s has been constant, inequality in gross and disposable income increased towards the early 2000s. From a comparative perspective, the increase in income inequality was exceptionally fast and steep in Finland during the period between 1990 and 2002 (OECD, 2008; OECD, 2011). Fifth, since the turn of the millennium, the development of income inequality has been rather stable. Comparing to other OECD-countries the growth of income inequality was tracked on the growing inequalities in the wages while the overall changes were less severe than in Finland (OECD, 2008).

![Figure 2. Gini-index during research measurement period, which includes the increase of income inequality and the following stagnation period.](image)

In addition to economic shocks, Finland has seen a wide range of changes in socioeconomic and demographic composition. The largest socioeconomic changes are an increase in the percentages of clerical workers and persons without any occupation and a decrease in the percentage of farmers and manual workers. Moreover, there are fewer households with two or more working adults. Overall, households are smaller than previously. Households with only one or two adults have become particularly common, and the percentage of households with multiple children has decreased. There has also been major educational expansion, where
persons with basic education has rapidly declined, while the percentage of persons with tertiary education has dramatically increased.

From the social policy perspective, the development of universal welfare programs began during 1960s (Alestalo & Uusitalo 1986). The overall involvement of the government in social protection grew in the 1980s and the compensation levels of benefits increased following years (Nordlund 2000). While Finland did mature to welfare states, there has also been major reforms in the system. For example, during 1990s and 2000s, the Finnish welfare state enacted several retrenchments (Kuivalainen & Nelson 2010), where benefits were tightened and compensation levels reduced especially during economic crisis of 1990s (Nelson 2007; Nordlund 2000). While social policy did find its optimal path, there are several challenges on the demographic horizon, which connects to target of said policies.

Recent changes in global demographic structure, including to fertility, mortality and migration, has been noted as one of the most pressing issue of our time (Gruber and Wise, 2001). As universal development in most western countries, as main event of the global demographic transition, infant mortality fell drastically during the last century and adult life expectancy increased, causing a rise of population growth. Now, economists and social policy experts alike (see Pampel and Williamson, 1989; Huber, Ragin, and Stephens, 2001; Castles, 2004), are worried about the declines in birth rates. Before this century is half over, populations in some European countries are likely to be smaller than they were in 1990, with these declines in total populations being preceded by declines in the number and proportion of people of working age (IMF, 2004; Duncan and Wilson, 2004).

Indeed, conflicting demands on the prime age population to both provide for elder care and participate in the labour market will be a challenge, with consequences for work-life balance and productivity. Meanwhile, there are arguments that economic fluctuations play more central role than demographic change. For example, James Schulz (2002, 86) has even called demographic crisis as a “hoax” while others note that these problems are to be solved by adjusting labor market participation incentives through policy changes (see Shirer, 1996; Coleman 2001). Still today, the main mechanism of the validity of this threat seems to depend on whose perspective and expertise is used as a lens to observe if the problem is more policy or economy oriented. According to OECD (2008), while using reweighting method it can be
stated that age and household’s structure changes have caused 16% of growth of inequalities during period 1986–2004.

While major policy effects are important, the role of demographic change cannot be ignored. The consequent pressures may relate to the rising incidence of the implications of low fertility, the increased labour market participation of women, and more geographically dispersed families. Increasing health, home care and pension costs of an aging population will likely have implications on public finances, with implications for social programs and intergenerational equity. In Finnish context, the amount of elderly in the population has been steadily growing which impacts on the dependency ratio seen in figure 3. The increased demand on certain social services and the diminishing of working aged population has direct stress effect on the social security system, which also influences the taxation system. Thus, there is interlink on demographic changes and the policy measures themselves.

**Figure 3.** Dependency ratio in Finland in 1970–2016
Source: OSF Population Structure. (Total)Dependency ratio = ((N of people aged 0-14 + N of aged 65 and over)/N of people aged 15-64)

This twofold approach has been an academic interest especially in the field of social policy where “structure vs. policy” has produced some empirical results. Previously before utilizing modern microsimulation models the question of income inequality has been decomposed by different weighing methods. Central idea of the method is weigh the population in the data so it represents different population structure, such as the composition in different statistical year. These methods are mainly used to observe sociodemographic effects on income distribution
and poverty. One great example of this is the study by Olli Kangas and Veli-Matti Ritakallio (1998) who used reweighing to measure poverty in different states. In addition, OECD (2008) has done similar analysis in the context of Finland. The main downside of this method is the accuracy. To differentiate on how policy effects on income in relation to other factors it would require that reweighing should be done to all variables which play a role in income distribution. This of course is not possible by the sheer magnitude of the factors.

