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A Generational Accounting Analysis of Sweden*

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Abstract

Generational Accounts measure the fiscal sustainability of the public sector. We ask whether the Swedish demographic development leads to an unsustainable situation and which effect the highly praised pension reform has on the intertemporal condition of public coffers. Our results show firstly that the demographic changes alone cause significant intertemporal imbalances. Secondly, we demonstrate that the pension reform has a substantial effect and eliminates nearly the whole intertemporal public liabilities. In comparison to Germany and Norway which both adapted pension reforms as well the Swedish public finances seem in a much better state. However, this outcome comes with the price of a significantly low pension benefit ratio in the future.

1 Introduction

When it comes to the fiscal consequences of the demographic development in member countries of the Organization of Economic Co-operation and Development (OECD), most people think of pay-as-you-go financed public pension systems and the associated problems of the double-ageing process most countries face. Since the 1980s the academic community has published in relation to these problems in various strands. At the beginning of the 21st century politicians reacted as well, leading to certain reforms of the retirement schemes in countries such as Austria, France, Germany and Switzerland. Sweden, however, began to reform its pension scheme already in the mid 1990s. The question is whether this reform (and certain smaller ones during the last decade) were enough for Sweden's public finances to reach a really sustainable path.

This report aims to measure the sustainability of Sweden's public coffers via the method of *Generational Accounting*. Therefore, we introduce the method of *Generational Accounting* and discuss its advantages and shortcomings in section 2. We then present the necessary data for Sweden in the selected base year 2009 and present the development of the Swedish population given three different scenarios (see section 3). Based on these data, we can derive *Generational Accounts* and corresponding fiscal sustainability indicators for the Swedish general government pre and post the pension reform of 1994. The Swedish pension reform replaced a typical defined benefit system with a pay-as-you-go notionally defined contribution system. However, the phasing-in of this reform is still going on, which necessitates a very detailed model covering the transition process. We conclude the section with a thorough sensitivity analysis of central parameters like the growth and discount rates and different population projections. Furthermore, we show how the sustainability of Sweden's fiscal system would be affected if the pension reform not only changes the retirement benefit structure but also encourage people to work longer. We then conclude the report with a brief international comparison of the results in respect to Norway and Germany in section 5.

2 Methods and General Assumptions

Generational Accounting is a well-recognized concept to answer questions about a country's fiscal sustainability and its intergenerational balance or imbalance.[1] The background to its development was that Auerbach, Gokhale and Kotlikoff (1991, 1992 and 1994) sought to illustrate the effects of intergenerational policy. Nearly every piece of legislation affects not only living, but future generations as well. In the following, we provide a detailed overview of the concept of *Generational Accounting* with three subsections covering the mathematical and statistical background of the methodology, a critical discussion of the concept, and a brief literature survey about studies using a *Generational Accounting* framework. The subsequent section explores a demographic framework based on the idea of *Generational Accounting* in order to measure how much of the increase in public health care expenditure can be assigned to demographics and how much to an increase in benefit levels. In the last part of this section we provide some evidence as to why the direct impact of rising life expectancy on public health expenditure, a hotly debated academic topic, is not of significant importance for our analysis.

2.1 Generational Accounting – Methodology

To measure the sustainability of a country's public sector we use the method of *Generational Accounting* developed by Auerbach, Gokhale and Kotlikoff (1991, 1992 and 1994). In contrast to traditional budget indicators based on annual cash flow budgets, *Generational Accounting* is founded on the intertemporal budget constraint, and therefore the long-term implications of a current policy can be computed.[2] The intertemporal budget constraint of the public sector, expressed in present value terms of a base year b is:

$$B_b = \sum_{k=b}^{b-D} N_{b,k} + \sum_{k=b+1}^{\infty} N_{b,k} \,. \tag{1}$$

Let D denote agents' maximum age and $N_{b,k}$ the present value of year *b*'s net tax payments, i.e. taxes paid net of transfers received by all members of a generation born in year k over the remaining lifecycle. Then, the first right-hand term of equation (1) represents aggregate net taxes of all generations alive in the base year b. The second term aggregates the net tax payments made by future generations born in year $b+1$ or later. Together this is equal to the left-hand side of equation (1), B_b, which stands for net debt in year b. That means if the sum of all living generations' net taxes, $\sum_{k=b}^{b-D} N_{b,k}$, is negative (i.e. if they receive a net transfer) the sum of future generations' net taxes has to be positive to balance the government's intertemporal budget. In other words, in a long-term perspective net transfers received by living generations plus the net

[1] For an overview of the history of fiscal sustainability and methods to measure it, see Besendorfer (2010).
[2] The further description of the methodology of *Generational Accounting* is mainly based on Raffelhüschen (1999a) and Bonin (2001). For an analytical derivation of the intertemporal budget constraint see Benz and Fetzer (2006) or Fetzer (2006).

debt of the base year have to be financed by net taxes paid by future generations.

To calculate generations' aggregated lifecycle net tax payments, the net payment terms in equation (1) are decomposed into:

$$(2) \qquad N_{b,k} = \sum_{s=\max\{b,k\}}^{k+D} T_{s,k} \; P_{s,k} \; (1+r)^{b-s} \; .$$

$T_{s,k}$ denotes the average net tax paid in year s by a representative member of the generation born in year k, whereas $P_{s,k}$ stands for the number of members of a generation born in year k who survive until year s. In order to compute the remaining lifetime net payments of living generations, the future demographic structure is specified conducting long-term population forecasts.

Typically, *Generational Accountants* disaggregate equation (2) even further. To incorporate gender-specific differences in average tax payments and transfer receipts by age, separate aggregation of the average net taxes paid by male and female cohort members is required. The products aggregated in equation (2) represent the net taxes paid by all members of generation k in year s. For generations born prior to the base year the summation starts in year *b*, while for future born cohorts, the summation starts in year $k > b$. Irrespective of the year of birth, all payments are discounted back to the base year b by application of a real interest rate r.

The age-specific net tax payment in year s of agents born in year k can be rewritten as

$$(3) \qquad T_{s,k} = \sum_i h_{s,k,i} \; ,$$

where $h_{s,k,i}$ stands for the average tax or transfer of type i paid or received in year s by agents born in year k, thus of age $s-k$. In equation (3), $h > 0$ indicates a tax payment, whereas $h < 0$ denotes a transfer.

Applying the method of *Generational Accounting* it is conventionally assumed that initial fiscal policy and economic behavior are constant over time. Under this condition it is possible to project future average tax payments and transfer receipts per capita from base-year's age profile of payments according to

$$(4) \qquad h_{s,k,i} = h_{b,b-(s-k),i} \; (1+g)^{s-b} \; ,$$

where *g* represents the annual rate of productivity growth. Equation (4) assigns to each agent of age *s-k* in year *s* the tax and transfer payment observed for agents of the same age in base year *b*, uprated for gains in productivity. The base-year cross section of age-specific tax and transfer payments per capita is generally determined in two steps. First, the relative position of age cohorts in the tax and transfer system is estimated from micro-data profiles. In a second

step the relative age profiles are re-evaluated proportionally to fit the expenditure and tax revenues of the base year.

For living and future generations, division of the aggregate remaining lifetime net tax payments by the number of cohort members alive in year *s* yields the cohort's *Generational Account* in year *s*:

$$GA_{s,k} = \frac{N_{s,k}}{P_{s,k}} \quad . \tag{5}$$

Generational Accounts are constructed in a purely forward-looking manner; only the taxes paid and the transfers received in or after the base year are considered. As a consequence, *Generational Accounts* cannot be compared across living generations because they incorporate effects of differential lifetime. One may compare, however, *Generational Accounts* of base-year and future-born agents who are observed over their entire lifecycle, respectively.

To illustrate the fiscal burden of current fiscal policy we use seven sustainability indicators:[3] The starting point for these indicators are the *intertemporal public liabilities* that can be computed by the assumption that the intertemporal budget constraint of the public sector (1) is violated:

$$IPL_b = B_b - \sum_{k=b-D}^{\infty} N_{b,k} \; . \tag{6}$$

The amount of *intertemporal public liabilities* measures aggregate unfunded claims on future budgets, assuming that the present policy will hold for the future. The first sustainability indicator, the *fiscal gap* (FG_b), can be derived by setting the *intertemporal public liabilities* in relation to base-year GDP (GDP_b). This indicator is akin to the debt quota well known since the Maastricht treaty but it addresses the debt which will occur in the future and in the past:

$$FG_b = \frac{IPL_b}{GDP_b}. \tag{7}$$

It is uncertain how the policy adjustment required to redeem *intertemporal public liabilities* will affect generations' fiscal burdens. For illustrative purposes, *Generational Accounting* typically assigns the entire adjustment to future generations, which is equivalent to $k > b$. All tax payments made by members of future born cohorts are adjusted proportionally with the help of a uniform scaling factor θ. The factor θ is set to ensure balance the intertemporal public budget as defined in equation (1). The expression

$$h_{s,k,i} = \theta \times h_{b,b-(s-k),i} \left(1+g\right)^{s-b} \tag{8}$$

[3] For a discussion of measuring fiscal sustainability and the development of sustainability indicators, see Raffelhüschen (1999a) and Benz and Fetzer (2006).

replaces equation (4). Computing the average age-specific net taxes paid by representative future born agents, the burden for future generations can be illustrated as an absolute difference between the *Generational Account* of the base-year agent and the *Generational Account* of the agent born one year later. This is our second sustainability indicator, the *future generations' burden*.

The third indicator illustrating the burden from current fiscal policy is the *revenue gap*. In this case the scaling factor in equation (8) is $\theta = \theta_{rev}$ and reflects the necessary enhancement of age-specific revenues for all generations to close the intertemporal public budget constraint. It can also be interpreted as the ratio of *intertemporal public liabilities* to the present value of all age-specific revenues of the fiscal system:

$$\theta_{rev} = \frac{IPL_b}{\sum_{s=b}^{\infty} Rev_s \cdot \frac{1}{(1+r)^{(s-b)}}}, \tag{9}$$

with Rev_s referring to the sum of revenues in year s from all living generations in year s. Analogous to the *revenue gap*, we compute the so-called *transfer gap*. In this case the scaling factor $q = q_{trf}$ reflects the necessary cutback (in percent) of age-specific public transfers (*Trf*) that is necessary to satisfy the intertemporal public budget constraint. Constructing the *revenue* and *transfer gap*, we implicitly assume that the government is able to enforce an immediate adjustment of all taxes and contributions or transfers, respectively. This assumption, however, is not very realistic as it usually takes time for research results to enter society and pass the political process. In addition, decisions in democracies are influenced by so-called policy cycles, i.e. unpopular laws are rarely passed on the brink of important elections. Therefore, as an alternative indicator we consider the so-called *delayed revenue gap* $\theta_{rev,X}$ (or *delayed transfer gap* $\theta_{trf,X}$), which corresponds to the fiscal adjustment necessary, if the adjustment is postponed by X years. Like θ_{rev}, the indicator $\theta_{rev,X}$ is given by:

$$\theta_{rev,X} = \frac{IPL_b}{\sum_{s=X}^{\infty} Rev_s \cdot \frac{1}{(1+r)^{(s-b)}}}. \tag{9'}$$

The indicators *delayed revenue gap* $\theta_{rev,X}$ and *delayed transfer gap* $\theta_{trf,X}$ can be interpreted as the costs of a delay in the political decision-making process or, in contrast, as the advantage of acting fast without postponement.

Another way to illustrate the fiscal burden is the so-called *annual fiscal gap* indicator, often times also referred to as *S2*. As with the *revenue* or *transfer gap*, the *intertemporal public liabilities* are divided by the present value of all future GDPs. Therefore, a projection of GDP is necessary. Equation (10) shows the respected formula:

$$S2 = \frac{IPL_b}{\sum_{s=b}^{\infty} GDP_s \cdot \frac{1}{(1+r)^{(s-b)}}} \quad (10)$$

.

A by-product of *Generational Accounting* are annual cash flows of transfers and tax payments for each i that can be used to illustrate the development of payments over time. This is especially useful to illustrate demographic development peaks in the cash flows and to determine when unbalanced situations (i.e. primary deficits) occur. For another interpretation of the *intertemporal public liabilities* is the sum of all primary deficits from the base year to infinity plus the explicit debt.[4]

Theoretically, all indicators have to be computed over an infinite time horizon. However, for practical reasons all relevant variables are only projected over a period 300 years from the base year onwards.[5] Afterwards a geometrical series is used to determine the remaining net tax payments. Table 1 provides an overview of the indicators used and their measurement of fiscal sustainability.

[4] Keuschnigg et al. (2001) introduced this interpretation.
[5] The choice of 300 periods is nearly completely arbitrary and just reflects a good approximation point for our analysis.

Table 1: Sustainability Indicators

Indicator	Interpretation	Remarks
Fiscal Gap	The sum of implicit and explicit debt compared to base-year's GDP	Highly sensitive to changes in the underlying growth-interest-spread and to different demographic scenarios; easy to interpret as comparable to the Maastricht criteria
Future Generations' Burden	The difference between the *Generational Account* of the newborn in the base year and the account of the newborn one year after if only future generations close the intertemporal budget constraint	Difficult to interpret; highly sensitive to changes in the underlying growth-interest spread
Revenue Gap	Enhancement of age-specific revenues for all generations necessary to close the intertemporal public budget constraint	Robust (non-sensitive) indicator for changes of growth and interest parameters because nominator and denominator are effected in the same way[6]
Transfer Gap	Decrement of age-specific transfers for all generations necessary to close the intertemporal public budget constraint	See *revenue gap*
Delayed Revenue Gap	Illustrate the costs of delaying or waiting when compared to the *revenue gap* indicator	Robust (non-sensitive) indicator for changes of growth and interest parameters because nominator and denominator are effected in the same way; highly sensitive to the time of delay
Delayed Transfer Gap	Compared to the *transfer gap* indicator one can illustrate the costs of delaying or waiting	See *delayed revenue gap*
Annual Fiscal Gap (in the literature often times referred to as "S2")	Average annual deficit in terms of annual GDP	Robust (non-sensitive) indicator for changes of parameters of growth and interest because nominator and denominator are effected in the same way

Source: Own illustration.

The following data are necessary to compute *Generational Accounts* and the associated sustainability indicators: Firstly we need a population projection. These are usually deterministic and follow the assumptions of the respective official statistic bodies. To project the population we use a demographic program developed by Bonin (2001).[7] Secondly, the general government's budget of the base year including social security funds is required. Owing to cross-country comparability we use standardized data from national accounts according to the international standard *System of National Accounts 1993* jointly developed by leading international bodies.[8] Thirdly, age- and sex-specific

[6] In sensitivity analyses of the underlying growth-interest spread (*g–r)* the *revenue gap* (and related indicators) change only due to the geometric series used to determine the remaining net tax payments beyond the projection horizon of 300 periods.
[7] Bonin's (2001) projection program is based on the component method proposed by Leslie (1945). The standard procedure has been extended to distinguish between genders and to incorporate immigration.
[8] For a detailed description of the *System of National Accounts 1993* standard see United Nations (2003).

profiles are required for each position of the budget. These stem mostly from micro-data sets like household panels or are derived from economic assumptions. In some studies current reform acts are already implemented even when their effect on net tax payments is restricted to the future. Such implementations require data on expected payments or discounts of payments. We abstract from this point—except for the Swedish pension reform that is our focus. The data underlying our study will be described in detail in section 3.

2.2 Generational Accounting – Limitations

Over the last 15 years *Generational Accounting* has been topic of recapitulating debate and criticism, pointing at theoretical and empirical limitations and drawbacks of the concept. In this section we address firstly the theoretical objections with a brief overview of several demurs in the literature before we turn our attention to the empirical shortcomings and uncertainties. Reviews of *Generational Accounting* can also be found in Cutler (1993), Haveman (1994) and Diamond (1996), whereas Kotlikoff (1997) and Raffelhüschen (1999a) summarize the critics and reply to several objections.

Theoretical Limitations

Two major theoretical objections arise when applying *Generational Accounting*. The first scrutinizes the validity of the underlying *neo-classical life cycle hypothesis*.[9] The second targets the static framework of the concept and the associated incidence assumptions.

