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Fiscal Sustainability and Policy Rules

under Changing Demographic Forecasts

Jukka Lassila* – Tarmo Valkonen** – Juha M. Alho***

* ETLA – The Research Institute of the Finnish Economy, jukka.lassila@etla.fi
** ETLA – The Research Institute of the Finnish Economy, tarmo.valkonen@etla.fi
*** University of Eastern Finland, School of Computing, Statistics, juha.alho@uef.fi

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Abstract

All practical evaluations of fiscal sustainability that include the effects of population ageing must utilize demographic forecasts. It is well known that such forecasts are uncertain, and that has been taken into account in some studies by using stochastic population projections jointly with economic models. We develop this approach further by introducing regular demographic forecast revisions that are embedded in stochastic population projections. This allows us to separate systematically, in each demographic outcome and under different policy rules, the expected and the actualized effects of population ageing on public finances. We show that the likelihood of sustainability risks is significant, and that it would be wise to consider policies that reduce the likelihood of getting highly indebted. Furthermore, although demographic forecasts are uncertain, they seem to contain enough information to be useful in forward-looking policy rules.

Key words: Public finance, fiscal sustainability, stochastic population simulations, changing demographic forecasts

JEL: H30, H62, H63, J11

Tiivistelmä

Julkisen talouden kestävyysarvioissa tarvitaan ennusteita tulevasta väestökehityksestä, jos väestön ikääntymisen seuraukset halutaan ottaa mukaan. Väestöennusteiden epävarmuus on suurta, ja tämä on eräissä aiemmissa tutkimuksissa huomioitu tekemällä kestävyyslaskelmia stokastisten väestösimulaatioiden avulla. Tässä tutkimuksessa näihin simulointeihin on lisätty periodeittain päivittyvät väestöennusteet. Tämän uuden tekniikan avulla tutkimme sekä odotettuja väestön ikääntymisen vaikutuksia julkiseen talouteen että odotuksista poikkeavien toteutumien vaikutuksia erilaisten politiikkavalintojen oloissa.

Julkisen talouden nykylinjaa kuvaamme politiikkana, jossa työeläkemaksuja nostetaan eläkemenojen rahoittamiseksi, ja terveys- ja hoivamenot rahoitetaan kunnallisveroilla ja valtionavuilla. Valtion veroasteet pidetään nykyisillä tasoillaan. Osoitamme, että riski valtion velan kasvusta kestämättömäksi on merkittävä, ja ylivelkaantumisen estämiseksi olisi syytä miettiä vaihtoehtoisia tai täydentäviä politiikkavalintoja. Osoitamme myös, että vaikka väestöennusteet ovat hyvin epävarmoja, niiden varaan voidaan rakentaa hyödyllisiä politiikkasääntöjä velkaantumisen rajoittamiseksi.

Asiasanat: Julkisen talouden kestävyys, muuttuvat väestöennusteet, stokastiset väestösimulaatiot

1 Introduction

Population ageing will in the coming decades result in age structures vastly different from anything previously experienced. It will put pressure on public finances, since the elderly, whose population shares are increasing, are net recipients of public outlays and those in working ages, a declining group at least relatively and in many countries absolutely, are the net payers.

Analysis of sustainability is thus needed to make a realistic foresight on whether the public sector can in the future finance the services and transfers it has explicitly or implicitly promised to citizens. This is especially important in Nordic countries where public welfare transfers and services are extensive and people on the whole seem to count on them when pondering on how the old age will turn out economically.

This study concerns the sustainability of public finances in Finland. It considers the large public sector which consists of the state, the municipalities and the social security institutions including the statutory earnings-related pension system.

We wish to utilize the empirical research concerning the uncertainty in demographic projections. Studies show that official long-term demographic projections, both national and international, have in the past been highly uncertain and in some respects systematically biased (see Keilman, 2008). Although better use of statistical methods might reduce the biases, the uncertainty remains. Other studies have evaluated the effects of demographic uncertainties on the economic consequences of population ageing, and shown, not surprisingly, that economic estimates also become very uncertain (see Alho, Lassila and Valkonen, 2005). The results of this study support these findings.

The key novelty here is that, in a setup of stochastic population projections, we also include changing demographic forecasts. This allows us to separate expected and actual outcomes in fairly realistic situations and analyze the consequences of some policy rules, especially from their timing point of view.

Recently, Leeper (2010) criticized fiscal policy analysis in general and sustainability analysis as a specific part of it for a poor state of modelling. He longed for a situation where 'detailed analyses of "unsustainable fiscal policies" are no longer conducted without explicit analysis of expectations and dynamic adjustments" (Leeper, 2010, p.2). Our approach fully agrees with Leeper's suggestions.