To improve on reweighting, new models were created. Static microsimulation is a method that aims to purely focus on decomposing different causes which generate differences in taxation and income transfer systems. Usually analytical framework such as this is paired with microdata with structural information about demographics and administrative registers on market incomes which are applied with legislative parameters of social security and tax systems. Static microsimulations are usually based in contrafactual simulation method which produces annual results. This lets researcher compare income distribution changes between the original and the simulated data and pinpoint the effectiveness of tax and income transfer system. This method can be used to evaluate how great (positive or negative) the individual parameter change from the total income distribution effect is. In addition, weighing can be used in unison with simulation analysis to enhance the estimates of demography changes.

One example of previous research is the Olivier Bargain’s and Tim Callan’s (2010) study which evaluated income transference policy on 12 European countries. In addition, in Finnish context, there are several examples such as Anita Haataja (2005), Pertti Honkanen and Jussi Tervola (2014). Previous results indicate that the changes in poverty were more connected to the population socioeconomically structure rather than changes in family policy. In addition, when focused on upper and lower income deciles, the results show that legislative changes explain most of the variation in lower income classes. Although, the increase of the income inequality is mostly explained by the income growth of upper deciles which are connected to the increased capital incomes after 1990’s recession.

There are few contrafactual simulation studies that utilize population-aging methods as part of their research and reinterpreted Shapley value methods (Bargain 2012, Brewer et. al. 2004; Bargain and Callan 2007). Previous research found that there are substantial income change depending on income groups observed. Even though surge in top incomes over Europe was to a extent market driven, tax policy explains substantial part of this trend. These studies on
overall found that there is no large sensitivity to the population to evaluate policy changes, where usually social policy had more impact on incomes than population distribution. Although there are three major concerns regarding these studies. First, most of them lack proper sample size and full legislative parameters to model social policy. For example, structural changes in the population and their influence on inequality were found but the accuracy was a concern (Bargain and Callan 2007). Sample size is major contributor to volatility of results because even small adjustments on reweighing methods or policy parameters can generate unwanted fluctuations on results. Second, usually studies lack robust legal parameters for wide measurement period which usually lacks full social policy model. For example, analysis by Avram et. al. (2012) does not include cuts in-kind benefits and services on households, which hinders the ability to assess the role of social policy as whole.

Data and variables

Our empirical analyses are based on the administrative registers on Finnish Income Distribution Statistics (IDS), which is optimized for SISU-microsimulation model provided by Statistics Finland. This dataset belongs to the series of the Official Statistics of Finland (OSF). SISU variant of IDS provides data on incomes and extensive legislative parameters. The register data consist of 15% individual level sample of population during 2016 and consists of 820,880 individuals. Income data are collected from tax and other registers and are generally considered to be of high quality. The data are harmonized to be a representative sample of the Finnish population. The basic unit of analysis is individual. In addition, sample contains data on every individual who belongs on household unit chosen for the sample. The sample consists of 421,434 households units.

Our main focus is to measure direct effects on income distribution made by the legislative changes on tax and income transference system. Thus, we utilize SISU microsimulation model, that models the personal taxation and social security systems of Finland. The SISU model is a calculation tool intended for the planning, monitoring and assessing of personal taxation and social security legislation. SISU includes legislative parameters for the income tax, sickness insurance and family benefits, unemployment insurance, children home care allowance, child benefits, maternity allowance and child maintenance allowance, daycare benefits, student benefits, general housing benefits and pensioners housing benefits, social assistance
(supplementary benefit) and real estate tax. The SISU model is composed of the main model that combines the whole income transfer system, and of sub-models that can also be used independently in simulation calculations. Each sub-model thus generally contains the taxes and benefits belonging to the same legislative collection.