According to neo-classical theory rational agents determine their life cycle consumption path at the beginning of their planning horizon taking into account their available lifetime resources. Under the additional assumption of perfect capital markets lifetime resources equal the present value of summarized future income (that can be allocated over the remaining lifecycle by either borrowing or saving). Intergenerational policy will not affect the optimal consumption pattern as long as it does not affect the present value of after-tax future income. *Generational Accounting* stands on this theoretical pillar as it measures remaining lifetime resources under current fiscal policy. If the individual planning horizon were shorter or longer than lifetime, conclusions on the ground of *Generational Accounts* could be misleading.

One of the most extreme forms of thinking about this is the model of Ricardian Equivalence as posted by Barro (1974). This model, also known as the *Barro-Ricardo equivalence proposition*, assumes that families act as infinitely living dynasties due to intergenerational altruism. If this kind of altruism is boundless, fiscal policy affecting future generations will be offset by living generations through higher bequests. As a consequence there would be no need for such analysis as *Generational Accounting*—nor for debt quotas as in the Maastricht treaty. However, empirical evidence does not suggest that people

[9] The lifecycle hypothesis goes back to Modigliani and Brumberg (1954, 1980).

behave in the strong Ricardian sense.[10] Then again, if individuals acted myopically or were liquidity-constrained due to imperfect capital markets the lifecycle postulate would overestimate the planning horizon and consumption would be based on current income.[11] Evidence suggests that consumers do put more weight on current income. Whether this is due to myopic behavior or credit rationing is presently not fully understood.[12] However, as we also see non-myopic behavior like volitional inheritance and voluntary long-term saving, pure myopic preferences seem too strong an assumption, just like the *Barro-Ricardo equivalence proposition*.

The life cycle model seems to be a good middle way between the myopic and Ricardian assumption and so *Generational Accounting* delivers a fairly good approximation of intergenerational redistribution through fiscal policy. This also holds when considering the second theoretical objection: the underlying incidence assumptions. *Generational Accounting* is a partial equilibrium analysis, neglecting the impacts of the net tax burden on quantities and prices of consumption and saving, as well as the repercussions on factor inputs in the production process. To assess tax or transfer incidence accurately, only fully specified dynamic general equilibrium models are sufficient. Three empirical studies have tested *Generational Accounting* in this respect, i.e. to what extent the results of intergenerational redistribution as measured by *Generational Accounts* would change when considering the macroeconomic feedback effects. Again, the evidence is mixed.

Fehr and Kotlikoff (1996) show that "in general changes in generational accounts provide fairly good approximations to generations' actual changes in utility. The approximations are better for living generations. They are worse for policies that involve significant changes in the degree of tax progression and for economies with sizeable adjustment costs. Finally, *Generational Accounting* needs to be adjusted in the case of small open economies to take into account the fact that the incidence of corporate taxation is likely to fall on labor. The method of adjustment is simply to allocate changes in corporate tax revenues to generations in proportion to their changes in labor supply." [Fehr and Kotlikoff 1996, 25]. Raffelhüschen and Risa (1997) on the other hand show that an equalization of the intertemporal burden as suggested by *Generational Accounting* might not be optimal in a welfare sense or time inconsistent depending on the selected discount rate. Börstinghaus and Hirte (2001) question both former studies regarding their methodology of assessment. They use a general equilibrium model to assess *Generational Accounting* in the context of tax and pension reform in Germany. They conclude "Generational Accounting is a bad shortcut for the incidence of the income tax reform, but gives a good impression of the quality and sign of the incidence for all but the younger cohorts in the case of the pension reform." [Börstinghaus and Hirte 2001, Abstract]. As a conclusion of these studies, it can be stated that *Generational Accounting* represents a superior alternative to annual cash flow

[10] The empirical evidence is at least mixed. See for example Mello, Kongsrud and Price (2004), Reitschuler and Cuaresma (2004) and Kotlikoff (2003).
[11] See Buiter (1995) and Buiter and Kletzer (1995). For a model of myopically acting agents see Brown and Lewis (1981).
[12] See CBO (1995) and Hayashi (1985).

budgets also in a theoretical framework. However, just like annual cash flow accounting *Generational Accounting* does not provide enough information to base welfare judgments on the computed accounts alone.

Empirical Limitations

After considering the main theoretical objections, the empirical shortcomings are discussed in the following paragraphs. Firstly, the most central objection is the use and selection of time-invariant growth and interest rates as stated in equations (2) and (4). As stated in CBO (1995) "there is no uniquely right discount rate" [CBO 1995, 41]. A single discount rate combines the cost of waiting and the risks associated with the payment streams, i.e. risky tax and transfer payments. These two categories should ideally be divided. Furthermore the cost of waiting could be different for several generations.[13] As a result a single discount rate will typically distort the outcome of *Generational Accounting*. Furthermore the selection of the discount rate is rather arbitrary. Normally, *Generational Accounting* uses a historical average of long-term government bonds. Some studies use a historical average of equity (instead of long-term government bonds) as a measurement of risk for net payments. Equally applicable would be the base-year's rate of inflation-indexed bonds. These differ from the historical average of long-term government bonds in some countries.[14] The same criticism applies for the growth or productivity rate.

Two arguments can mitigate the criticism to some degree, however. Firstly, only the spread between interest and growth rates is relevant, at least approximately in the one digit area. With macro data, this relationship seems to be relatively stable over time, as Fetzer (2006) shows. Secondly, the "right" growth-interest spread can be determined by sensitivity analysis in the relevant areas. Apart from that indicators like the *revenue* or *transfer gap* are not very sensitive to variations in the growth-interest spread.

The second empirical shortcoming is the fixation of the age- and sex-specific profiles. For example an increasing female labor participation rate (due to demographics) would, e.g., trigger a change of the relevant profiles. Likewise, health-related profiles could be a subject to change due to the medical-technical progress.[15] However, as, e.g. Fetzer (2006) or Breyer and Felder (2006) show for the health sector—and as we will discuss in the last part of this section—the constant profile assumption is a good approximation in the face of different possible scenarios. However, as time series of age-specific data will be available in the next years, the profiles could be stochastically enhanced in future research. These stochastic elements could alleviate the next point of criticism, too: the deterministic population projection.

As demographics are the driving force behind *Generational Accounting* results, the population projection is a particular point of relevance. Population

[13] For all these arguments see CBO (1995).
[14] In the case of Germany, an inflation-indexed bond yields a return of about 1.4 percent while the 30 years average return of a ten-year government bond lies around 3.8 percent as Fetzer (2006) has shown.
[15] See for example Felder (2006).

projections are uncertain in two ways. Firstly, the expected future parameters, e.g. like life expectancies or fertility rates, are uncertain. Secondly, given informed assumptions on future values of these parameters the path of development from base-year values to expected values is uncertain, too. Stochastic population projections could deal at least with the latter problem. Alho and Vanne (2006) show that the indicators used by *Generational Accounting* are (in some degree) sensitive to stochastic demographics. For the first problem, sensitivity analysis is the only remedy, again. To take this point into account, we provide results for three different population projections for each country.

The fourth empirical drawback is the base-year's budget. As the starting point of the analysis with *Generational Accounts*, possible business cycle effects could distort the results. Hagist et al. (2012) show that this is true for Norway while Benz and Hagist (2008) show that the effects of the business cycle are rather small for the German *Generational Accounts*.

Conclusion

Concluding this section, it can be said that *Generational Accounting* has important limitations which have to be kept in mind interpreting the results. However, some of these limitations apply to every kind of projection or forecast due to fundamental uncertainty of future parameters. Others are specific to *Generational Accounting*. Overall, *Generational Accounting* is not to be understood as a forecast but rather as a thought experiment. Surely, at some point in time, governments have to, and will, act and thereby drive analysis and reality apart. *Generational Accounting* can thus only be considered as a highly unlikely "worst-case" scenario. Furthermore the method is very valuable despite its limitations in comparing different reform proposals. Relative changes of *Generational Accounts* and the associated sustainability indicators are a reliable gauge for evaluating the effects of competing reform proposals or policy changes in any field of public finance.

2.3 Generational Accounting – Empiricism

During the last 15 years several *Generational Accounting* studies for 28 different countries have been added to the literature. Some countries like Norway even include *Generational Accounts* in their government reports. Table 2 provides an overview of studies using *Generational Accounting* to assess a country's fiscal situation. We sort the studies not by date but by countries' names and only cite the most recent study for each country. Other international overviews can also be found in Raffelhüschen (1999b) and Kotlikoff and Raffelhüschen (1999).

Most of the cited studies cannot be compared quantitatively but only in a qualitative way. One main difference between the countries concerns their development status. Against layman's intuition developing countries (or countries which recently belonged to that group like Ireland) seem to be better off in the long-run than major OECD countries like the US, Japan or Germany. This is due to two reasons. Firstly, developing countries have in general more dynamic demographics (i.e. a higher fertility rate) and so the

aging of the populations remains slower than e.g. in G7 countries. Furthermore, and probably more important, social insurance systems are not as generous in countries like Argentina or Ireland than in classic welfare states or even the US. This could be due to several reasons like higher inflation (which works towards sustainability if benefits are not inflation-indexed) or different government policies. The obvious question is whether fiscal policy in these countries will become as generous as in highly-developed countries.[16]

Table 2: Generational Accounting studies around the world

Country	Authors	Conclusion
Argentina	Altamiranda (1999)	Argentina's fiscal policy is not intergenerationally balanced according to the author's calculations. Future generations face a burden of nearly double the amount of net tax payments in comparison to their living counterparts.
Australia	Ablett (1999)[17]	Despite its high immigration of younger working cohorts Australia's fiscal policy remains unbalanced in the intertemporal sense. The pension system is identified as the major source of unsustainability.
Austria	Hagist (2011)	Although necessary reforms of the public pension system were put through, other forms of social security remain unchanged. Hence the Austrian fiscal policy is unsustainable.
Belgium	Decoster et al. (2011)	The authors develop a *Generational Accounting* model for Belgium as a whole and also for its two main regions, Wallonia and Flanders. They conclude: "Although the fiscal imbalance is biggest in Wallonia due to lower participation rates and higher unemployment, the projected demographic evolution, and more specifically the ageing of the population, has higher budgetary repercussions in Flanders."
Brazil	Miessi and Souza (2007)	Brazil's fiscal policy is unsustainable even after several reforms. Future newborns face a 98 percent higher burden than current newborns. The RGPS and RPPS Systems are the main driving forces behind this result.
Canada	Oreopoulos (1999)	Canada's fiscal situation is nearly sustainable with only minor magnitudes of policy changes needed to rebalance. Net tax burden for future generations is considered to be only 3.1 percent higher than for living generations.
Denmark	Jensen et al. (2002)	The main conclusion of the paper is that Denmark's fiscal policy is almost sustainable, with a *revenue gap* of only 1.1 percent.
Finland	Vanne (2002)	In 1995 the Finnish public economy showed a severe unsustainability and intergenerational imbalance. In the 2000 analysis, it has arrived at or close to intergenerational balance, depending on some assumptions.

[16] Kotlikoff and Walliser (1995) examine e.g. how US accounts would differ if the US population had the structure of a typical developing country. They also describe in some detail why fiscal sustainability might be different between developed and developing countries and how reform proposals for developing countries should look like.

[17] Coombs and Dollery (2006) investigate regional differences of fiscal sustainability with *Generational Accounts*. They do not report indicators on a federal level, which is why we opted for Ablett (1999).

France	Hagist et al. (2009)	Despite its relatively high fertility rate for a European economy, France's fiscal situation is very imbalanced in the long run. Public pensions and the generous health insurance scheme are the major drivers.
Germany	Hackmann et al. (2011)	German policy makers still face a big challenge on the way to sustainable fiscal policy. Especially health and long-term care are of great concern.
Hungary	Gál and Tarcali (2003)	The Hungarian fiscal imbalance results mainly from its public pension scheme and could be severely reduced by the indexation of benefits to prices instead of wages.
Ireland	McCarthy and Bonin (1999)	Ireland is in generational balance, which is mainly due to two factors: the relative youth of its population and the relative lack of generosity of its welfare state compared to European continental economies.
Italy	Rizza and Tommasino (2010)	The authors conclude: "Based on our computations, we argue that current fiscal policies are neither financially sustainable nor fair to future generations, due to the generous treatment awarded to past and currently-living cohorts."
Japan	Takayama and Kitamura (1999)	The authors find a *fiscal gap* of 338 percent of GDP. This implies that future generations will have to bear between 2.7 and 4.4 times the fiscal burden of present generations—a huge imbalance by international standards.
Korea	An et al. (2011)	The dramatic demographic transition will lead to a heavy fiscal burden for future generations. The life cycle deficit of the elderly is smaller but the net benefit is growing rapidly. These benefits will grow much more in the future because of the more generous pension system established in the year 2008.
Mexico	Sarrapy and Caso (1999)	The main finding of the study is that there is no evidence of a fiscal sustainability problem of the sort found for other countries in similar studies. The result is mainly due to favorable demographic dynamics over the coming decades and is robust to several alternative data assumptions.
The Netherlands	ter Rele and Labanca (2011)	The calculations indicate that the Dutch fiscal policy is unsustainable. The authors suggest five different sustainable policies, e.g. a cut in expenditures on general government (4.5 percent of GDP) or a rise in indirect taxes (about one third).
New Zealand	Baker (1999)	New Zealand appears to have avoided expensive long-term commitments that would lead to unsustainable levels of government outlays. In the base year actually the government could have decreased tax payments for future generations and would still be in balance.
Norway	Hagist et al. (2011)	The oil and gas wealth of Norway seemed to stabilize the sustainability of the fiscal policy. The authors demonstrate nevertheless that the pension reform and the vast resources are not sufficient for sustainability.

Portugal	Auerbach et al. (1999)	Portugal's fiscal policy is unsustainable with a *revenue gap* of 4.2 percent and a *transfer gap* of 9.6 percent. These measures would establish generational equity with different burdens for the living depending on the exact policy.
Spain	Patxot et al. (2011)	The authors augment the model and divide transfers into public and private items. Public transfers are mostly burdened by the younger as private transfers are burdened by the older generations.
Sweden	Hallberg et al. (2011)	The authors find a substantial shift of the burden to the younger and unborn generations by calculating the net tax rate. For age groups older than 65, the net tax rate and the burden fall.
Switzerland	Hagist (2011)	Swiss fiscal policy can be described as exemplary sustainable due to its fine public pension reform. However, if the medical-technical progress is taken into account, the Swiss will face intergenerational imbalance, too.
Thailand	Kakwani and Krongkaew (1999)	Thai fiscal policy is typical for developing countries, as it favors future generations. However, adoption of developed countries' social policies such as unfunded pay-as-you-go pension systems could change these results.
United Kingdom	McCarthy, Sefton and Weale (2011)	In order to achieve a sustainable fiscal policy, the authors suggest a tax raise of six percent of GDP or changes in the social securities system like later retirement.
United States	Hagist et al. (2009)	The United States are far from intergenerational balance despite their relatively dynamic demographics. This is due to structural problems especially with the inefficient public health care systems.
Uruguay	Bucheli (1998)	The author investigates the impact of the public pension reform in 1995. He concludes that the reform proposal decreases the burden of future generations by lowering the payoffs for current retiree cohorts.

Source: Own illustration.

2.4 Constant age-specific Profiles of Health Expenditures – A reasonable Assumption?

While most items in the public budget do not directly interact with an increasing life expectancy, this may be different for health expenditure in general. For health related expenditure a crucial assumption of the analyses described in sections 2.1 and 2.4 is made in equations (4) and (12), i.e. the assumption that the distribution of (public) health care expenditure by age remains constant over time. In the following we will call this the status quo hypothesis. The economic literature in this field suggests otherwise. There are (mainly) two contradicting hypotheses regarding the outcome of the age-specific distribution when life expectancy of the old population (60 years and more) will increase. This has occurred in all analyzed countries over the last 30 years and will carry on based upon our population projections.[18] The first

[18] See OECD (2006a).

theory is the so-called *medicalization hypothesis* that goes back to Verbrugge (1984): Due to the observed multi-morbidity of elderly patients, certain treatments (e.g. for heart diseases) prolong the life without restoring the health of the patient fully. This leads to further treatment in case of another disease. Hence, the *medicalization hypothesis* predicts a "steeping" of the age-specific health expenditure profile with increasing life expectancy while controlling for the effect of medical-technical progress.[19] In this case we would underestimate the demographic effect on the growth of public health care expenditure because we neglect this shift by assumption of constant profiles.