This study is made for the National Audit Office of Finland. It is Finland's Supreme Audit Institution and reports directly to Parliament. It audits the state's finances and asset management in order to ensure that public funds are spent wisely and in compliance with legislation. Thus the results and messages of this sustainability analysis are being disseminated to a vast group of political decision-makers. Disseminating the uncertainties involved is difficult. It is, however, an integral part of this project. We aim to develop graphical representations, examples of which are included here, that hopefully clarify the issues without simplifying any essential features away.

In Section 2 of this study, we first discuss general issues of sustainability and the role of uncertainty in the analysis, based on previous research. We then discuss in Section 3 the key methodological improvement in stochastic population projections, namely embedding periodically updated demographic forecasts to each time-point in each simulated population path. Section 4 describes the economic model and the long-term projection outcomes for the Finnish public sector finances under our base policy assumptions. The role of additional policy rules and their implications for sustainability of Finnish public finances is analyzed and discussed in Section 5, using VAT-rules that are based on the expected size of the sustainability gap or expected indebtedness. Section 6 contains some observations concerning the effects of tax increases on the sustainability gaps that will be calculated in the future. Section 7 concludes.

Fiscal crisis and sustainability analysis

The European fiscal debt crisis changes the way how fiscal sustainability will be assessed in future in the EMU. The previous practice of publishing target-orientated non-binding Stability and Convergence Programmes for the medium term and numerical illustrations of the way how government debts explode in the long term has turned out to be useless and even misleading in the case of the strongly indebted Member States. Markets do not any more trust promises or lax agreements prone to political discretion and wait for the accumulation of debt, but raise the interest rate. Also the EU has been compelled to react to the crisis by reforming its surveillance, guidance and sanction mechanisms.

From the point of view of sustainability evaluations, this development raises three issues. The first is the credibility of the new EU rules. If they are effective, the existing structural deficits will be corrected in the medium term, public debts will be lower in the long term and the main focus of sustainability analysis returns to long-term ageing expenditure. The second issue is the increased sensitivity of the interested rates on government bonds on the deficits and debts in the euro area. This will be the more important the less credible and efficient the new EU rules are. The third issue is the political capacity of the governments to follow strict fiscal policy and implement large enough austerity measures, if necessary.

The challenge is aggravated by the need to simultaneously improve competitiveness in the crisis countries. This reminds of the situations in which many developing countries have struggled for a long time, with one important exception: devaluation is not allowed for single Member States. Improvement in competitiveness requires structural reforms, lower wages, fiscal devaluations and weaker euro.

European Commission aims to learn from recent experiences, when it reforms its sustainability analysis. It suggests introducing several new methodologies (European Commission, 2011). The first is to measure the fiscal risk linked to the banking sector in order to estimate the possible impact that a banking crisis could have on the public finances. Second methodology uses fiscal and macroeconomic variables to identify thresholds which have in the past been linked to the onset of crises. Third one estimates country-level fiscal reaction functions and combines them with the intertemporal budget constraint to calculate sustainable debt levels under different assumptions for the interest rate-growth rate differential. Finally, since the required fiscal measures are large leading to substantial changes in behavior and market prices, numerical general equilibrium models are suggested to be used to simulate the outcomes of the reforms.

The main new pillar in the economic governance system of EU is legislative package called 'six pack'. It entered in force December 13, 2011, allowing it to be applied in time for the next European Semester*. Six pack aims to stronger preventive and corrective action to ensure fiscal sustainability

* European semester is a governance architecture, aimed to improve ex ante coordination of budgetary and economic policies.

and to identify and correct competitive gaps and macroeconomic imbalances. The elements of the six pack are the following.