The SISU model can be used to calculate from unit-level data on a sample representing the whole population the overall effects of legislative amendments on different types of households as well as the whole population. A static model does not take into consideration any possible behavioral effects caused by reforms in legislation (e.g. labour supply) or long-term dynamics. A static simulation model is thus suitable for assessing the immediate and potential effects of different policy alternatives. The models are used to estimate tax revenues in the public sector, to examine the financial positions of individual persons and household units, and to study income differentials and incentive effects.

As income concept we use disposable income, which is inflation adjusted (Index of wage and salary earnings) and equivalized by modified OECD scale. In addition, we use various indicators to decompose effects of demography and social policy impact, such as income inequality index, risk-at-poverty measures and change on income transfers.

**Description of the simulation model**

We use the decomposition approach, which relies on counterfactual scenarios obtained with SISU-model. In addition, we base our simulation analysis on Oliver Bargains and Tim Callen’s (2010) inequality measuring unit. This method decomposes changes in the income distribution into policy, other and nominal effects and we extend it by decomposing the policy effect into structural change, as in demographic effects. This opens a possibility to attain a deeper understanding of the nature of policy changes but also in how (and if) simulation models are sensitive to structural variations which opens more broader discussion on the nature of reliability as supporting instrument on policy decisions. There is well-documented discussion on simulation models and economic literature, which focuses on decomposing the distribution on earnings which is not revised here (see further discussion Juhn et al 1993; DiNardo et al. 1996, Lemieux 2002, Fields 2003, Yun 2006; Fortin et al. 2011). It is also important to note that the counterfactual distributions have only a statistical interpretation and do not have any
economic meaning per se, as we have not estimated behavioral (as in dynamic) effects and responses to changes in attributes.

We decompose policy and demographic effects from income distribution, where attributes in one period are replaced sequentially with those from another period, one at the time. The counterfactuals also involve inflation adjusted monetary parameters so that nominal units would be comparable over time. The policy effect shows the direct impact of tax-benefit policy changes on the income distribution. The other effect is the impact on the income distribution from changes in the market incomes and characteristics of the population, such as population structure, age and schooling. Policy effect is assessed conditional on the population characteristics either period 0 or period 1, and the other effect conditional on the tax-benefit system in period 0 or 1. In this model inequality measuring unit \( G \) that measures the total change on decomposition of \( \Delta T \):

\[
\Delta_T = \{ G[d_u(p_u,y_u)] - G(d_t(ap_t,y_u)) \} \quad (\text{Effect of policy})
\]

\[
+ \{ G[d_t(ap_t,y_t)] - G[d_t(ap_t,ay_t)] \} \quad (\text{Effect of other variables})
\]

\[
+ \{ G[d_t(p_t,ay_t)] - G[d_t(p_u,y_t)] \} \quad (\text{Effect of unlinearity})
\]

\[
= \Delta_P + \Delta_O + \Delta_N
\]

In decomposition \( \Delta T \) operator \( t \) denotes the beginning of observation year and \( u \) is the last observation year. The legislation of the year \( i \) is denoted by the function \( d_i \) where the year \( i \) monetary parameters are denoted as value \( p_i \). The year \( i \) data is described as \( y_i \). The change in the value of money (inflation) is taken account by elevating monetary values by using parameter multiplier from year \( a \) to year \( t \) to year \( u \).

First term of equations sum (\( \Delta_P \)) is created from the contrafactual simulation where two different annual legislation parameters are used in one yearly data point. For example, one could simulate different effects of year 2001 and year 2009 on the actual data of 2016. Thus, the results would show how these two legislations would affect at the given attached data point.