The other scenario is the so-called *compression hypothesis* first formulated by Fries (1980). Under this scenario, observed differences in health expenditure per capita in different age groups are not due to the calendar age but to the remaining lifetime to death.[20] Old cohorts simply cost more because they are more likely to die and not per se because they are old. If the life expectancy of the elderly increases, the costs that they will cause will just be shifted into the future, again controlled for the effect of the medical-technical progress. The age-specific distribution would flatten over time. In this case, we would overestimate the demographic effect on the growth of governmental outlays for health.

Both hypotheses are discussed controversially and both lack sufficient empirical evidence, at least for most OECD countries with the exception of Switzerland and the US Stearns and Norton (2004) have shown for the US using Medicare data and expected life tables for 2020 that our approach will overestimate the average lifetime health care expenditure by about 16 percent if the compression hypothesis holds. Miller (2001) stated that our approach will overvalue Medicare expenditure by about 14 percent when the life expectancy increases from 76.1 to 81.7 years and if the compression hypothesis holds. For the case of Switzerland, Steinmann, Telser and Zweifel (2005) find that aging per se contributes only relatively little to the growth of health expenditure regardless of whether the cost of dying is accounted for. For Germany, Breyer and Felder (2006) show that the miscalculation will be five percentage points, again if the compression hypothesis holds. Fetzer (2006) shows that in the case of Germany, the resulting sustainability gap is not strongly influenced by the choice of the underlying scenario.[21]

To summarize the status quo hypothesis, i.e. the assumption of constant age-specific profiles of health expenditure. may not be the ideal model to forecast future health care outlays or to calculate *Generational Accounts*. However, as long as evidence is mixed, it seems to be a reasonable assumption and a good approximation for current research.

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[19] See Buchner and Wasem (2004). For an overview see also Breyer and Felder (2006) and Fetzer (2006). Empirical evidence for the *medicalization hypothesis* can be found in Nocera (1996) or Polder et al. (2002).

[20] See for example Zweifel, Felder and Meiers (1999) and Zweifel, Felder and Werblow (2004).

21 The calculation is based on a 8.8 percentage points difference between the compression and status quo hypothesis and 25.5 percentage points between the status quo and medicalization hypothesis.

3 Demography and Data

3.1 Demography

As shown in section 2, *Generational Accounting* requires comprehensive population data. Sweden's official statistical body, Statistics Sweden, calculates three different scenarios that could be titled *medium*, *high* and *low variant*. Based on the central assumptions about life expectancy, fertility and migration of these three scenarios we calculate our own projections for the Swedish population. These are necessary because of our infinity assumption: The official projections end in 2060 while we need a horizon of 300 years.[22] Table 3 shows the central assumptions of the three scenarios. Based on the population of 2009 (divided by sex and one-year cohorts) together with age-specific mortality and fertility rates and a constant age- and sex-specific migration pattern our projections are calculated according to the above-stated assumptions about the development of the demographic parameters life expectancy, fertility and migration.[23] The outcomes of the three population projections for Sweden are plotted in Figure 1. Compared to the official calculations of the medium variant we underestimate the Swedish population by about 0.3 millions in 2060; the maximum deviation between the projections (in 2060) is 2.8 percent.

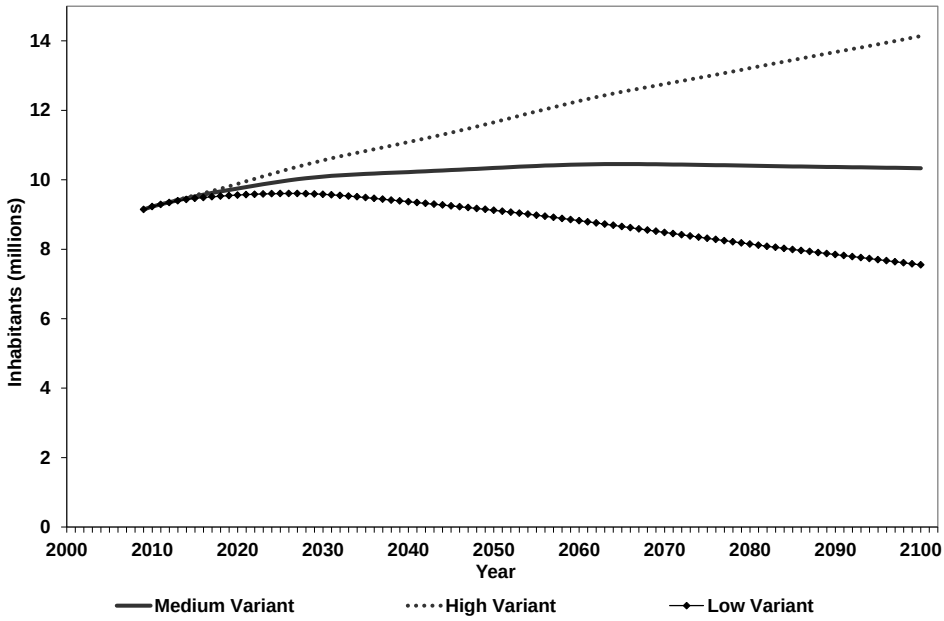
Table 3: Central assumptions of Swedish population projections

Parameter	Year	Scenarios		
		Medium variant	High variant	Low variant
Total fertility rate	2009	1.85	1.85	1.85
	2060	1.83	2.05	1.66
Life expectancy at birth for females/males in years	2009	83.2/79.1	83.2/79.1	83.2/79.1
	2060	86.8/84.7	91.0/88.2	83.2/79.1
Net migration	2009	63,040	63,040	63,040
	2060	19,000	27,700	11,800

Source: Statistics Sweden (2009).

[22] See Statistics Sweden (2009) for details.
[23] Population data and the migration pattern for the base year as well as mortality and fertility stem from Statistics Sweden's website, www.scb.se.

Figure 1: Different developments of the Swedish population until 2100

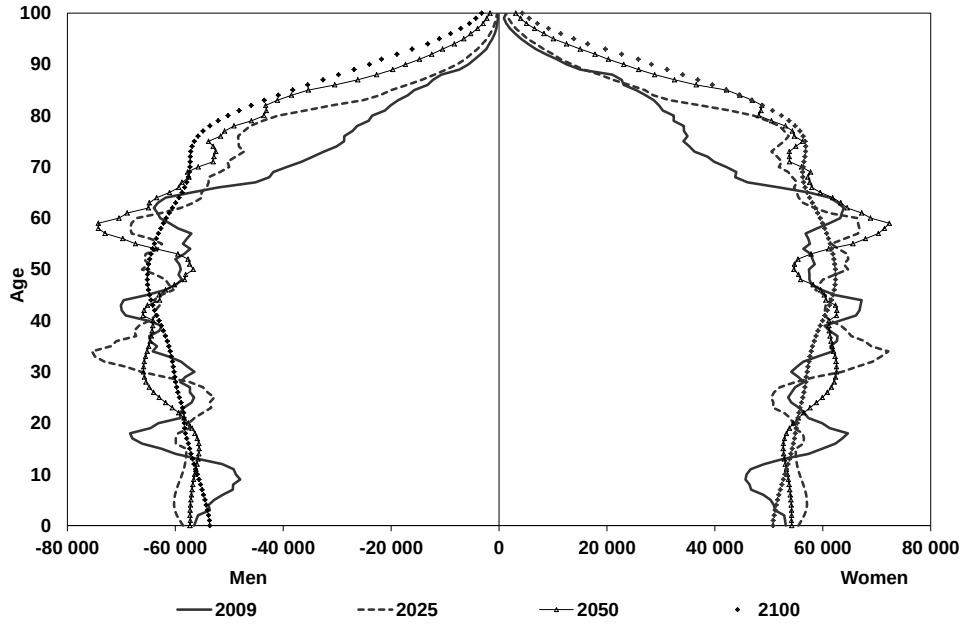


Source: Own projections based on Statistics Sweden (2009)

In the *medium variant*, the Swedish population increases until 2065 and then decreases at an approximately constant rate over the projected horizon. However, the population is always larger than in the base year. In case of the *high variant* the population increases continuously. According to this scenario Sweden will have 14.3 million inhabitants by the year 2100. Although the *low variant* is the one with the lowest assumptions regarding the central parameters, the population still grows slightly over the next 17 years due to the positive net migration. From 2026 onwards the population declines steadily. For the following analysis we take the *medium variant* as our standard scenario if not stated differently.

Figure 2 presents exemplarily the population projection based on the *medium variant* in the years 2009, 2025, 2050 and 2100 divided by age and sex. In the base year the Swedish population shows an atypical pattern for a developed middle-European nation. As Sweden had no armed conflicts over the last 100 years (which normally go along with a lower annual fertility rate), the only similarity with countries like Germany or France is the baby boom in the late 1950s and early 1960s. This original baby boom had two echo-effects resulting in two other baby booms around the age groups of 45 and 20 years. After this last baby boom the fertility rate decreased to a lower level which can be seen around the cohorts of the 10 year-olds. However, over the last years the fertility rate recovered to the level stated in Table 3.

Figure 2: Swedish population in 2009, 2025, 2050 and 2100

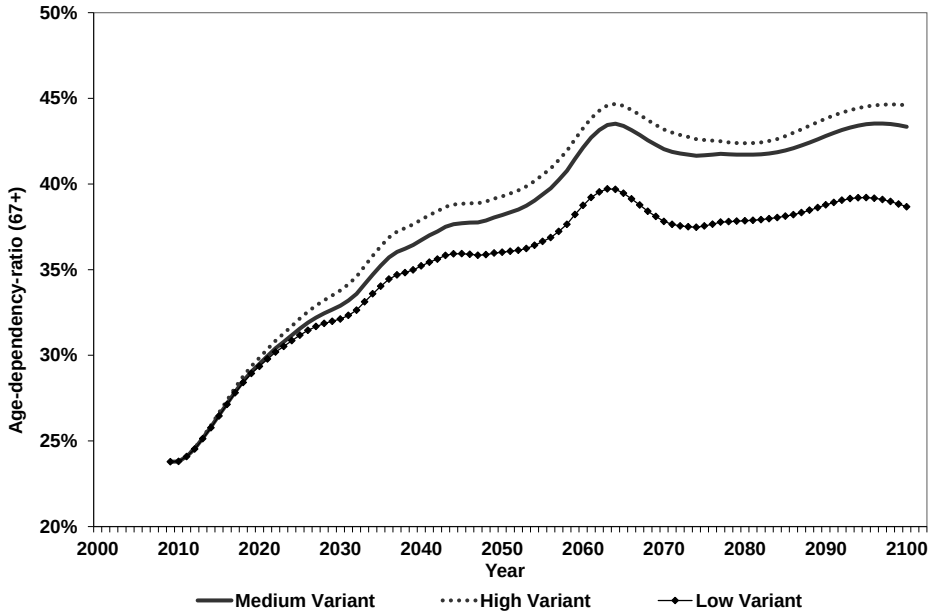


Source: Own projections based on Statistics Sweden (2009)

Furthermore Figure 2 shows that the population over 80 years will constantly increase until 2050. The absolute number of births is in contrast nearly constant. The average age of the Swedish population is increasing due to the augmentation of life expectancy. This can also be demonstrated by the so-called age-dependency ratio which is defined as the ratio between members of cohorts older than 67 years to the population between 20 and 67 years.[24] The development of the (old) age-dependency ratio gives a first hint of how social security systems organized in a pay-as-you-go pattern will be unbalanced in the future (see Figure 3).

[24] In the literature one can find various different definitions with different age groups or restricted groups like working people under a certain age.

Figure 3: Development of the age-dependency ratio until 2100 in Sweden



Source: Own calculations.

3.2 Budget of the Swedish General Government

The budget of the Swedish general government which is shown in Table 4 (based on data from both Eurostat's and Statistic Sweden's websites) is characterized by 61 expenditure entries and 39 revenues items. Revenues include taxes on labor and capital income, value added tax, property tax, and social insurance contributions. The public expenditures contain expenses for general public services, defense, public order and safety, economic affairs, environmental protection, housing and cultural activities, health expenditures, and social items like pensions and social assistance in a sub-aggregated matter.

As we include the external debt according to the Maastricht criteria, we report interest payments in Table 4 but exclude them from the analysis. According to economic theory, the eternal sum of interest payments in present value terms should be equal to the debt in the base year. We would thus count the external debt twice if we included interest payments. The external debt on the 31st of December 2008 (i.e. the beginning of 2009) was 1,243,295,000 SEK or 40 percent of the GDP in 2009 according to Eurostat. Excluding the interest payments results in a primary surplus of 8.2 million SEK.

Table 4: Public expenditures and revenues of the Swedish General Government in 2009 (in million SEK)

Central government income tax	40.1	Subsidies	-47.1
Local income tax	511.1	Contractual pension. central government	-8.3
General pension contribution	86.8	Old-age pension social security	-217.4
Income tax on foreign artists	0.1	Guarantee pension	-19.1
Tax reduction general pension contribution	-86.8	Activity and sickness compensation	-60.6
Tax reduction labor	-65.2	Survivors pension	-15.8
Tax reduction domestic services	-10.4	Child pension	-1.0
Other tax reductions	-0.2	Optional retirement	0.0
Capital income tax	44.5	Sickness benefit	-19.3
Capital deficit	-19.4	Parent´s insurance	-27.6
Self-employed funds retained for expansion	-0.3	Work injuries insurance	-4.7
Tax on motor vehicles	8.4	Open unemployed	-19.3
Tax on holding gains	7.4	Labor market political measures	-10.4
Other taxes on households	0.1	Redundancy compensation	-3.0
Corporate tax	86.5	Other transfers labor market	0.0
Other taxes on income of companies	5.7	Housing supplement for pensioners	-6.9
Value added type taxes (VAT)	298.1	Child allowance	-23.4
Import duties	0.0	Educational grant	-4.0
Tax on fuel	46.3	Study grants	-9.4
Tax on electrical power	20.7	Adult education	0.0
Tax on beverages	12.2	Asylum seekers	-0.7
Tax on tobacco	10.6	Housing allowance	-3.4
Tax on financial and capital transactions	8.1	Maintenance support	-2.0
Other excise duties and consumption taxes	10.2	Allowance for handicapped children	-2.6
Real estate tax households	0.9	Measures for getting handicapped a job	0.0
Real estate tax companies	10.1	Assistance allowance	-21.8
Local real estate tax households	10.8	Handicap allowance	-1.2
Local real estate tax companies	3.0	Elderly allowance	-0.5
General payroll tax	90.0	Other transfers central government	-6.5
Part of pension fee to state budget	15.8	Contractual pension	-12.0
Tax on salaried employees life insurance	0.9	Change in pension liabilities	-7.4
Special payroll tax	32.5	Property income attributed to insurance policy holders	-2.9
Remaining production tax	9.9	Social allowance	-13.1
Social contributions	269.4	Lease hold	-0.1
Operating surplus. net	-4.3	Other transfers local government	-1.3
Consumption of fixed capital	73.4	Capital transfers from general government sector	-1.4
Interests	29.1	Transfers to non-profit institutions serving households	-24.9
Dividends	35.2	Transfers to corporations	-4.2
Other receipts	29.2	Transfers to abroad	-48.7
		Interests	-36.3
		Medical products. appliances and equipment	-27.0
		Outpatient services	-94.0
		Hospital services	-86.1
		Other health expenditure	-12.6
		Pre-primary and primary education	-126.8
		Secondary education	-44.1
		Post-secondary non-tertiary education	-0.8
		Tertiary education	-27.0
		Other education	-5.9
		Sickness and disability	-47.9
		Old age	-78.4
		Family and children	-26.5
		Unemployment	-11.6
		Other social protection	-18.9
		Other final consumption	-249.9
		Fixed investment primary education	-4.6
		Fixed investment secondary education	-1.8
		Fixed investment tertiary education	-3.7
		Fixed investment other	-99.6
		Changes in inventories	-0.2
		Acquisitions less disposals of land etc.	6.8
Deficit	28.1		
Sum	1620.8	Sum	-1648.9

Source: Own calculations based on the websites of Eurostat and Statistic Sweden.