- A concept of prudent fiscal policy-making (PFPM) will be adopted as the basis of preventive surveillance. It implies that the growth rate of government expenditure does normally not exceed growth rate of GDP in the medium term.
- It will be possible to open an Excessive Deficit Procedure (EDP) also on the basis of the debt criterion. Member States with government debt ratios in excess of 60% of GDP should reduce this ratio in line with a numerical benchmark, which implies a decline of the amount by which their debt exceeds the threshold at a rate in the order of 1/20th per year over three years. If they do not, they could be placed in EDP.
- The threat of progressive sanctions will be strengthened:
  - Large deviations from prudent fiscal policy-making may lead to interest-bearing deposit of 0.2% of GDP.
  - A non-interest-bearing deposit of 0.2% of GDP may be requested from a euro area country that is placed in EDP.
  - In case of non-compliance with the initial recommendation for corrective action, this non-interest-bearing deposit will be converted into a fine. The fine will be increased in case of repeated non-respect of the recommendations.
  - On a recommendation by the Commission, sanctions will be imposed by the Council unless a qualified majority of Member States vote against it.
- A new directive on national budgetary frameworks will be adopted. Fiscal frameworks should be reliable, multi-annual and transparent and include numerical fiscal rules.
- A new surveillance and enforcement mechanism will be set up to identify and correct competitiveness gaps and major macroeconomic imbalances within the EU. It is called the Excessive Imbalance Procedure (EIP). An early warning mechanism is adopted that may trigger in-depth studies. The Commission and the Council may adopt preventive recommendations to correct the imbalances. If these recommendations are not followed, EIP may be opened.
- For euro area countries an interest-bearing deposit can be imposed after one failure to comply with the EIP's recommended corrective action. After a second compliance failure, this interest-bearing deposit can be converted into a fine (up to 0.1% of GDP). Sanctions can also be imposed for failing twice to submit a sufficient corrective action plan. The fine can only be stopped by a qualified majority vote.

Another agreement, called 'fiscal compact' was preliminarily approved in the beginning of December 2011. This agreement includes e.g. the following elements.

- It obliges eurozone countries to incorporate a balanced general government budget provision into their national constitutions, committing them to keeping annual structural deficits at or below 0.5 per cent of nominal GDP. The provision must also include an automatic correction mechanism that kicks in if the deficits exceed the ceiling.
- The EDP will be reinforced by automatic consequences as soon as the euro area Member State is in breach of the 3 % deficit ceiling. Again, a qualified majority of these countries is needed to avoid the steps and sanctions proposed by the Commission.

The stricter and the more automatic the new rules are the more fiscal policy autonomy is lost, which may be difficult to accept in some countries. Another point is that since there are so many countries in EU that does not currently comply with the criteria, the requirement of qualified majority may not be as binding as desired. Possible weak point may also be the difficult measurement of structural deficits.

2 Fiscal sustainability and uncertain demographics

A well-known definition of the sustainability of fiscal policies is the OECD view: "Sustainability is basically about good housekeeping. It is essentially about whether, based on the policy currently on books, a government is headed towards excessive debt accumulation." (Blanchard et al. 1990, p. 8). More precisely: "Fiscal policy can be thought of as a set of rules, as well as an inherited level of debt. And a *sustainable fiscal policy* can be defined as a policy such that the ratio of debt to GNP eventually converges back to its initial level" (p.11).

Forward-looking approaches to sustainability, like the one we apply here, projects future values for the determinants of the debt dynamics and develops measures that quantify the needed adjustment if unsustainable dynamics is detected. The quality of data and the elaborateness and sophistication level of the models used have developed a lot in past few years, but there is still much room for improvement[1].

Blanchard (1985) defines a 'tax gap' as an immediate adjustment in the total tax rate that allows the debt/GDP ratio to converge to the current level at a give terminal date. A corresponding flow indicator, developed by Buiter (1985) is a 'primary gap' defined as an immediate adjustment in the primary balance that would fulfill the same terminal debt condition.

It was later noted, however, that the required fiscal adjustment depends heavily on the chosen terminal date. Therefore, alternative specifications, which estimate these indicators assuming infinite horizon, have been developed. Another later refinement considers the amount of terminal debt. A more stringent condition assumes that the present value of all future surpluses and deficits equals current debt, implying that the debt will finally be fully repaid (Heller, 2003). This condition is known as the present value budget constraint.

In practice, the choice of the initial values is also important. Business cycles may cause temporary variation in tax receipts, expenditure, interest rates and in the value of the government's assets. The magnitude of the necessary discretionary measures depends, however, on the cyclically adjusted initial total tax rate or primary balance.

European Commission uses two sustainability measures that are directly elaborated from these indicators. The first one measures the difference between current total tax rate and a tax rate that is required to generate public debt/GDP ratio of 60 percent in 2050. The second measures the tax gap that would equalize the current public debt and the present value of all future surpluses and deficits (EPC, 2006). We use the latter measure here.

2.1 Economic models

Recent sustainability assessments have utilized three types of economic models. Majority of the calculations has been made with accounting models. A special example of these models is generational accounts. A less frequently used framework is macroeconometric models. Third choice is numerical dynamic general equilibrium models, often with overlapping-generations household structure.

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[1] "The process of developing long-term budgets is in its infancy, and there is neither a single analytical approach nor a fiscal rule for sustainable development that has achieved agreement as best practice." Ulla (2006).