On the level of sum equation, in the second term (\( \Delta_O \)) we apply same legislation parameters on the data of end of the year and after this to the data of beginning of the year where monetary values (such as income) are elevated with the parameter multiplier. The third term of this sum (\( \Delta_N \)) can be assumed as zero if the taxation system and income redistribution system is linear.
Thus, if the system is linear, the distribution of income does not change when all incomes, taxation system and income redistribution system monetary parameters are changed with the same multiplier. We can denote following:

\[ G[d_t(ap_t, ay_t)] = G[d_t(p_u, y_u)] \]

Previous and this simulation experiment indicate that Finnish tax system and income redistribution system is almost linear (Honkanen and Tervola, 2004). Thus, the change in income distribution indicators can be divided in two main components: the effects of policy change and the effects of other variables. To measure effectiveness of policy changes, we can use the sum of \( \Delta \rho \):

\[ \Delta \rho = G[d_u(p_u, y_u)] - G[d_t(ap_t, y_u)] \]

This can be stated as following: the year \( u \) data is the so called “attachment point” in which the legislative changes are applied from the end of year \( u \) and also the beginning of year \( t \). When legislation at year \( t \) is applied the monetary parameters are multiplied with value \( a \) which will take account the change in value of the money from the year \( t \) to year \( u \). From these simulations the income distribution indicator \( G \) is calculated. The effect of policy on indicator \( G \) is measured by subtracting \( \Delta \rho \) indicator.

Finally, we can derive results from the data by measuring total change in income distribution \( \Delta T \) that allows the subtracting of the other effects on income distribution:

\[ \Delta_O = \Delta_T - \Delta \rho \]

**Demographic weighing method**

For demographic weighing we utilize Calif 4.0, which is calibration method created by Statistical Office of the Slovak Republic (SO-SR, 2018). Calif package\(^1\) operates in statistical program R and is open source software. Our reweighing solution is based on calculations made in individual level data, where we used population frequencies from the population registers to

---

account demographic distributions by the factors of age, gender and education. We gathered population distribution data on age year level from 0 to 100 years. As exception, education stratification frequencies were obtained on age group level (5-year intervals), which was the most accurate available data.

We used two distance functions to obtain measures for the distance between initial and calibration weights. First, we applied linear distance functions to find exact solution for minimal deviation for the upper and lower bounds. The linear function is denoted as follows:

\[ G(r) = \frac{1}{2} (r - 1)^2 \Rightarrow F(u) = 1 + u \]

After obtaining minimal deviation for the bounded function and confirming, that average difference feasibility does not deviate too much from linearity. We run calibration on linear bounded function with user specified lower and upper bounds for \( r_k = \frac{w_k}{d_k} \). Linear bounded solution is defined as:

\[ G(r) = \begin{cases} \frac{1}{2} (r - 1)^2 & L \leq r \leq U \\ +\infty & r < L \end{cases} \]

When demographic weights are applied, we can observe differences in income distribution between data level measures and both weighted and unweighted model. Figure 4 shows standard normal density curves to illustrate how variances change between all measured levels. Result show that non-demographic model shows much smaller variance compared to data level distribution and higher average income. Instead, demographically adjusted simulation shows higher variance and lower overall average income. Thus, compared to data level, simulations without demographic weighing seems to slightly overestimate income and narrow income distribution while demographic weights seems to have slight income decreasing effect.
Results

In this chapter, we examine simulation results with and without demography-calibrated weights to compare how changes in population structure affects the income distribution compared to social policy.

Here, we have simulation level measures between first and last year of observational period. In the first measurement period $t_1$ is 1990 and $t_2$ is 2002 whereas in second measurement period contains beginning year $t_3$ as 2003 and end year $t_4$ as 2016. Model level simulation results contain socio-political effects where data level measures do not include these tax- and income transfer additions. In addition, we calculated separate results for weighted model, which include demographic effects. Finally, we decompose social policy and demographic effects from the total simulation result.

Figure 4. Standard normal density curves for simulation model with demographic weights, without weighing and data level income distribution.
Table 1. Periodical change in inequality measures and difference between weighted and non-weighted simulation model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini-index, %</td>
<td>24.97</td>
<td>24.2</td>
</tr>
<tr>
<td>At-risk-of-poverty rate, 60 %</td>
<td>9.57</td>
<td>8.5</td>
</tr>
<tr>
<td>Men in low income households, 60 %</td>
<td>9.92</td>
<td>8.8</td>
</tr>
<tr>
<td>Women in low income households, 60 %</td>
<td>9.23</td>
<td>8.21</td>
</tr>
<tr>
<td>Share of income, upper- &amp; lower 20 % (S80/S20)</td>
<td>3.41</td>
<td>3.28</td>
</tr>
</tbody>
</table>

First, we measured basic inequality and poverty measuring units between demography weighted and non-weighted models during both periods. Table 1 shows results on periodical rate and change in inequality measures using Gini-index, at-risk-of-poverty rate, men and women in low income households and share of income in upper- and lower income groups. Results show that when we take account demographic structure and educational rates, all inequality measures decrease approximately one percent between period of $t_1$ and $t_2$ while change in $t_3$ and $t_4$ shows similar – albeit smaller – decrease. Only women’s low income rates and at-risk-of-poverty rates increase slightly between $t_3$ and $t_4$.