3.3 Micro Profiles

Beyond the population projection and the base-year budget of the public sector, age- and sex-specific micro-profiles are necessary to define the intertemporal budget constraint of the public sector. These profiles are needed to assign the base-year's revenues and expenditures on the cohorts which live in the base year and hence to determine the future path of public finances implied by the demographic development. Budgetary items which like government consumption cannot be assigned to a specific cohort are distributed with a flat per capita profile. The age-and sex-specific profiles used in the current study stem from various sources and have been obtained upon request from Statistics Sweden or the Ministry of Finance. For most social expenditure aggregates, the associated micro-profiles stem from Försäkringskassan (2010). All profiles are plotted in Table A-1 in the appendix.

3.4 Interest and Growth Assumptions

Due to the infinite time-horizon it is not straightforward to define the constant interest and growth rates, which are essential to predict the future revenues and expenditures of the public sector and to analyze the sustainability of the system. We assume a growth rate (g) of 1.5 percent and a discount rate (r) of 3.0 percent for the standard calculation. These assumptions are altered in the sensitivity analysis in section 4 of the report.

4 The Sustainability of Sweden's Fiscal System

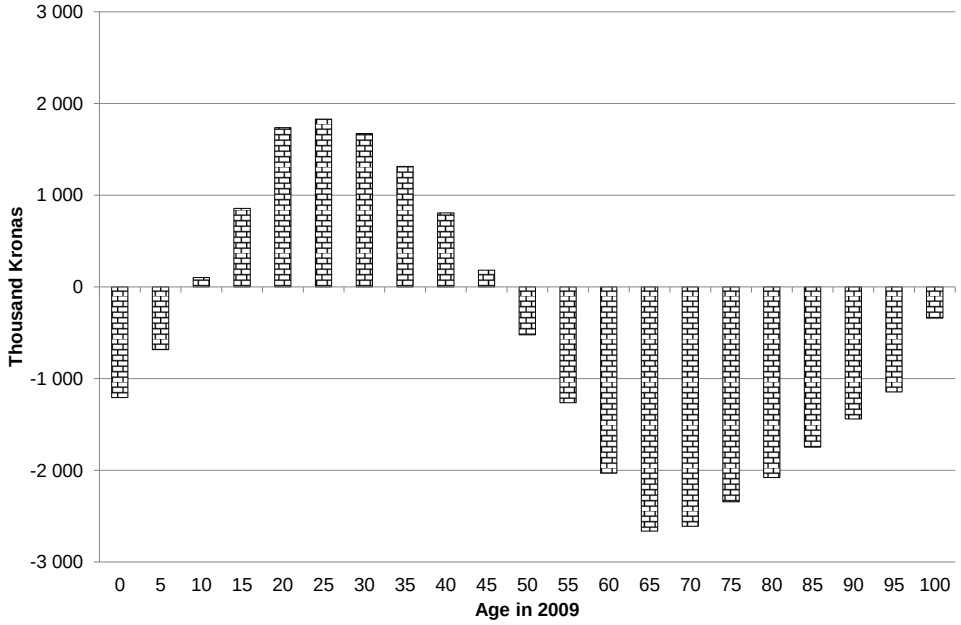
As described above, the Swedish state is in the comfortable situation to have a primary budget surplus even in a crisis year like our base year 2009. However, due to the demographic development this will change over time. For example, an expanding number of retirees are expected. They are entitled to benefits in the public pension system and they will receive a major part of public health care transfers. Public pensions as well as public health care transfers are therefore expected to increase. The financial consequences of the described revenue effect and the aging effect can be calculated by the method of *Generational Accounting*. The results of these calculations are shown in the following.

4.1 Generational Accounts (ignoring the Pension Reform)

Figure 4 presents the *Generational Accounts* of Sweden in our base year 2009 according to our standard scenario (medium variant, g=1.5 percent, r=3 percent) – yet without the consequences of the pension reform.[25] The sinus-shaped pattern is very common in OECD countries with generous pay-as-you-go systems. The young (between 10 and 46 years) finance the elderly generations (aged 47 years and older). *Generational Accounts* begin with minus 1,205,775 SEK for the present newborn and are at a maximum of 1,829,783 SEK paid by the representative 25 year-old. This means that a 25 year-old Swede (nearly half male/female) pays 1,829,783 SEK more in taxes and contributions over his/her remaining life cycle than he/she will receive in transfers and subsidies from the Swedish general government. The generation of 47 year-olds is the first one to receive more than he/she pays in taxes over his/her remaining life cycle. However, one should keep in mind that *Generational Accounting* is strict forward looking so living generations' accounts are not comparable. The major receiver is the generation of 65 year-olds because after 65 years discounting lowers the *Generational Accounts* significantly. This pattern can generally be observed in many developed countries.

[25] For the further analysis we statistically treat that migrants as Swedish citizens, i.e. a 50 year-old immigrant receives the same transfers and pays the same amount of taxes as his Swedish counterpart.

Figure 4: Generational accounts of Sweden 2009



Source: Own calculations.

4.2 The Fiscal Gap and other Sustainability Indicators (ignoring the Pension Reform)

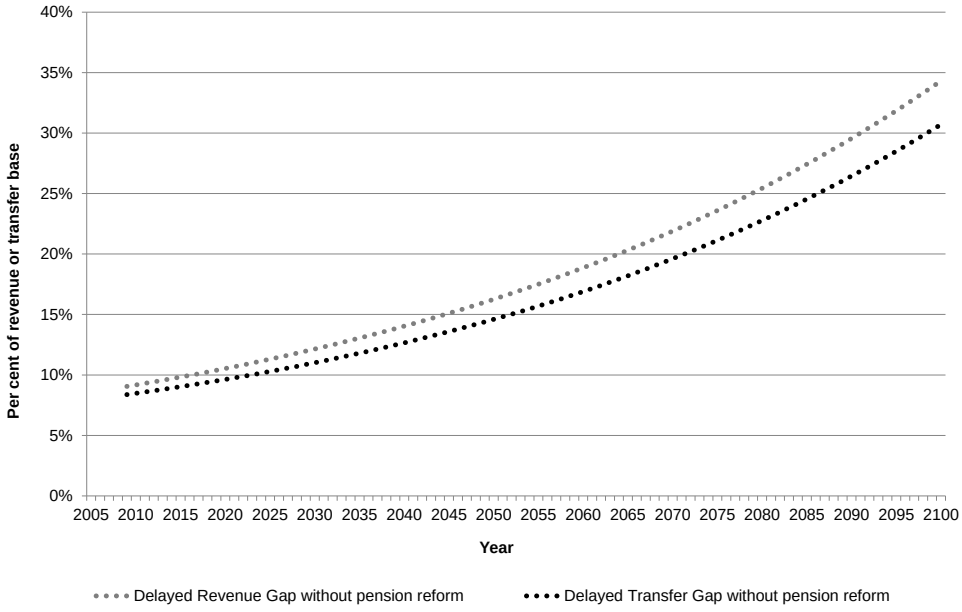
Our first sustainability indicator is the *fiscal gap* as defined in equation (7). It measures the sum of the *Generational Accounts* for living and future generations weighted with their (expected) cohort size, set in relation to base-year GDP. The magnitude of the *fiscal gap* for the whole Swedish public sector in our standard scenario (medium variant, g=1.5 percent, r=3.0 percent*)* is 359 percent.[26] This means that the Swedish fiscal policy in 2009 is not sustainable per se. However, as we have pointed out in the introduction, the conversion to a notionally defined benefit system is not modeled at this point and will be introduced in section 4.4. The Swedish *fiscal gap* is derived as follows: The implicit debt of Swedish fiscal policy (taxes, social security contributions, expenditures for health and public pension, etc.) is 319 percent of GDP. Adding the explicit public debt with 40 percent of GDP in 2009 results in a gross debt of 359 percent of GDP.

Our second indicator is the *future generations' burden*. To calculate this indicator, the *intertemporal public liabilities* and the number of people in future generations are set in proportion to each other (equation 9). This indicator implies that the entire adjustment is borne by future generations. The burden for future generations can be illustrated as the absolute difference between the *Generational Account* of the base-year cohort and the generational account of the agent one year younger. The latter would have to pay about 119,800 SEK per person more in taxes over their entire life cycle than they would receive in

[26] In the literature, the *fiscal gap* is normally positive if a government is in debt, i.e. if the demographic development puts a burden on public coffers. Hence, a negative algebraic sign imputes a net wealth over the long-term of the country's fiscal policy. Accordingly, in our other reported indicators we maintain this terminology.

transfers. On the other hand, the base-year-born agent gets a net-transfer over his/her remaining life cycle of about 1,205,775 SEK, yielding a *future generations' burden* of 1,325,500 SEK (equivalently a tax increase of 18.6 percent). This burden is also reflected in our last two sustainability indicators, the *revenue* and *transfer gap*. Sweden's government would have to raise all taxes by 9.1 percent or could decrease all transfers by 8.4 percent to have a balanced budget in the long run.

Figure 5: Delayed Revenue and Transfer Gaps



Source: Own calculations.

Figure 5 shows the cost of postponing the fiscal adjustment to balance the intertemporal budget in the long-run. While every year of waiting costs approximately the same during the first years, the increasing slopes in Figure 5 suggest that postponing becomes more expensive over time.

All indicators reported in sections 4.1 and 4.2 are rather theoretical as they treat pension expenditures like other expenditures, i.e. assume a fixed benefit structure and a constant growth rate of benefits for all generations. However, this is clearly not the case as the Swedish government introduced a major pension reform in the mid 1990s whose consequences will be the topic of the next sections.

4.3 The Swedish Pension Reform

The OECD's "Pensions at a glance" report 2011 (OECD, 2011) provides a good overview about the Swedish pension system and the reform measures undertaken. For our *Generational Accounting* analysis we concentrate on three main measures:

I. Change from a defined benefit to a defined contribution system

We include this reform measure in our *Generational Accounting* framework via data taken from the Orange Report published by the Swedish Pension Agency (Swedish Pension Agency, 2011). The data distinguish between entitlements from the old pension system (ATP), the new major pension system (Inkomstpension) and the supplementary but privately organized premium pension system (see Swedish Pension Agency (2011), 34-36 and Figure A-1 in the appendix). As we focus on public coffers, we ignore the latter. Given the contributions to the system (projected in our *Generational Accounting* framework) and the probabilities to retire we can scheme the pension expenditures of both types of pension. The probabilities to retire are as well estimated based on the Orange report (see Swedish Pension Agency, 2011, 4 and Figure A-2 in the appendix).

II. Calculation of benefits via annuity factors

To account for increasing life expectancy, benefits of the new pension system are calculated via annuity factors. We are computing these annuity factors taking into account the increasing life expectancy from our demographic projections as well as the standard growth rate of pensions of 1.6 percent p.a. (see Swedish Pension Agency (2011), 68).

III. Balancing of benefits and entitlements

Together with the shift to a notional defined contribution system and the application of annuity factors to determine a cohort's pension amount a so-called balance ratio was introduced. This balance ratio accounts for changes in the demographic structure as well as economic shocks via a ratio of the pension system's assets (the present value of contributions and the buffer fund) and liabilities (present value of benefits and entitlements). The initial values of these parameters in 2009 stem from the Orange Report (see Swedish Pension Agency 2001, 56), whereas our Generational Accounting framework is applied to project the value of the balance ratio in the future.

4.4 The Consequences of the Swedish Pension Reform for Generational Accounts and Fiscal Sustainability Indicators

Table 5 shows the consequences introducing the pension reform measures in our *Generational Accounting* analysis. As one can see it has a severe effect reducing the *fiscal gap* from 359 percent of GDP to 85 percent. All other indicators change their value by the same magnitude. Judging the actual status quo, i.e. a situation with the pension reform, Swedish public coffers are nearly sustainable. This outcome corresponds well with the European Commission (2009) which reports an *annual fiscal gap/S2* value of 1.8. The international comparison by Moog and Raffelhüschen (2011) who report a *S2* value of minus 0.5 percent, is in line with these findings, too. Moog and Raffelhüschen (2011) do not apply a *Generational Accounting* approach but rather project the outcomes of the European Commission (2009) over an infinite time horizon.

Table 5: Indicators in Comparison – Pre- vs. Post-Reform

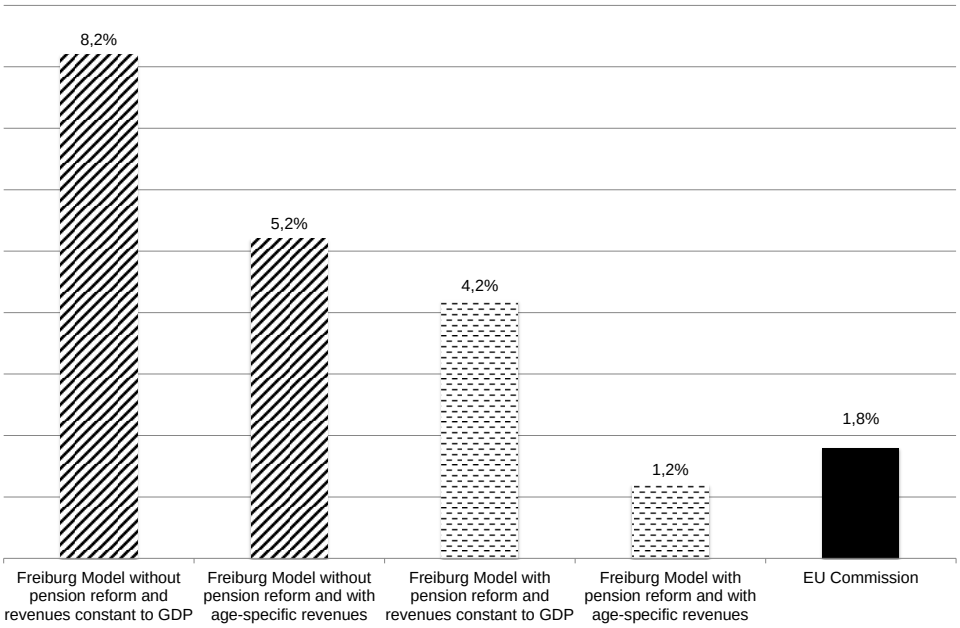
Spread	Indicators	Scenario – Medium variant	
		Pre-Reform	Post-Reform
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	358.7	85.2
	Future Generations' Burden (in Thousand SEK)	-1205.2	-310.4
	Revenue Gap (in %)	9.1	2.2
	Transfer Gap (in %)	8.4	2.1
	Annual Fiscal Gap/S2 (in %)	5.2	1.2

Source: Own calculations.

The differences between our calculations and the European Commission (2009) are twofold: Firstly, we project the revenue side as well as public transfers via demographic projections while the European Commission (2009) projects revenues via GDP. As a result, revenues grow stronger in our case due to the high level of consumption taxes in the Swedish system (old people consume only slightly less than the younger working cohorts, see profiles in the appendix). This positive effect is counteracted by the second difference which is health and long-term care expenditure. While the European Commission assumes that half of the increment in life expectancy is spent in good health, we assume a constant health expenditure profile (see the discussion in section 2.5). This leads to a stronger growth in both health and long-term care expenditures.[27] Figure 6 shows the differences of both approaches via the *S2* indicator.

[27] Also the IMF expects a stronger growth in health expenditures in Europe as the European Commission (2009) assumes. See Clements et al. (2010) for details.