Generational accounts include detailed description of the current links between age structure of population and the public sector finances. The other data needed consists of a population projection and assumptions about future employment rates, productivity growth rate and interest rate (see e.g. Alho and Vanne, 2006). A similar simple macroeconomic setting is in use also in other accounting models (see e.g., Duyck et al., 2005). Accounting models thus often provide elaborated description of financial flows between individuals and public sector, but have minimum macroeconomic contents and no behavioral effects.

Sustainability analysis performed by the European Commission takes the results of the national pension projections as given, but projects the other age-dependent expenditures using similar methodology as in generational accounts. They consider also the influence of the size of the working-age population on the growth rate of the GDP. The lack of any behavioral reactions weakens the relevance of the performed sensitivity and policy analysis.

Dynamic general equilibrium models, with overlapping generations of household, take into account the interaction between demographic structure and the factor markets of the economy, encompassing thereby implications of growth models. They can also produce the outcomes of actuarial pension models and generational accounts, since it is possible to model the pension system rules and detailed links between age of the household generations and public expenditures and revenues. They suit well to policy analysis, since households and firms react to policy. For the same reason, they are able to track the sensitivity of the public sector finances to variation in factors that are out of reach of domestic policy.

2.2 Risks and stochastic projections

The forward-looking approach is sensitive to the accuracy of the projections. Uncertainty in numerical analysis of public finances is typically assessed by generating a baseline scenario and some alternatives in order to reveal the sensitivity of the baseline to some salient variables. For example, European Commission (EPC, 2009) uses a large amount of different scenarios for the most important variables to describe alternative futures.

It has long been known that this scenario approach suffers from many problems (see, Törnqvist, 1949). A general finding in new demographic studies is that uncertainty is typically underestimated in official national demographic forecasts (Anderson et al. 2001) and thereby e.g. in pension expenditure projections (Lassila and Valkonen, 2008a). As a consequence, too narrow range of policy alternatives is often entertained. One way to avoid this is to use stochastic models.

Stochastic sustainability analysis can be described by four steps[2]. First, a large amount of sample paths of the key variables is produced using stochastic models. Second, future public expenditure and taxes associated with each of these paths are simulated using an economic model. Thirdly, the simulation results are transformed to sustainability gaps or primary gaps. Fourthly, the predictive distributions of the gaps are presented and the probabilities of unsustainable paths are evaluated.

[2] There is also another branch of numerical stochastic sustainability analysis, performed mainly by IMF. It analyses the vulnerability of debt to adverse shocks. Sustainability simulations are performed typically for the short or medium term using highly aggregated econometric models (see e.g. Mendoza and Oviedo, 2004).

Studies that utilize stochastic population projections mainly use accounting models to analyze the sustainability of pension systems (e.g., Burdick and Manchester 2003, Holmer 2003, Congressional Budget Office (CBO) 2001, Auerbach and Lee, 2006, Keilman, 2005). The exceptions in this line of research are Lee and Miller (2001) and Lassila and Valkonen (2004), who study health care and Creedy and Scopie (2002), who forecast also social expenditures with an accounting model. The method of stochastic forecasting has been applied also to the unit costs of health care, see Boards of Trustees (2003). The effects of both economic and demographic uncertainty on aggregate public finances are studied in a similar accounting framework by Lee and Tuljapurkar (1998, 2001). Alho and Vanne (2006) and Sefton and Weale (2005) used generational accounting to perform a corresponding risk analysis.

Alho et al. (2002) and Alho, Jensen, Lassila and Valkonen (2005) were the first to analyze ageing using a large set of OLG model simulations; the application concerned the Lithuanian economy. Alho et al. (2008) present similar results for some other countries. Lassila and Valkonen (2008b) analyze financial sustainability of the Finnish public sector using stochastic projections to describe the uncertain future demographic trends and asset yields. They also analyze three policy options aimed at improving sustainability. Longevity adjustment of pension benefits and introduction of a NDC pension system both reduce the expected problem and narrow the sustainability gap distribution. If pension funds invest more in equities and expect to get higher returns, that would also limit the sustainability problem, but only with a precondition that policymakers in the future can live with substantially larger variation in the value of the funds without adjusting tax rules or benefits.

3 Forecasting demographic forecasts

To illustrate how long-term demographic forecasts can change substantially in a relatively short time, Figure 1 shows four forecasts, made between 2002 and 2009, for the future population in Finland. The total population was forecasted in 2002 to be about 5 million in 2050. The view has changed gradually, and the latest forecast is about 6.1 million in 2050. That means a 22 percent difference between forecasts made during seven years.

There were large and systematic changes also in the number of working-age population and the number of elderly. These changes can be traced back to changing views on fertility, migration and longevity. They have affected empirical sustainability evaluations in various ways. There are more people working (good for tax revenues), more retirees (costly for public finances) and people live longer (good for individual welfare but costly for public finances).