Table 1 indicates that demographic effects lower inequality measures, which could indicate that income distribution does diversify in age group such a way that lowers income gap between individuals. Probably, this is due increased population in pensioners. It is to be noted, that this is to be interpreted in the context of simulation analysis. It is likely that contrafactual analysis attached to original non-weighted static demography is cause of biased results whereas demographic weighing will compensate this effect. Although, this is far cry from causal modeling of such effect but it shows the importance of changing structure. Policy is always relational to the structural composition of its users: shift in demography will show itself as users of dictated policies.

Table 2. Disposable individual income decomposition over income transfers before and after demographic weights simulation model, in euros

<table>
<thead>
<tr>
<th>Year</th>
<th>Residual DII</th>
<th>Income transfers On DHI</th>
<th>Income transfers Demographic change</th>
<th>Demographic Weight on DHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>6092</td>
<td>6506</td>
<td>316</td>
<td>2472</td>
</tr>
<tr>
<td>2002</td>
<td>11440</td>
<td>4385</td>
<td>345</td>
<td>1492</td>
</tr>
<tr>
<td>2003</td>
<td>11745</td>
<td>4482</td>
<td>286</td>
<td>1282</td>
</tr>
<tr>
<td>2016</td>
<td>11440</td>
<td>3668</td>
<td>706</td>
<td>2919</td>
</tr>
</tbody>
</table>
Table 2 shows decomposition of disposable income by income transfers, transfers due
demographic effect and demographic effect in absolute incomes. In addition, in figure 5 we
provide relative measures of this decomposition. Between measurement periods we can
observe overall mean income growth and drop in the share of income transfers. In addition,
demography seems to play important role on income distribution as its effects are more major
than the effect on income transfers themselves after demographic weighing.

Figure 5. Absolute and relative disposable individual income decomposition over income
transfers before and after demographic weights simulation model, in euros and percentages.

More in-depth analysis on income distribution is shown on table 3 and in figure 6. Here we
measured income deciles and periodical change with percentage point difference between
weighed and unweighted model. Overall, it seems that demographic model increases income
in all deciles but lowest and during $t_3$ and $t_4$ $10^{th}$ decile shows almost uniform income
movement in both models. Curiously, during $t_3$ and $t_4$ income seems to lower in the model
without demographic weighing taken account.
Table 3. Periodical change in relative disposable household income over income deciles and difference between weighted and non-weighted simulation model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.97 %</td>
<td>-9.67 %</td>
<td>-6.69 %</td>
</tr>
<tr>
<td>2</td>
<td>1.61 %</td>
<td>-3.47 %</td>
<td>1.85 %</td>
</tr>
<tr>
<td>3</td>
<td>4.99 %</td>
<td>-0.38 %</td>
<td>4.61 %</td>
</tr>
<tr>
<td>4</td>
<td>2.71 %</td>
<td>1.37 %</td>
<td>-1.34 %</td>
</tr>
<tr>
<td>5</td>
<td>0.95 %</td>
<td>3.09 %</td>
<td>2.14 %</td>
</tr>
<tr>
<td>6</td>
<td>1.40 %</td>
<td>4.60 %</td>
<td>3.20 %</td>
</tr>
<tr>
<td>7</td>
<td>1.44 %</td>
<td>5.28 %</td>
<td>3.84 %</td>
</tr>
<tr>
<td>8</td>
<td>1.22 %</td>
<td>6.29 %</td>
<td>5.06 %</td>
</tr>
<tr>
<td>9</td>
<td>1.72 %</td>
<td>7.54 %</td>
<td>5.82 %</td>
</tr>
<tr>
<td>10</td>
<td>-1.77 %</td>
<td>7.12 %</td>
<td>8.89 %</td>
</tr>
</tbody>
</table>