Figure 6: *S2*-indicator in different set-ups

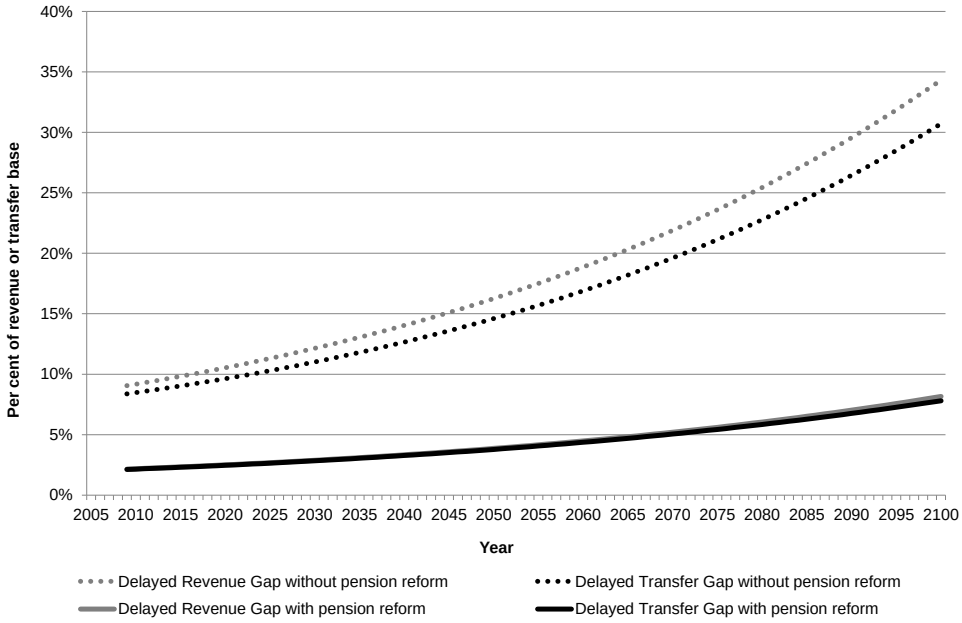


Source: Own calculations.

As one can see, if we would apply the European Commission (2009) framework without the pension reform, we would receive a *S2*-indicator of 8.2 percent p.a. Taking into account the pension reform reduces S2 about 4 percentage points. So it could be stated that the pension reform is worth 4 percent of GDP per annum in both of our revenue approaches (via GDP or via demographics). The difference between the two approaches is 3 percent of GDP per annum. So given the European Commission evaluation, health and long-term care expenditures are underestimated by 2.4 percent of GDP per annum compared to our approach.

Of course, the pension reform also changes the delayed indicators showing the cost of waiting as shown in Figure 7, too. The balance ratio of the pension system influences the slope of both delayed indicators over time as the demographic shifts between 2030 and 2050 are already taken into account via the balance ratio, at least for the pension system.

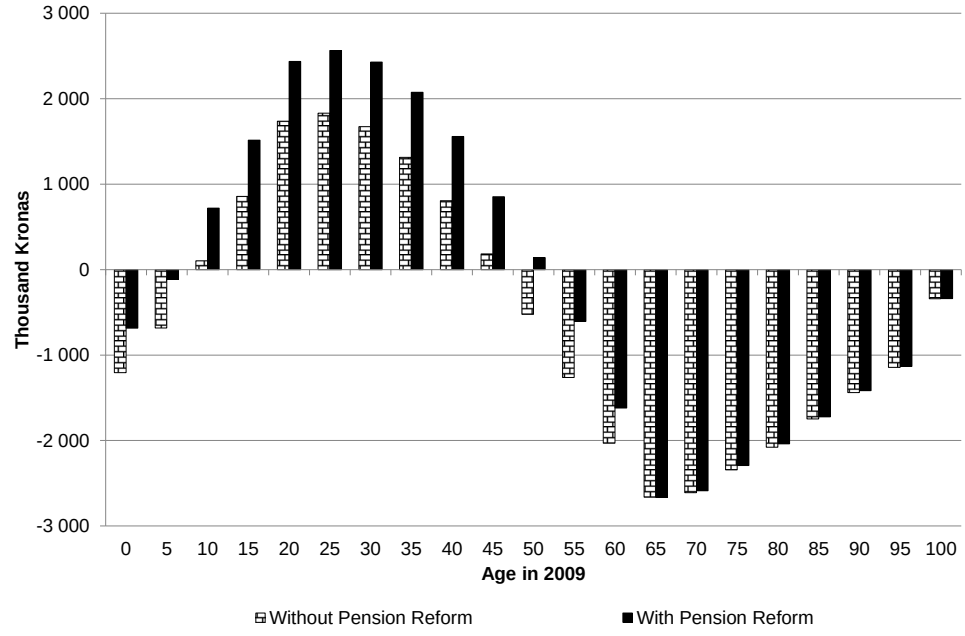
Figure 7: Delayed Indicators Pre- vs. Post-Reform



Source: Own calculations.

As we have shown in the previous paragraphs, the Swedish pension reform reduces the burden for future generations significantly. This implies, however, that living generations have to take some of the burden – in form of lower pension benefits. This result could also be seen in a comparison of the *Generational Accounts* before and after the introduction of the pension reform as presented in Figure 8.

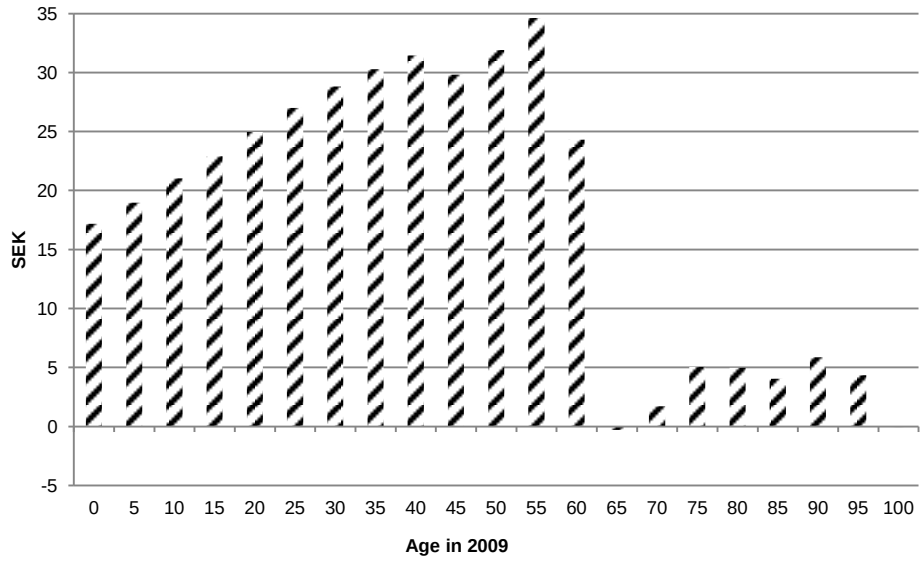
Figure 8: Generational Accounts Pre- vs. Post-Reform



Source: Own calculations.

To compare the generational accounts not only from the viewpoint of one cohort but between cohorts, we have to look at the differences of the generational accounts in annuities per cohorts as it is shown in Figure 9. Remarkably, the picture is not clear-cut. Laymen's intuition concerning the burden of the pension reform may be that the pensioners are hit the hardest by a pension reform but they are not. Pensioners are in fact the ones affected the least. In our calculations the cohort of 65 years olds even gains a little amount through the pension reform. This counter-intuitive result is probably due to missing data. As we rely on estimations about the probabilities of retirement and these lack a clear trend, we may miscalculate the true effect especially in the current living cohorts between 60 and 70 years. This does not alter the macro outcomes in respect to the sustainability indicators, however, it may lead to the counter-intuitive pattern of *Generational Accounts*.

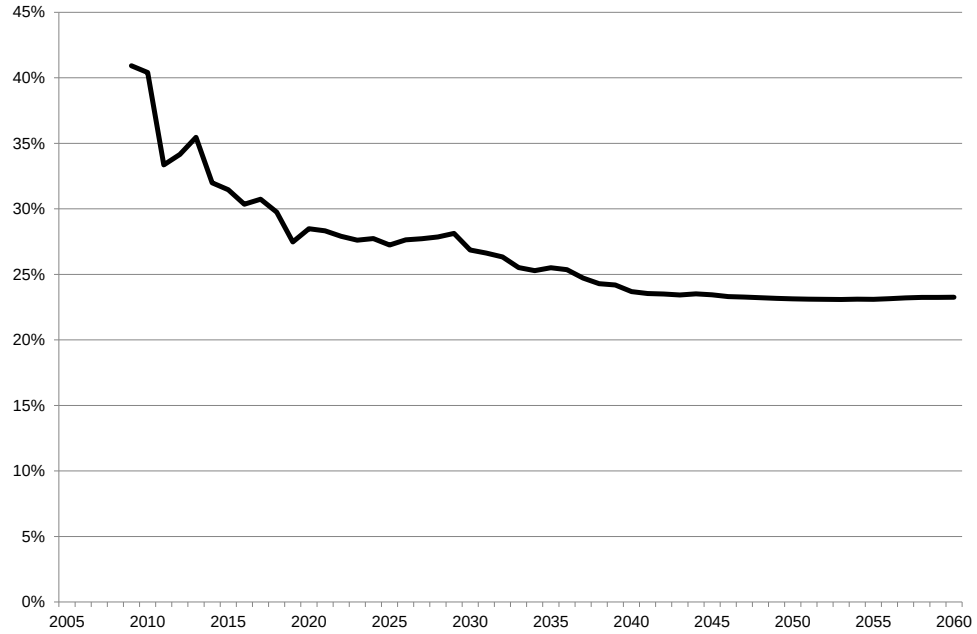
Figure 9: Induced Burden of the pension reform per cohort in annuities



Source: Own calculations.

Interestingly, the baby-boomer generations are hit the hardest by the pension reform. This can be explained by the balance ratio that leads to significant cuts in benefit growth especially for these cohorts. Due to the discounting of the reform effects, younger generations are not burdened to the same extent. However, in sum younger generations under 40 have to shoulder most of the burden laid out by the reform measures. This can also be seen in Figure 9 which depicts the development of the replacement ratio, here shown as the ratio of the average pension of the 65 year old cohort to GDP per capita. This ratio shrinks from nearly 41 percent in 2009 to only 23 percent in 2060. Similar numbers are reported by the European Commission (2009) which predicts the benefit ratio (measuring the generosity of public pensions in relation to the average wage) to fall from 48.1 percent in 2010 to 30.1 percent in 2060. The joint implication is in both cases that today's Swedish teenagers have to live with a pension level roughly 40 percent lower than their grandparents. Sustainability of the pension system thus comes with a price tag for younger generations.

Figure 10: Development of the benefit ratio (Average benefit of 65 year-olds to GDP per capita, g=1.5%, r=3%)



Source: Own calculations.

4.5 Sensitivity Analysis

Sensitivity of parameters and demographics

In order to analyze the sensitivity of our results to the exogenous parameters interest and growth rate, *r* and *g*, and to our different population projections we compute 15 different scenarios. Apart from our standard scenario, we test four additional combinations of growth and interest: *g*=1.5 and *r*=4.0 percent, *g*=2.0 and *r*=4 percent, *g*=2.0 and *r*=3.0 percent as well as *g*=1.0 and *r*=3.0 percent. Furthermore, we distinguish between three possible population scenarios – medium, high and low variant – as discussed above. Table 6 shows the sustainability indicators for all possible population scenarios combined with the described growth and interest rate settings, calculated without the effects of the pension reform. Table 7 shows the corresponding sensitivity analysis for the case of the pension reform.

The basic interpretation of the results in Table 6 is straightforward. Higher interest rates discount future public liabilities more heavily, giving them lower weight, and thus reducing the present value of *future generations' burden*, and the *fiscal gap*.

Table 6: Sensitivity Analysis of the Sustainability Indicators without Reform Effects

Spread	Indicators	Population Projection		
		Medium	**High**	**Low**
g=1.5% r=4.0%	*Fiscal gap (in % of GDP 2009)*	194.1	301.5	114.4
	Future Generations' Burden (in Thousand SEK)	-1190.1	-1434.7	-877.5
	Revenue Gap (in %)	8.1	11.2	5.3
	Transfer Gap (in %)	7.7	10.2	5.2
	Annual Fiscal Gap/S2 (in %)	4.6	6.3	3.0
g=2.0% r=4.0%	*Fiscal gap (in % of GDP 2009)*	255.8	419.6	140.0
	Future Generations' Burden (in Thousand SEK)	-1250.1	-1538.6	-878.7
	Revenue Gap (in %)	8.6	12.0	5.4
	Transfer Gap (in %)	8.0	10.8	5.2
	Annual Fiscal Gap/S2 (in %)	4.8	6.8	3.0
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	358.7	632.1	179.7
	Future Generations' Burden (in Thousand SEK)	-1325.5	-1672.4	-884.2
	Revenue Gap (in %)	9.1	12.9	5.4
	Transfer Gap (in %)	8.4	11.5	5.2
	Annual Fiscal Gap/S2 (in %)	5.2	7.5	3.1
g=2.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	576.9	1135.5	255.2
	Future Generations' Burden (in Thousand SEK)	-1424.4	-1865.4	-889.1
	Revenue Gap (in %)	9.7	14.1	5.5
	Transfer Gap (in %)	8.9	12.4	5.3
	Annual Fiscal Gap/S2 (in %)	5.9	8.8	3.2
g=1.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	252.8	413.6	138.8
	Future Generations' Burden (in Thousand SEK)	-1247.4	-1534.0	-878.6
	Revenue Gap (in %)	8.5	12.0	5.4
	Transfer Gap (in %)	8.0	10.8	5.2
	Annual Fiscal Gap/S2 (in %)	4.8	6.8	3.0

Source: Own calculations.

Table 7: Sensitivity Analysis of the Sustainability Indicators with Reform Effects

Spread	Indicators	Population Projection		
		Medium	High	Low
g=1.5% r=4.0%	*Fiscal gap (in % of GDP 2009)*	74.6	150.5	28.0
	Future Generations' Burden (in Thousand SEK)	-453.9	-713.4	-210.4
	Revenue Gap (in %)	3.1	5.6	1.3
	Transfer Gap (in %)	3.1	5.4	1.3
	Annual Fiscal Gap/S2 (in %)	1.8	3.2	0.7
g=2.0% r=4.0%	*Fiscal gap (in % of GDP 2009)*	69.4	166.5	12.7
	Future Generations' Burden (in Thousand SEK)	-335.3	-607.4	-74.4
	Revenue Gap (in %)	2.3	4.8	0.5
	Transfer Gap (in %)	2.3	4.6	0.5
	Annual Fiscal Gap/S2 (in %)	1.3	2.7	0.3
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	85.2	237.2	2.1
	Future Generations' Burden (in Thousand SEK)	-310.4	-623.7	-4.7
	Revenue Gap (in %)	2.2	4.9	0.1
	Transfer Gap (in %)	2.1	4.7	0.1
	Annual Fiscal Gap/S2 (in %)	1.2	2.8	0.0
g=2.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	34.0	251.7	-64.3
	Future Generations' Burden (in Thousand SEK)	-78.5	-409.2	231.6
	Revenue Gap (in %)	0.6	3.1	-1.4
	Transfer Gap (in %)	0.6	3.1	-1.4
	Annual Fiscal Gap/S2 (in %)	0.3	2.0	-0.8
g=1.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	87.0	197.5	22.6
	Future Generations' Burden (in Thousand SEK)	-425.7	-729.1	-138.7
	Revenue Gap (in %)	2.9	5.7	0.9
	Transfer Gap (in %)	2.9	5.5	0.9
	Annual Fiscal Gap/S2 (in %)	1.7	3.3	0.5

Source: Own calculations.

Higher economic growth rates increase both taxes and transfers. However, the generational account of a newborn is negative, indicating that transfers have a larger share of the expanding economy than taxes. Expanding the economic base through economic growth will therefore exacerbate the *fiscal gap* – at least in the absence of policy changes that increase taxes relative to transfers.

The demographic profiles depend on migration, longevity, and fertility. The detailed impact of altering migration lies outside the scope of this analysis.