Figure 2 shows the forecasts for the number of people aged 65 and over. Although the changes have been significant, they all show the basic feature of an ageing society: the number is growing. The issue is quantitative – population is ageing but we don't know how much.

Statistical methods of expressing demographic uncertainty have been developed by many researchers (see e.g. Alho and Spencer, 2005). These methods quantify uncertainty probabilistically, based on analyses of past demographic data and the views of experts. Fertility, mortality and migration are considered as stochastic processes. The parameters of these processes are fitted to match the errors of past forecasts (see Alho et al., 2008). Again, judgment may be used. Thereafter, sample paths for future population by age-groups are simulated. We deal with demographic uncertainty by using such stochastic population projections.

We also pry more information out of stochastic population projections than has been done previously. In essence, we add demographic forecasts for the future that start in different time points in simulated population paths. Given the uncertainty of population forecasting, it might seem that trying to forecast what future population forecasts are like, would be nearly hopeless. We argue, however, that forecasts are, for both theoretical and practical reasons, more regular than actual developments. As a practical reason, it should be mentioned that the development of the recent past often has a heavy influence on projections of the remote future.

Figure 1 Population in Finland, as forecasted by Statistics Finland

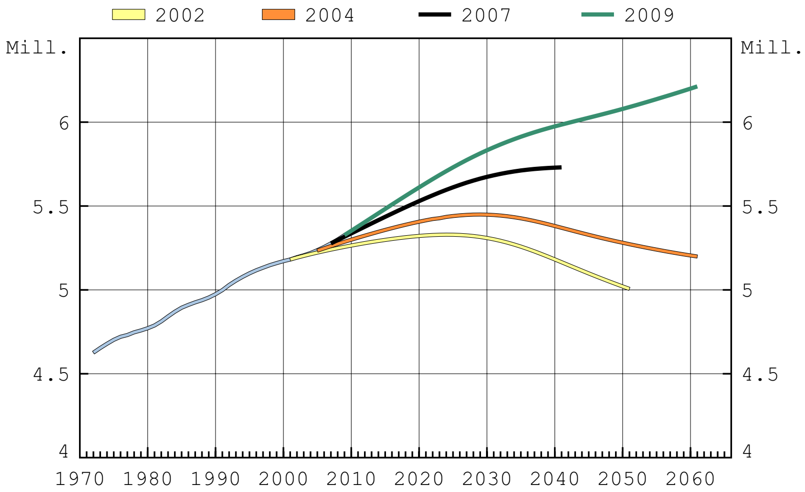
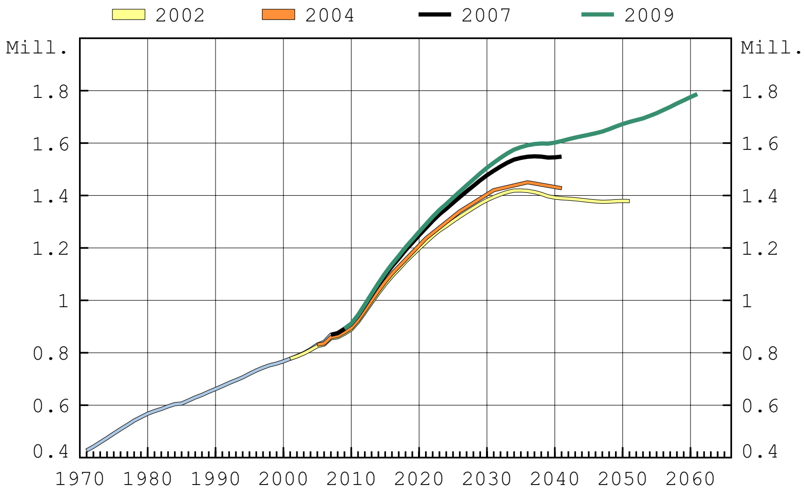


Figure 2 Population in ages 65+ in Finland, as forecasted by Statistics Finland



Stochastic population projections are produced by a computer program *PEP* (for a description, visit http://www.joensuu.fi/statistics/juha.html). Another computer program *FPATH* extends the application of results from *PEP* to forward-looking OLG models, where agents are allowed to revise their lifetime economic plans as they realize that population has not evolved according to the expected path. For this purpose *FPATH* calculates a numerical approximation to the conditional expectation of future population at future years for a (typically random) *subset of paths* We can think of the conditional expectation as being *a forecast of what would be a forecast* in a future year. This methodology is new, and is described in more detail in Alho (2011).

The stochastic projection for population in ages 65+ in Finland is presented in Figure 3. Half of the simulation outcomes are in the shaded area around the median. 10 % of the outcomes are above the 90 % line and 10 % are below the 10 % line.