Overall, results show that simulation without calibration tends to underestimate total income level. This applies to all measurement points, where individual income level is approximately 7-17 percentages lower than without calibration. Most interesting change in overall income trajectory between measurement points happens in the second period. We can observe income decrease between measurement points $t_3$ and $t_4$, where income has decreased compared to model with calibration. This is could be due demographic shift after 2008 shown in figure 2. There has been influx of people transitioning outside of the labour market to retirement, which is logical cause of decreased income between this time segments.
Table 4. Periodical change in relative disposable household income over age groups and difference between weighted and non-weighted simulation model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0-24</td>
<td>6.97%</td>
<td>3.32%</td>
<td>-3.64%</td>
<td>6.55%</td>
<td>2.99%</td>
<td>-3.56%</td>
</tr>
<tr>
<td>25-34</td>
<td>5.12%</td>
<td>2.44%</td>
<td>-2.68%</td>
<td>15.68%</td>
<td>4.49%</td>
<td>-11.19%</td>
</tr>
<tr>
<td>35-44</td>
<td>6.26%</td>
<td>2.45%</td>
<td>-3.81%</td>
<td>12.87%</td>
<td>5.54%</td>
<td>-7.34%</td>
</tr>
<tr>
<td>45-54</td>
<td>6.02%</td>
<td>2.30%</td>
<td>-3.72%</td>
<td>21.05%</td>
<td>7.37%</td>
<td>-13.69%</td>
</tr>
<tr>
<td>55-64</td>
<td>7.61%</td>
<td>-0.08%</td>
<td>-7.69%</td>
<td>22.39%</td>
<td>7.75%</td>
<td>-14.64%</td>
</tr>
<tr>
<td>65-74</td>
<td>1.70%</td>
<td>-3.94%</td>
<td>-5.64%</td>
<td>8.68%</td>
<td>9.06%</td>
<td>0.39%</td>
</tr>
</tbody>
</table>

This observation is measured in table 4, which shows periodical change in relative disposable income over age. Same results are shown also in figure 8.

Figure 8. Periodical change in relative disposable household income over age groups and difference between weighted and non-weighted simulation model

Results show that model without demographic weights tend to overestimate periodical income increase while weighed model – especially during $t_3$ and $t_4$ – show more restraint on income development. Overall, results indicate natural progression on income during age and improved status during longer careers, but in contrast, demographic weighing model shows income decrease between $t_1$ and $t_2$ on 65-74 age group. Latter could be intrepid as a transition period into retirement and related policy measures or lower average retirement age.
Conclusion

The main objective of this study was to capture the effects of income redistribution system and demographic factors on income distribution in Finland.

Central problem with demographic projections what local authorities do, is that they are traditionally trend-based. Reports continue focusing into the future the patterns of recent demographic change. They are said to be free of assumptions about policy, but on the contrary they assume that any impact which policy has had on the recent past will continue into the future. With simulation models, it is always wise to be critical on results. Simulations are always estimations, not straightforward facts. Then again, static models provide direct mechanical effects of system “as it is”. This brings certain advantage in its simplicity if researchers understand what models can and cannot explain. By comparison, dynamic models are forced to take account human behavior, which translates rather roughly as part of the models. In this study, we limit our conclusions on direct effects (as in mechanical socio-political fiscal impacts) on income distribution and thus do not take any stand on behavioral effects. Still, it is important to continue work on dynamic models.

Many of the changes in Europe’s future demographic and policy environment will hinge on the issue of population aging, resulting in wide-ranging implications for society. An aging population will likely cause a tightening of labour supply, affecting economic growth. Conflicting demands on the prime age population to both provide for elder care and participate in the labour market will be a challenge, with consequences for work-life balance and productivity. Increasing health, home care and pension costs of an aging population will likely have implications on public finances, with implications for social programs and intergenerational equity.

As our research did partially illustrate (at this preliminary stage), while microsimulation models are widely used in policy making, they should include population weighing to enrichen the understanding on how population structure affects in policy, and vice versa.
References