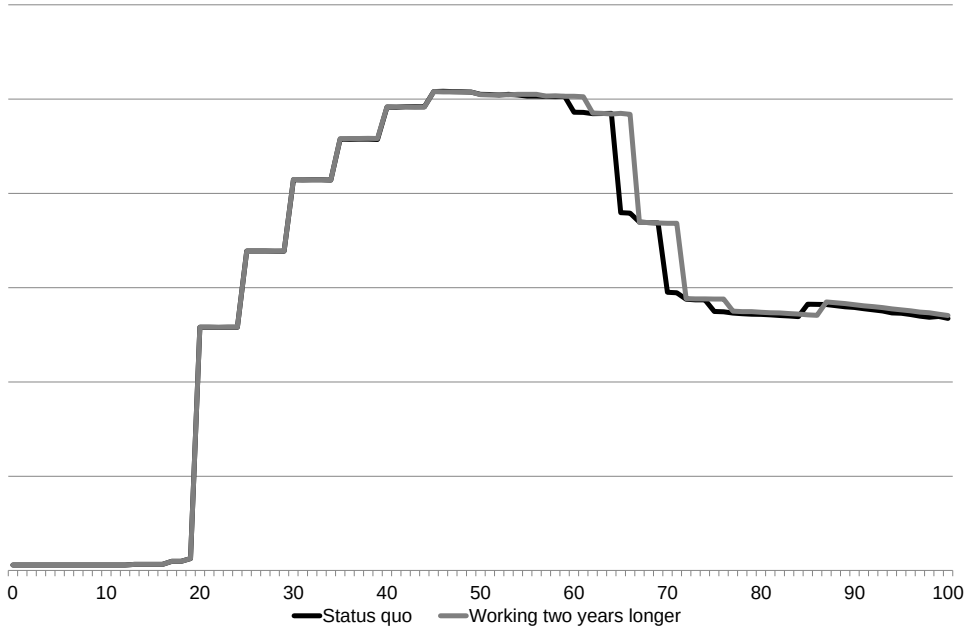
Increased longevity clearly amplifies the *fiscal gap* through the need for higher transfers. Sometimes it is argued that intergenerational economic imbalances can be alleviated through higher fertility rates. It turns out that when newborns have negative *Generational Accounts*, burdens on future generations increase with higher fertility. This effect is weaker in a country with high explicit debt, since the explicit debt can be shared on a larger population. The Swedish situation is different given its rather low level of external debt.

These conclusions also hold in case of the pension reform shown in Table 7 with one exception. Now a higher growth rate given a constant discount level reduces the burden. This is due to the balance ratio of the pension formula that drives a wedge between the growth of revenues and expenditures (a large part of which are pension-related). One setup even (low variant, g=2.0%, r=3.0%) results in intertemporal assets, i.e. a negative *fiscal gap*.

Sensitivity of working lifetime

One major goal of the Swedish pension reform —next to achieving a sustainable pension system—was to strengthen incentives to work longer. As the constant age-specific profiles of the *Generational Accounting* method do not take these effects into account, we apply an experiment to evaluate the effect of working two years longer. By design, this has no effect on the pension system's sustainability but rather on the rest of public coffers as people pay more in income and consumption taxes (given that with a higher income they consume more). Figure 11 illustrates this effect by adjusting the age-specific revenues from 55 years on. The prolongation is two months every year from 2010 to 2022.

Figure 11: Prolongation of working lifetime - Effects on age-specific public revenues



Source: Own calculations.

As Table 8 shows, this has a significant effect on fiscal sustainability as Sweden's intertemporal liabilities are reduced to less than the current external debt. Due to the prolongation of working lifetime for current living generations, they now carry most of the burden, thereby reducing the future generations' burden significantly. However, this is a stylized experiment and the actual incentive effects remain to be seen.

Table 8: Indicators in Comparison – Prolongation of working lifetime

Spread	Indicators	Scenario – Medium variant	
		Status quo	Working two years longer
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	85.2	34.3
	Future Generations' Burden (in Thousand SEK)	-310.4	-121.4
	Revenue Gap (in %)	2.2	0.9
	Transfer Gap (in %)	2.1	0.9
	Annual Fiscal Gap/S2 (in %)	1.2	0.5

Source: Own calculations.

5 International Comparison

Sweden's problems with aging and fiscal sustainability are quite similar to those of other countries. The relevant research question is whether there are quantitative differences between countries, and if so, how large they are and why they occur. We try to answer the first two questions and discuss the latter. Our choice for comparison, Germany and Norway, is based on the fact that all three countries have passed significant pension reforms in the last two decades. Outcomes for Germany are taken from Hackmann et al. (2011) while the results for Norway are supplied by Hagist et al. (2011). Both studies are also based on the public budgets of the base year 2009 and include pension reforms.

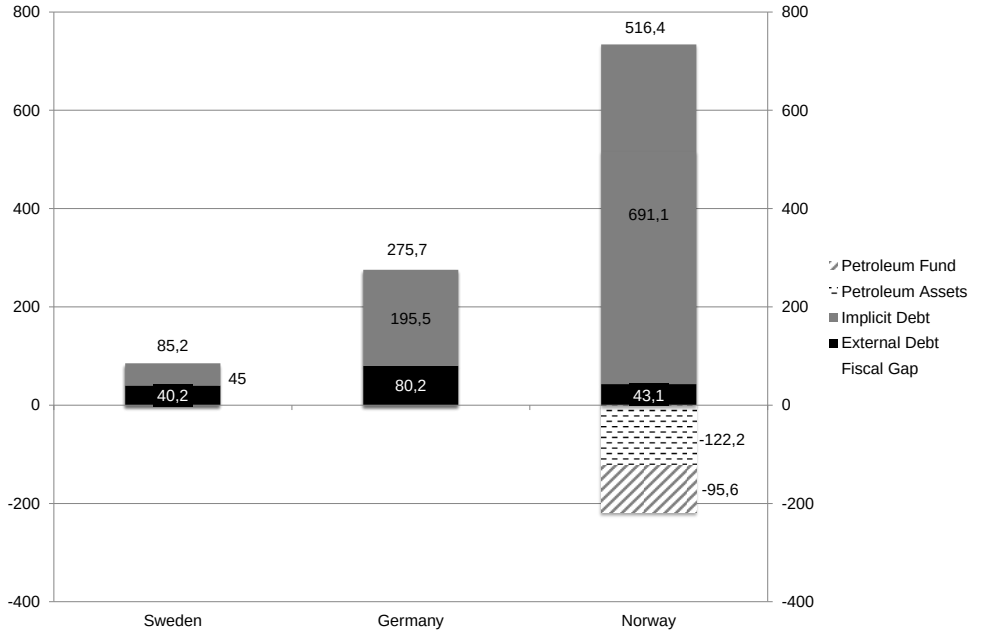
5.1 Indicators and Analysis

Figure 12 shows the fiscal gaps for the three countries. According to the relative magnitude of this indicator, Sweden is the front-runner with Germany in second place. Germany is clearly better off than Norway, trailing with a fiscal gap of about five times GDP.

However, there are caveats in this cross-country comparison. The fiscal gap might not be appropriate for an international comparison due to several reasons. Firstly, it is an indicator that reacts sensitively to changes of growth and discount rates, or more precisely to the spread between these.[28] Secondly, all of the three countries have different demographic developments which determine their future economic power and so their ability to pay their debts. With a rising population, the economic power of Sweden or Norway will differ from Germany's where not only the population will shrink but even more so but even more so its workforce which co-determines GDP. An appropriate indicator for an international comparison should take these facts into account.

[28] One could solve this problem by a thorough sensitivity analysis but it would still be preferable to have a robust indicator for comparison. We think that the fiscal gap for one country alone is a valuable indicator (for policy implications) since it is easy to understand and related to other fiscal indicators like the debt quota.

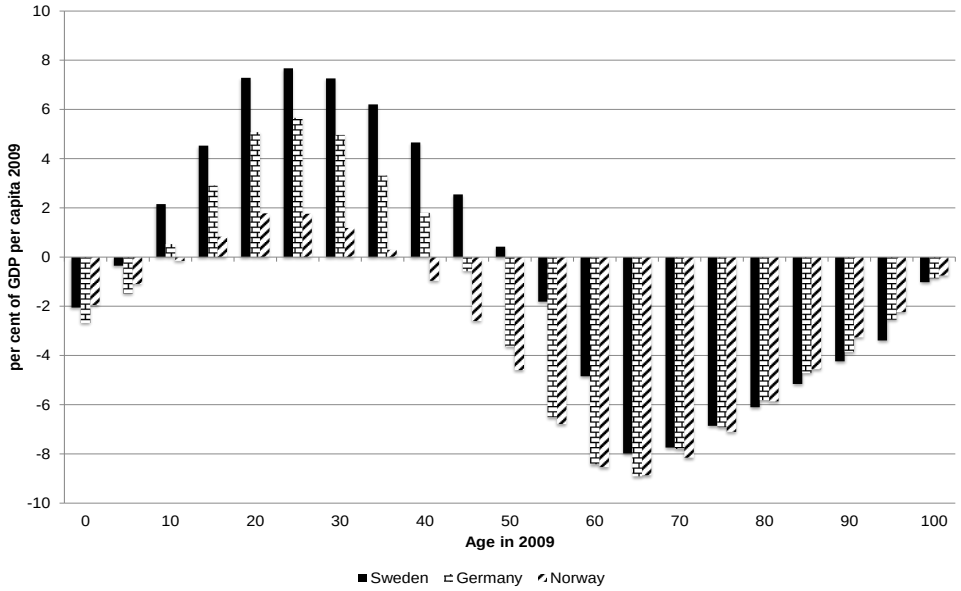
Figure 12: Fiscal gaps in comparison (Medium Population Scenarios, g=1.5%, r=3%)



Source: Own calculations.

Our second indicator, the *future generations' burden*, overcomes at least the second flaw of the *fiscal gap*. Now two dynamic values, the intertemporal public liabilities and the size of future generations, are set in proportion to each other. This ratio accounts for the differences in the demographic development. Table 9 shows the results for the *future generations' burden* for our different scenarios and countries. The findings revise the picture of the *fiscal gap*. Due to its demographic development, Germany burdens its future citizens with the highest debt. Every newborn after 2009 would have to bring 5.2 times the GDP per capita of 2009 with them to stabilize the current fiscal policy. Second comes Norway with over 4.2 times its GDP per capita of 2009. As its *fiscal gap* already hinted at, Sweden burdens its future citizens the least with "only" extra net taxes of 0.9 GDPs per capita compared to their living counterparts.

Figure 13: Generational Accounts in comparison (Medium Population Scenarios, g=1.5%, r=3%)



Source: Own calculations.

As the position of Sweden is relatively clear, one wonders why Germany and Norway change places given the future generations' burden. The explanation lies in the demographic development. Norway's growing population means that more unborn future generations shoulder the fiscal gap; Germany is the demographic opposite. In addition, although Germany has a lower fiscal gap overall, the especially costly living cohorts (see the *Generational Accounts* in Figure 13) are relatively larger in Germany. Interestingly, Norway taxes its younger generations the less with the 25 years old cohort pay only twice the GDP per capita while the transfer to the elderly are quite equal among Norway and Germany and even close to Sweden. The latter country is in every respect far more balanced than both its peers, with relatively equal net transfers to newborns (and so future generations), but relatively high net taxes of working generations and especially low transfers to baby-boomer generations.

Again the problem with the indicator *future generations' burden* is that it is, like the *fiscal gap*, very volatile to changes of the growth-discount spread. That is why we report two more indicators, the so called *revenue and transfer gap*, which are both very well comparable across countries because they are sensitive to the different demographic developments and thus to the differences in future economic power. Also, they are not sensitive to changes of the growth and discount rate. The *revenue gap* states how taxes would have to rise immediately for living and future generations to bring the current fiscal policy on a sustainable track. Accordingly, the *transfer gap* reports the proportion by which benefits and statutory transfers would have to be cut immediately to reach a sustainable level. Results for all indicators are shown in Table 9 together with the initial tax and transfer quotas.[29]

[29] Note that the initial transfer quota is calculated excluding interest payments.

Table 9: Indicators in International Comparison

Spread	Indicators	Country		
		Sweden	Germany	Norway
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	85.2	275.7	516.4
	Future Generations' Burden (in % of GDP per capita 2009)	0.9	5.2	4.2
	Revenues as share of GDP in 2009	47.1	40.1	44.3
	Revenue Gap (in %)	2.2	13.1	12.5
	Sustainable Tax Quota (in % of GDP 2009)	48.1	45.4	49.8
	Transfers as share of GDP in 2009	53.3	50.1	46.2
	Transfer Gap (in %)	2.1	11.2	11.0
	Sustainable Transfer Quota (in % of GDP 2009)	52.2	44.5	41.1
	Annual Fiscal Gap/S2 (in %)	1.2	5.5	-

Source: Own calculations and see above.

All indicators show that relatively Germany faces the biggest demographic challenge. Revenues must rise about 13.1 percent from their current level, which would lead to a new tax quota of 45.4 percent of GDP (compared to 40.1 without this uprating).[30] Transfer cuts turn out not to be as large as revenue increases because of their demographic profile. While taxes and duties are mostly paid by the working generations, the transfers are mainly received by the elderly, to whom the so-called baby boomer generations will also belong in a few years. Due to this demographic leverage effect, transfer cuts do not have to be as large as revenue increases. Norway comes in second with revenue increases of 12.5 percent. The tax quota would then be around 49.8 percent of GDP and so even higher than in Germany. Again, transfer cuts would not have to be as large as the tax changes but the difference between revenue increases and transfer cuts is not as large as in case of Germany. With a necessary increase in taxes of 2.2 per cent or a cut in transfer spending of about 2.1 percent Sweden remains in its favorable position.

5.2 Conclusion

The discussed sustainability parameters differ quite substantially across the three analyzed countries. The main cause for this is the Swedish pension reform. While the European Commission (2009) expects the German benefit ratio to shrink from 50.4 percent to 42.5 in 2060—a 16 percent cut —it will shrink about 40 percent from 48.1 to 30.1 percent in Sweden. This may lead to fiscal sustainability, but raises the question of political sustainability.

[30] This demonstrates why the results of the *revenue and transfer gap* have to be seen in a relative way because Germany already has a tax quota of 40.1 percent of GDP without any augmentation of the tax level. For large and middle-sized economic powers like Germany such rises in the level of taxation would also probably result in changes in relative factor prices (depending on which taxes would be increased). Generational Accounting cannot catch these effects. For small open economies like Sweden and Norway, factor prices would probably not change and so our results would not be impaired. For an analysis of Generational Accounting in General Equilibrium, see Fehr and Kotlikoff (1996), Raffelhüschen and Risa (1997) and Börstinghaus and Hirte (2001).

Another source of differential sustainability is clearly the diverging demographic development. Germany is already the oldest economy of the three in 2009. This will last due to relatively low net migration and a rather low fertility rate in Germany, while both Norway and Sweden enjoy quite high migration and fertility. Life expectancy is expected to rise similarly in all three countries with the highest current level in Norway. Furthermore it seems that Sweden taxes younger generations between 20 and 40 years relatively more that it is the case in Germany and especially in Norway. This is interesting and probably the main cause for the smaller fiscal gap, at least in our comparison. This, too, is probably due to Sweden's severe pension cuts.

An important lack of the Generational Accounting method, even more so in an international comparison, is the aspect of quality. Sweden may look more sustainable than Germany but it has also already a higher expenditure and tax ratio than the bigger partner. The relevant question is whether Swedes are getting better services and living standards from their higher taxes than their German counterparts. This is particularly relevant for the comparison of sustainable levels of taxes or public expenditure. Unfortunately, this question remains unanswered.