Figure 3 Predictive distribution of population in ages 65+ in Finland

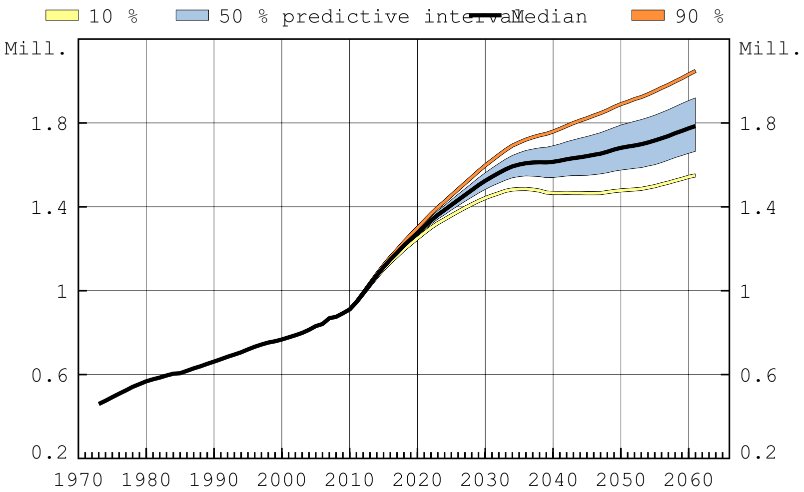


Figure 4 Population in ages 65+ in Finland in one simulated path

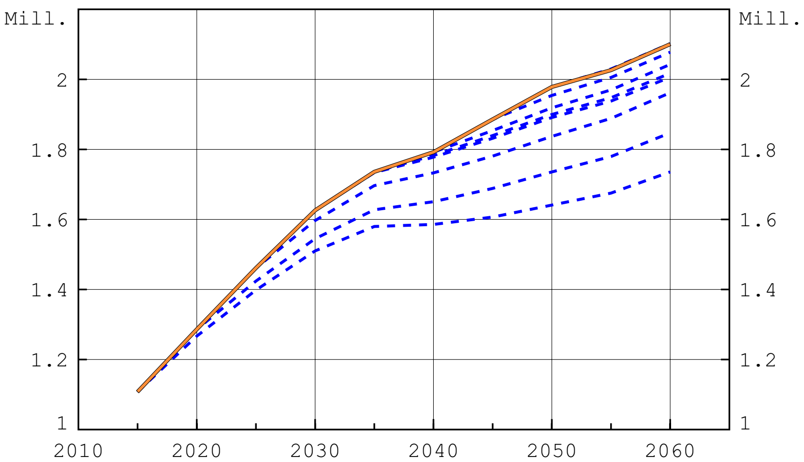


Figure 4 describes population in ages 65+ in one path of the simulated population projections for Finland, produced by the program *PEP*. The solid line is the actual simulated path, and the dotted lines represent the forecasted forecasts for the path. The forecasts lie nicely below the actual path, resembling those in Figure 4. This is not generally true in other simulated paths, where the forecasts can and do both overestimate and underestimate the 'actuals'.

4 The economic model and base policy outcomes

4.1 The model

The population projections with their embedded forecasts are used as inputs in an economic model. We simulate the sustainability of public finances using a perfect foresight numerical overlapping generations model of the type originated by Auerbach and Kotlikoff (1987). It is modified to describe a small open economy and calibrated to the Finnish economy. The FOG model consists of five sectors and three markets. The sectors are households, enterprises, a government, two pension funds and a foreign sector. The labor, goods and capital markets are competitive and prices balance supply and demand period-by-period. There is no money or inflation in the model. The unit period is five years, and the model has 16 adult generations living in each period. The model is described in more detail e.g., in Lassila and Valkonen (2007b).

We assume that the pre-tax rate of return on saving and investments is determined in global capital markets. In trade of goods the country has, however, some monopoly power, which makes the terms of trade endogenous. Foreign economies are assumed to grow with the trend growth rate of the domestic labor productivity.

The driving forces of the model economy are the transitions in the demographic and educational structure of the population and the trend growth of labor productivity. Population is ageing due to longer lifetimes, low fertility rates and the transition of baby boomers from working age to retirement. Educational level improves in the future since the current middle-aged generations have on average much lower level education than the young ones. The improvement raises productivity of labor. Each household generation is divided to three educational groups with different lifetime productivity profile determined by empirical observations of recent wage profiles. The educational shares are supposed to develop in future in line with the official projections.

Labor input is determined partly by exogenous assumptions and partly due to endogenous adjustments in the model. Exogenous factors are trend growth of labor productivity (1,75 % per annum in private goods production), demographic trends, educational gains and unemployment rate. The model is calibrated so that the trend labor productivity growth and the following higher wages do not affect the otherwise endogenous labor/leisure choice of the households.

The growing number of people in old age and near death increases the demand for health and old age care (see Lassila, Valkonen and Alho (2011) for a detailed description). We assume that these demography-driven additional services are produced in private sector, but production costs are paid totally by the public sector. These services are produced using labor and intermediate goods as inputs. There is no productivity growth in the production. The shares of employees in private and public sector are kept constant.

Real wage adjusts to equalize the value of marginal product of labor and labor costs in the production of private goods and services. The rest of the workers, who provide tax-funded services produced in private and public sector, earn the same wage.

Public expenditures have strong connection to the age of individuals. Provision of public services is allocated mainly either to the early part of the life cycle (day care and education) or to the last ten years (health care and old age care). Similarly, income transfers are distributed mainly either to young families or to retired individuals. This is why the changes in the demographic structure are so important for the public expenditures. We assume that all income transfers (except the earning-related pensions) are fully indexed to wages because any other assumption would have dramatic consequences to income distribution in the very long term analysis. Other than age-related expenditure is assumed to grow at the same rate as the GDP.

Revenues of the public sector originate from two types of sources in the model. The majority of the receipts are accumulated by income taxes, consumption taxes and social security contributions. Another noteworthy revenue source is the yield of the public sector wealth. The yield of the wealth is important especially for the pension funds, but also the central government has substantial amount of financial assets.

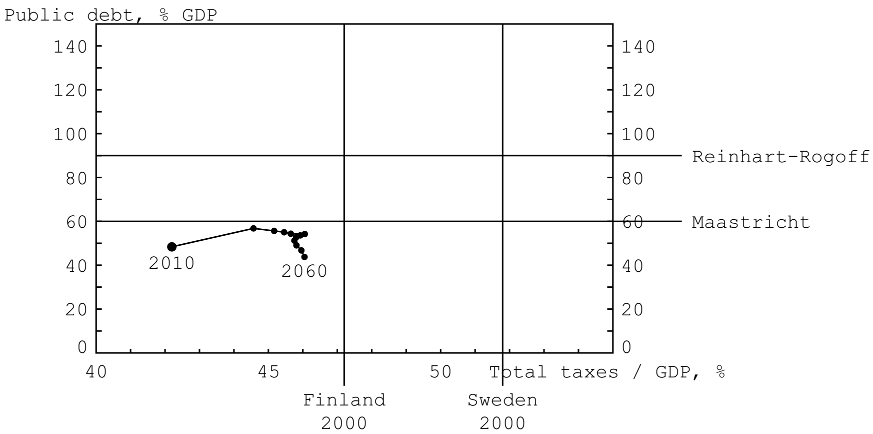
We assume that the modeled main subsectors of the general government, such as the municipal sector, the public and the private sector pension fund and the national social security institute, have their own budgets, which are balanced either by social security contributions or earned income taxes. The only exception is the state budget, which is balanced by borrowing until 2145, and after that by using a lump sum transfer. Earned income tax brackets are adjusted with the growth of the economy. The pension funds follow their current prefunding plans, and pension contributions are endogenous. Households react to the income and substitution effects of taxation and social security contributions.

In our analysis we substitute the perfect foresight assumption with a more realistic approach where decision makers sequentially optimize their behaviour according to revised demographic forecasts. We justify the use of a revised forecasts methodology by two points: First, it seems clear that households do not take uncertainties related to their future contribution rates or benefits fully into account when making their savings and labour supply decisions. These uncertainties are very seldom discussed, let alone quantified, in popular press. Second, by making the extreme assumption that households ignore these uncertainties altogether and base their decisions on deterministic forecasts, is a way of avoiding the difficulties related to general equilibrium heterogeneous agent models with aggregate uncertainty. This allows us to use a model that includes detailed descriptions of rather complex pension and other welfare systems.

4.2 Base policy outcomes

There is a base policy plan that is the same in each of the 200 model runs. In this plan, welfare transfers and services are provided according to current rules and practices. Mandatory pension contributions adapt to pension expenditure, which vary from one demographic path to another. Aggregate health and long-term care costs depend on population age structure and proximity to death. They are financed by municipal taxes, which thus also depend on demographic variables. Part of health and LTC is, however, financed by state aid to municipalities. State tax rates are held constant, so variation in expenditure and tax bases causes variation in public debt. We describe the outcomes of this base policy on gross public debt and on a total tax measure, which includes the pension contribution rate, municipal taxes and all state taxes. Both debt and taxes are related to GDP.