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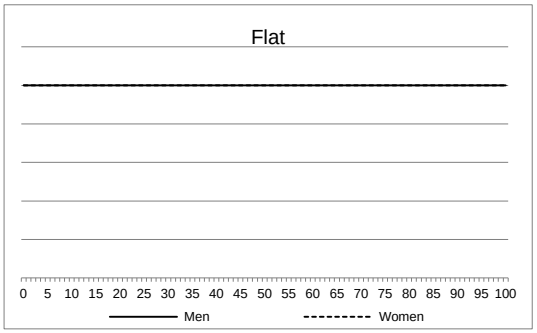
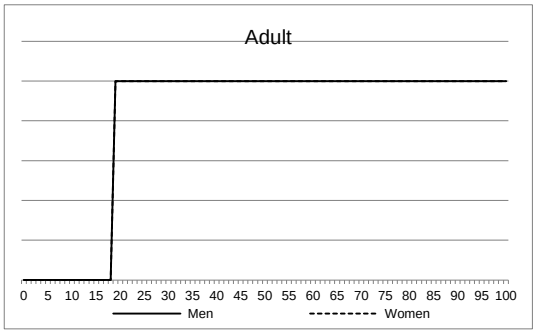
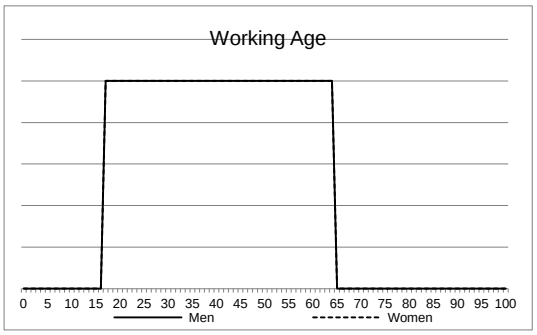
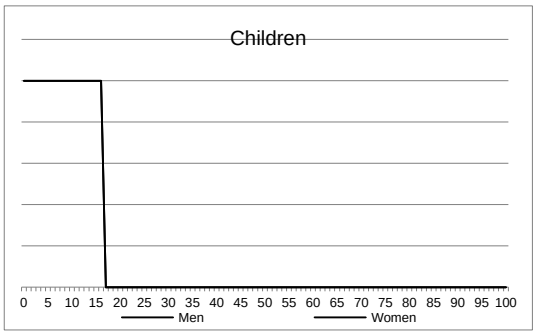
Appendix

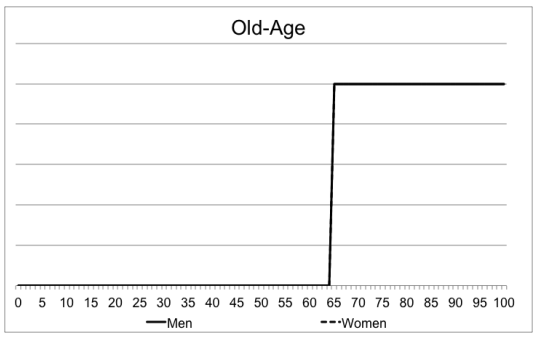
Table A-1: Swedish micro-profiles

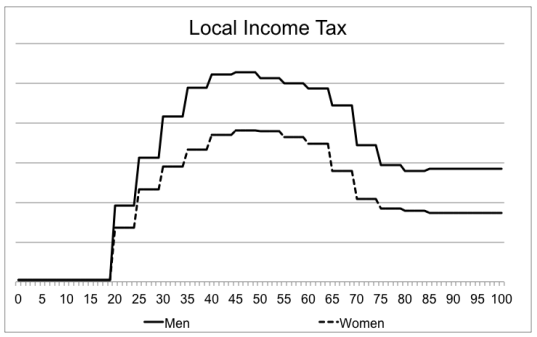


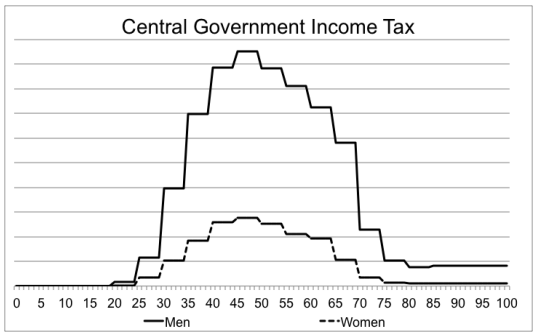


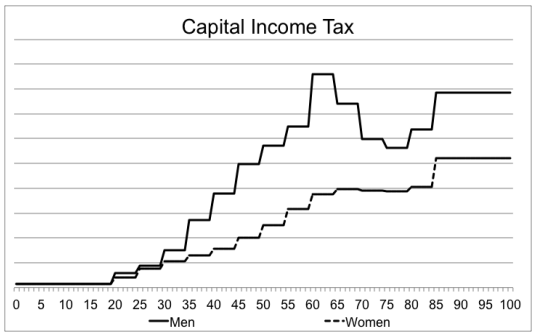












Source: Own calculations and see section 3.3

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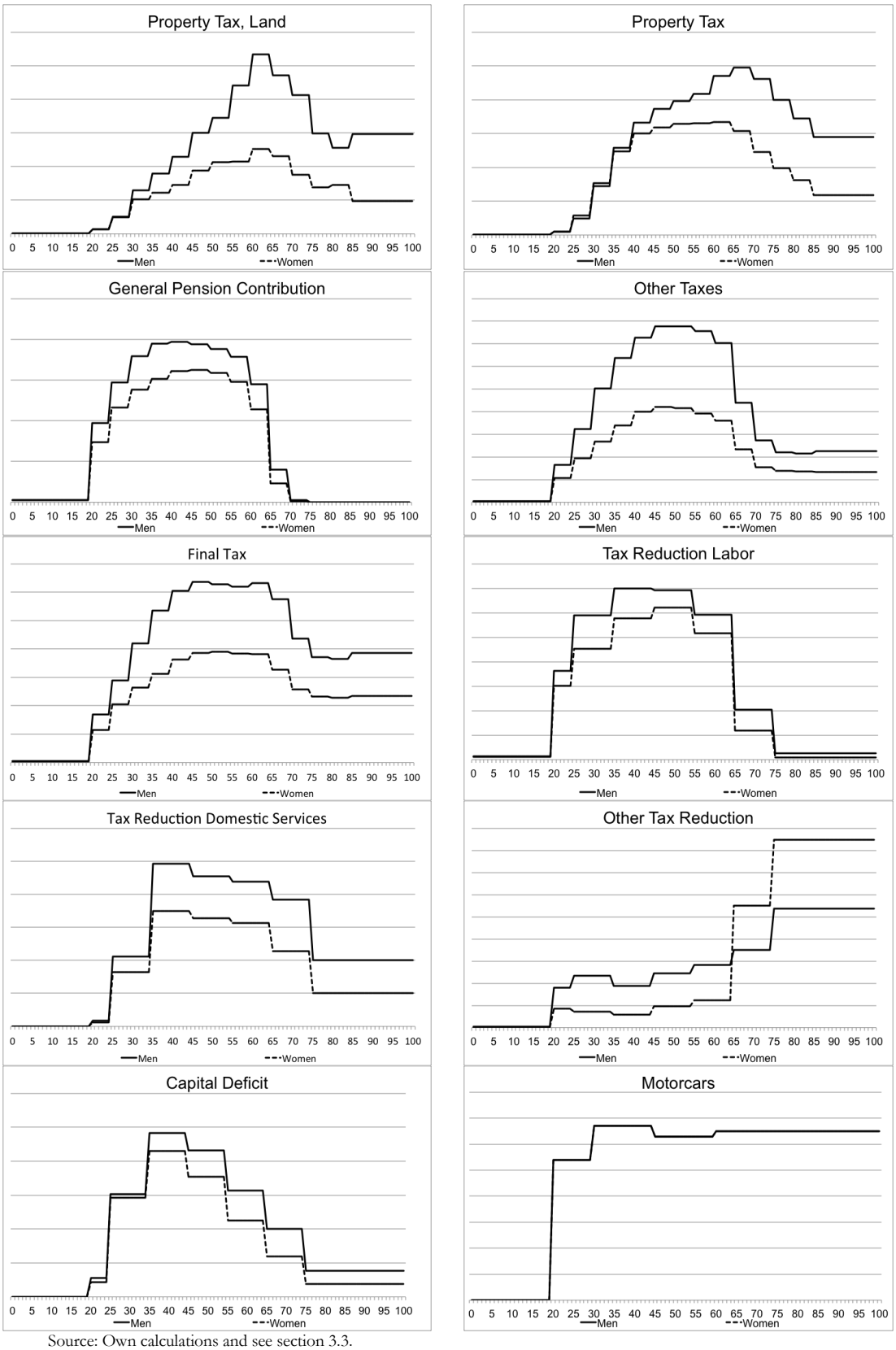

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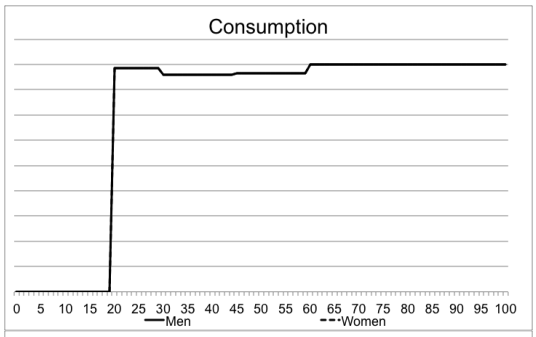

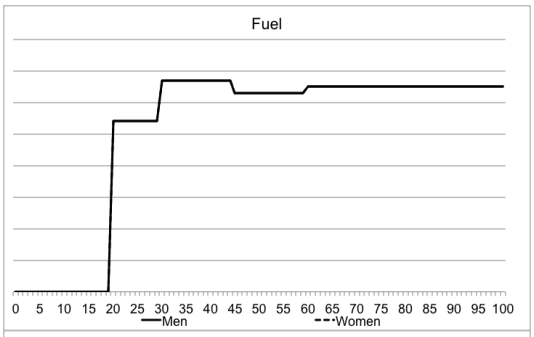

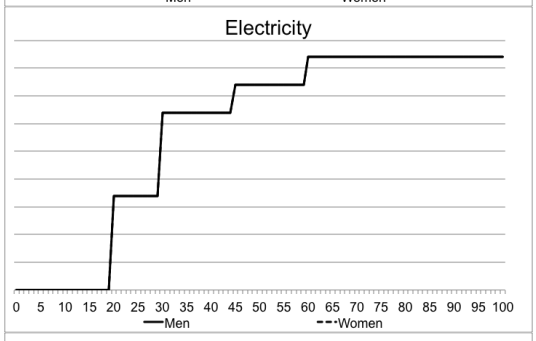

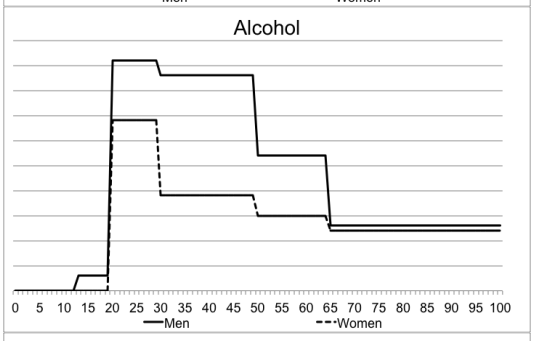

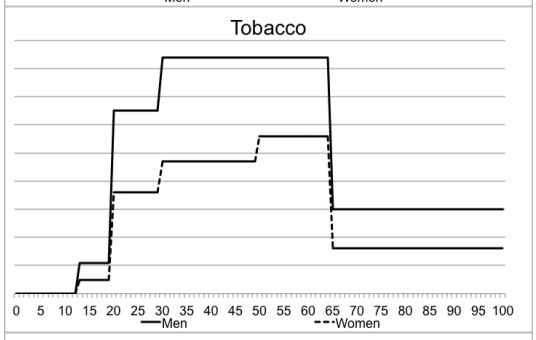

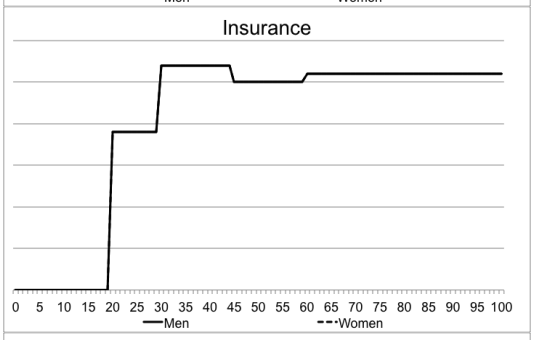

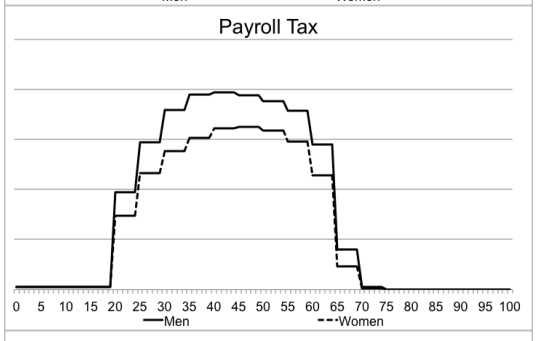

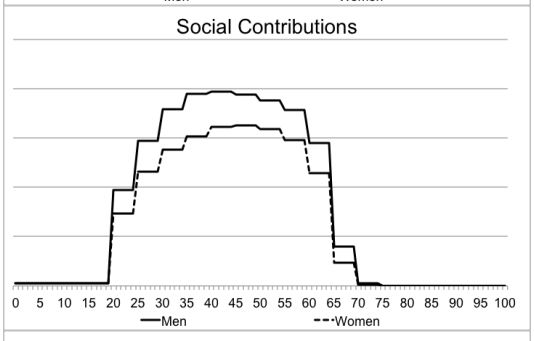

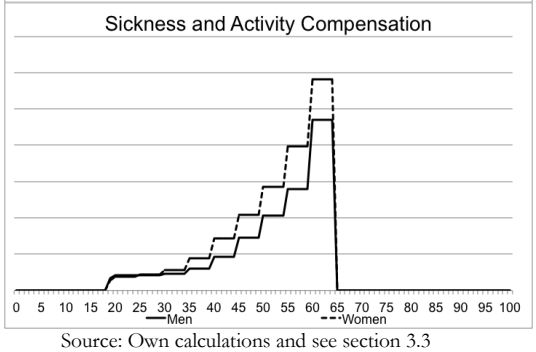

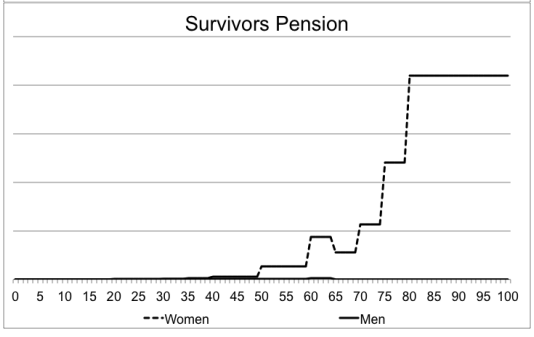

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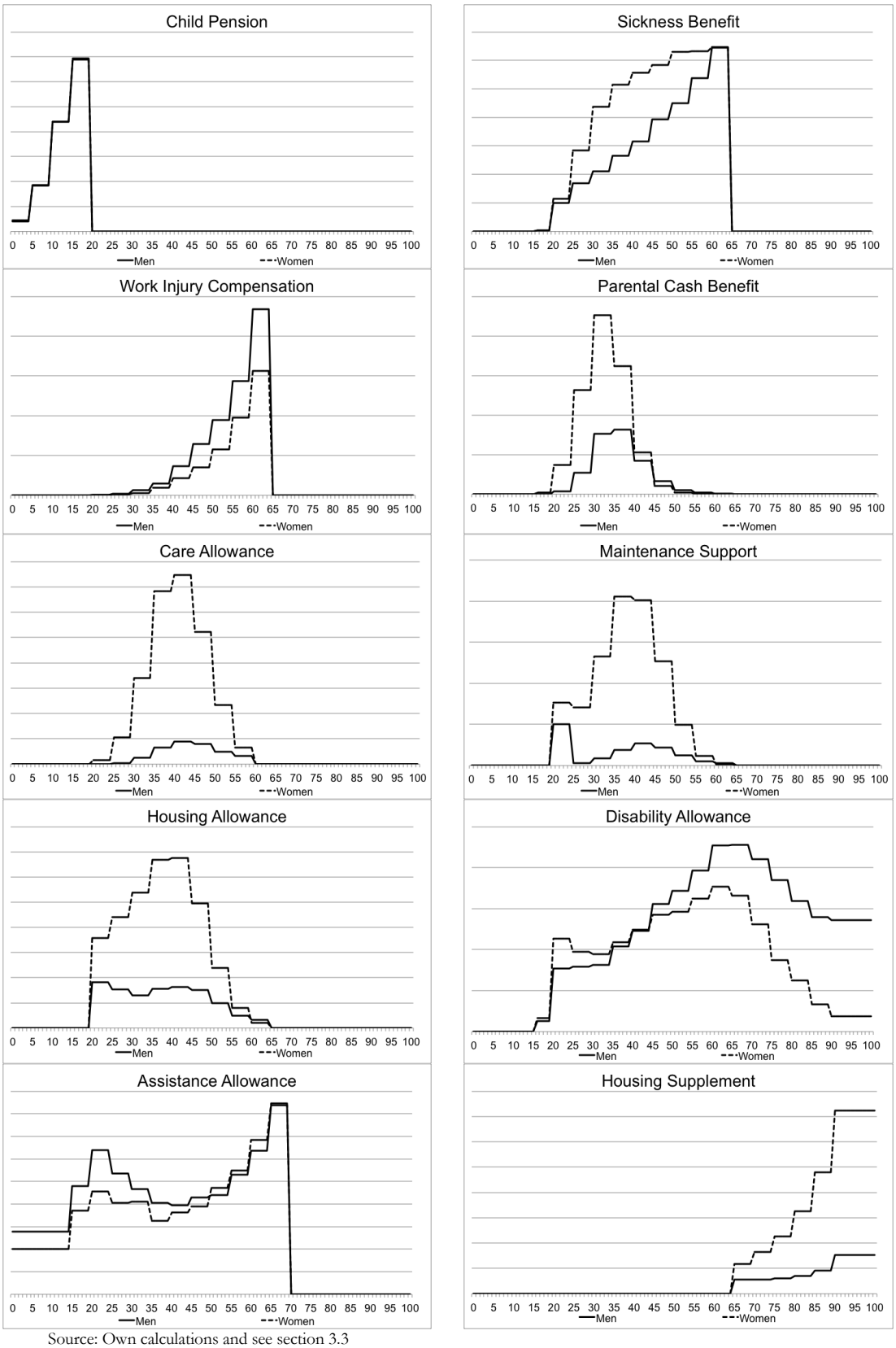

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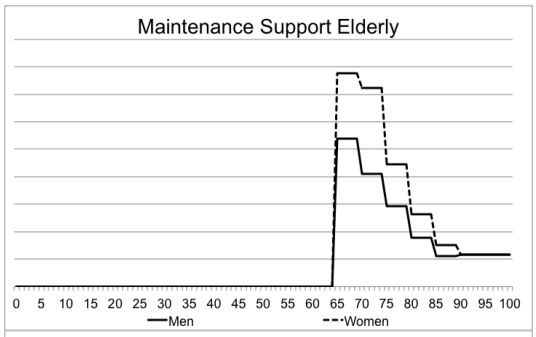

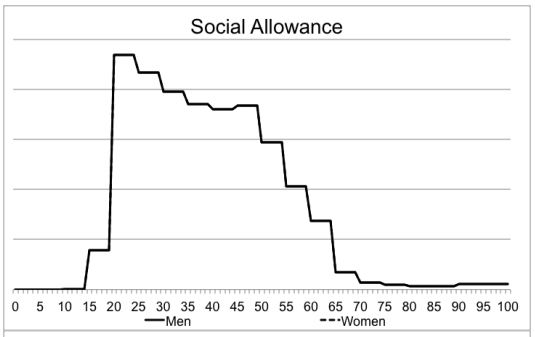

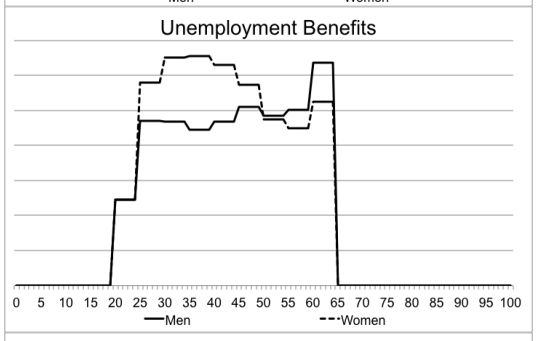

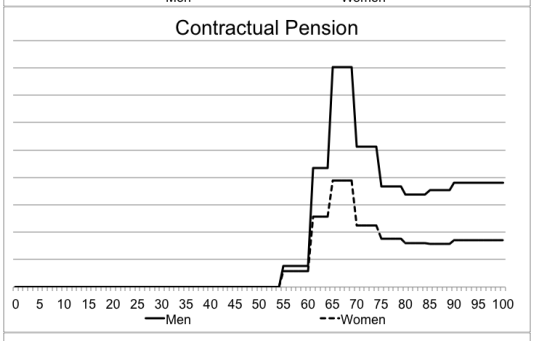

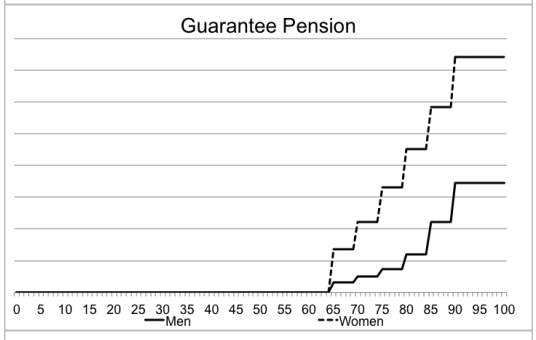

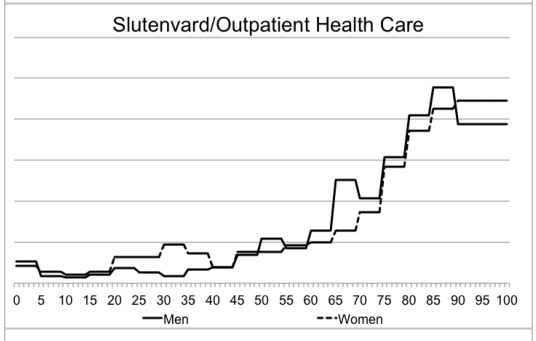

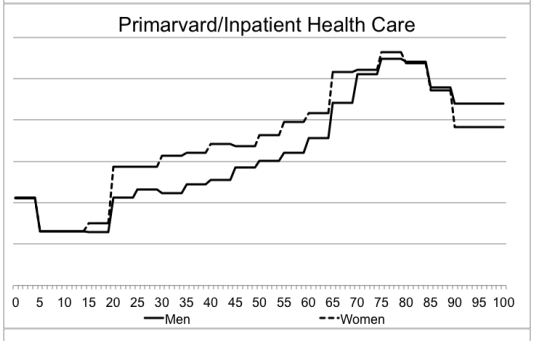

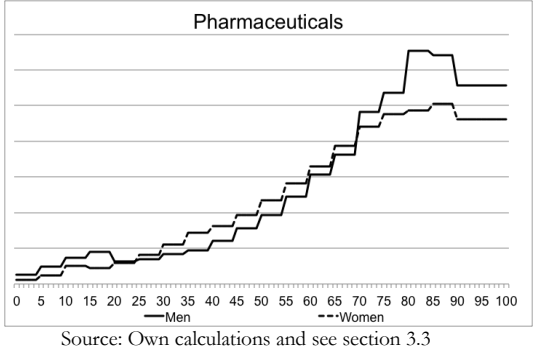

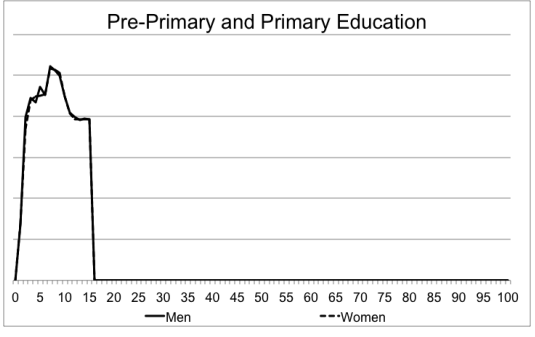

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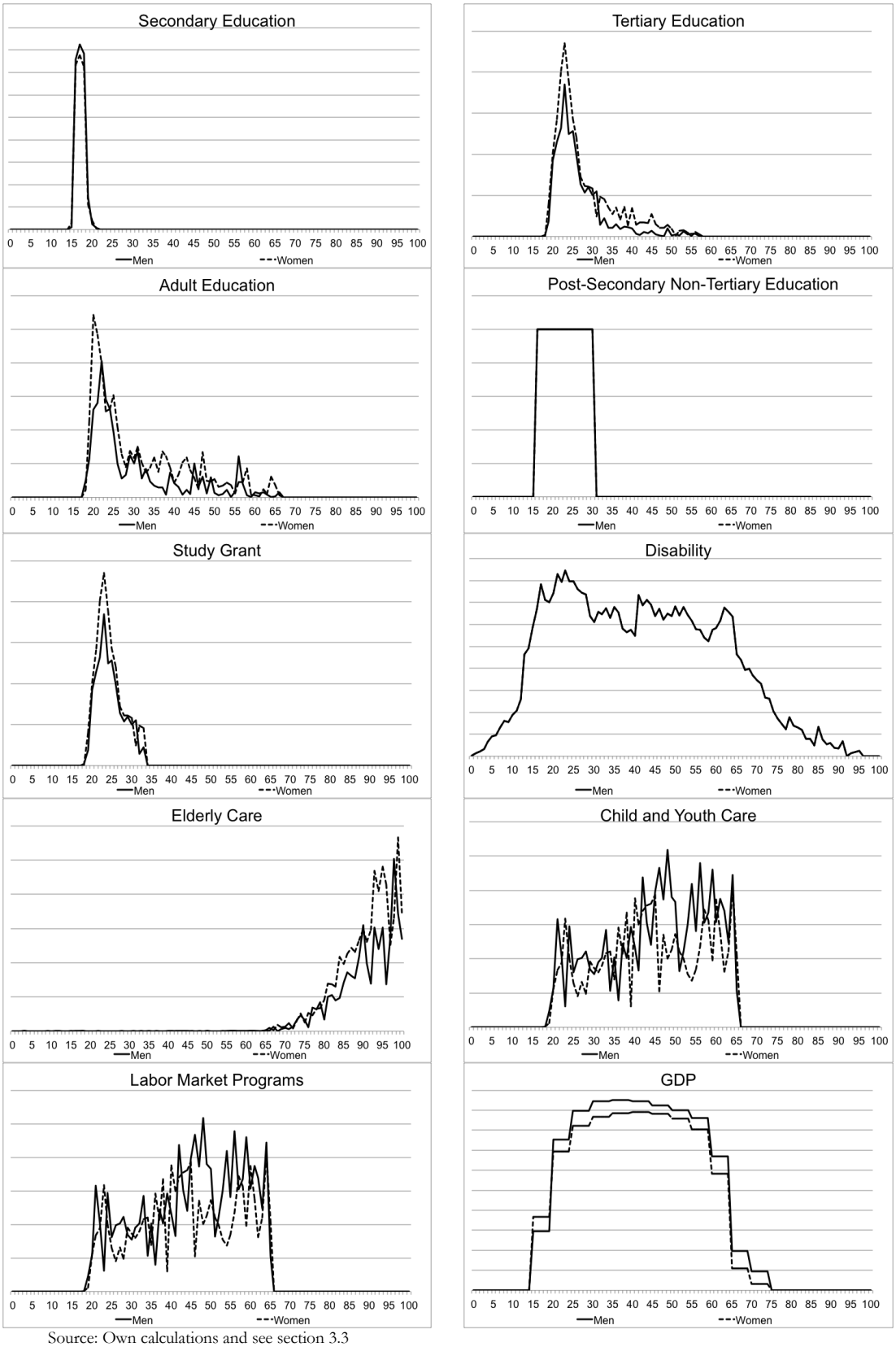
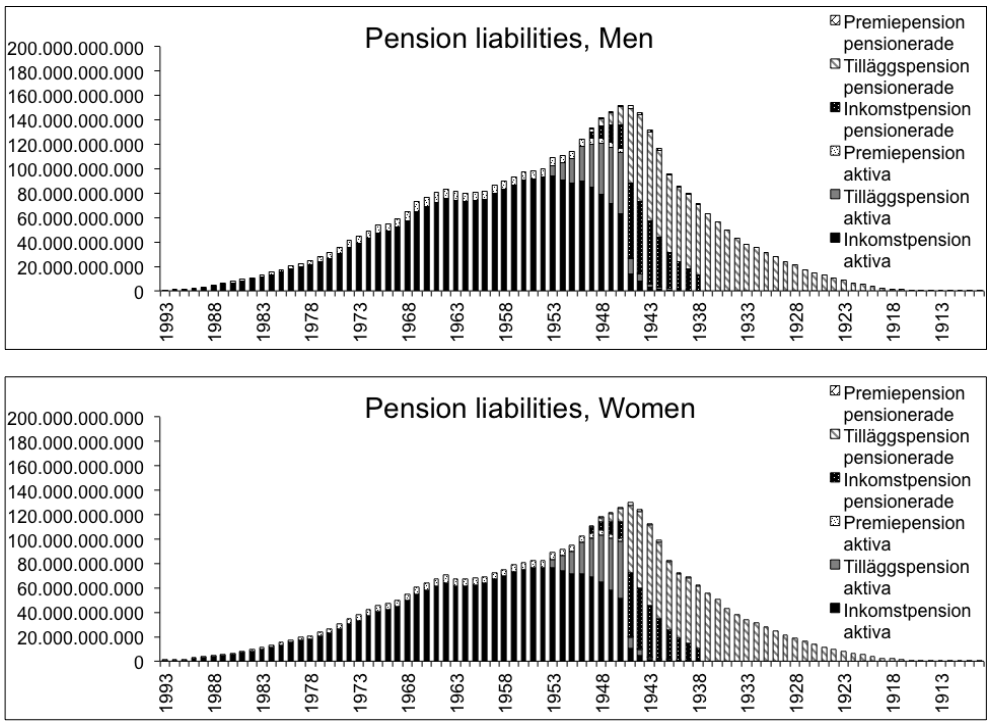


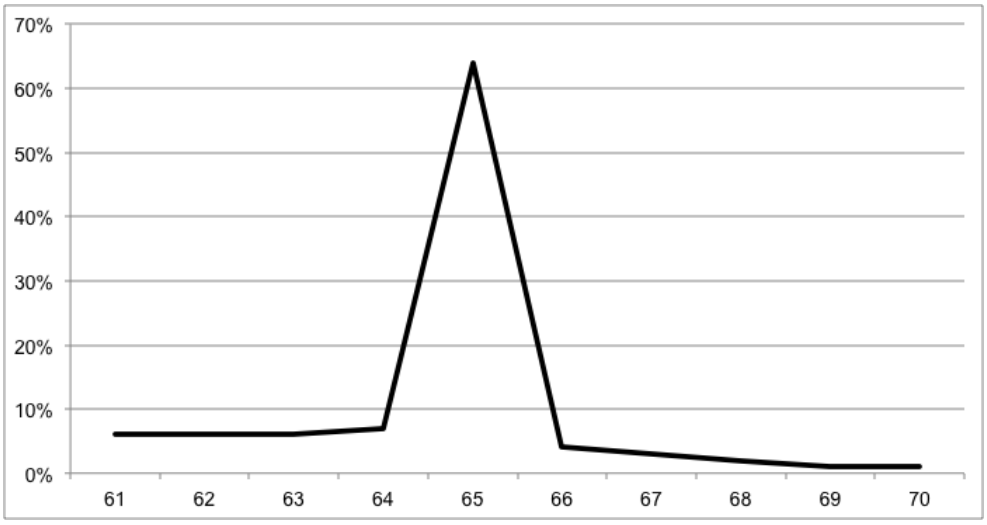
Source: Own calculations and see section 3.3

Figure A-1: Age-specific pension liabilities in 2009



Source: Swedish Pension Agency (2011)

Figure A-2: Probability to retire at a certain age



Source: Own calculations based on Swedish Pension Agency (2011)

Table A-2: Assets and Liabilities of the Pension System in 2009

Item	Value in 2009 (in million SEK)
Buffer Fund	827,069
Contribution Assets	6,361,925
Pension Liabilities	7,511,692

Source: Swedish Pension Agency (2011)