Figure 5 Public debt and taxes in Finland in the non-stochastic scenario



If demographics evolve according to Statistics Finland's projection, the base policy leads to increasing taxes in relation to GDP, and keeps public indebtedness roughly at the current level during the coming decades. Since total taxes/GDP stays well below the level they were in 2000 – a historical record – the base policy could be described as sustainable. But that is conditional on the demographics.

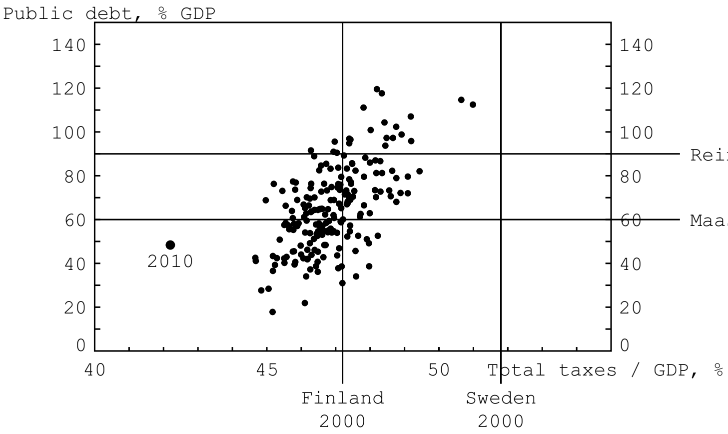
Figure 6 describes what kind of outcomes in 2060s[3] we can expect the base policy to produce under demographic uncertainty. Each dot represents the situation in one population path. The outcomes are separated only by demographic developments, and the economic reactions to both expected and actualized demographics that our model gives.

In an ageing society, it is the nature of this base policy that taxes will increase. But by how much, that we don't know but can make probabilistic statements about. As each stochastic population path is equally likely, and thus also the dots in Figure 4 are equally likely, counting the dots in different parts yields corresponding probabilities. The tax ratio has about one-third chance of exceeding the highest value thus far in Finland, 47,2 % in 2000. In all simulations the tax rate stays below that in Sweden in 2000, 50,8 % of GDP, which is the highest rate recorded in EU's tax statistics.

Despite growing tax rates, indebtedness is also likely to increase. The debt ratio is likely to rise over the Maastricht limit, and with a 10 % probability over the 90 % level that Reinhart and Rogoff (2010) consider harmful for economic growth.

[3] The model's unit period is 5 years. Thus '2060s' refers to years 2060–64 for flow variables such as GDP, and to end of 2064 situation for stock variables such as debt.

Figure 6 Public debt and taxes in Finland in 2060s



Whether this policy line would be sustainable or not, is a matter of opinion. Some may find most of the outcomes generally plausible, others perhaps not. But certainly the possibility of problems cannot be ruled out. There is about 30 % chance of taxes becoming higher than ever before in Finland and at the same time debt exceeding the Maastricht criterion. Furthermore, there is an 8,5 % chance for the very difficult outcome that tax rates are higher than in 2000 and indebtedness exceeds 90 % (see Table 1 in the following section).

5 Expected sustainability and policy rules

5.1 Enhancing sustainability with VAT increases

The base policy contains many rules. Besides those concerning pension contributions and municipal taxes, there is longevity adjustment of pension benefits, and several indexing rules. Still it seems from the 2060 outcomes that fiscal policy does not react to expected difficulties in public finances in a sufficient manner. In many empirical sustainability analyses this is the case throughout, as Leeper (2010) criticizes. In model-based analysis, such as ours, we can go further and study the effects of specific additional policy rules.

The first policy rule we study relates taxation to the view about fiscal sustainability that prevails at different time points. Heuristically, we assume that each time the demographic forecast is revised, the ministry of finance or some other fiscal authority publishes its assessment on the sustainability of public finances, in the form of sustainability gap. In the policy rule we then tie increases in the VAT rate to the sustainability gap.

The second policy rules looks at forecasts of public debt that are updated each time a new population forecast is made. An increase in the VAT rate is triggered by a high forecasted level of the debt/GDP ratio. The third policy rule is a combination of the first two rules.

The sustainability gap is the difference between a hypothetical constant tax rate and the initial tax rate. The constant tax rate should be such that, if implemented immediately, it would exactly suffice to pay the projected public expenditure and keep net public wealth on the initial level. We are thus using the *s2* definition of the gap.

Let $Y(i,t)$ and $\pi(i,t)$ denote GDP and the total tax rate in simulation i in period t, $V(i,t)$ the public debt at the end of period t, and $\pi(t(0))$ the initial tax level. The bond yield r is assumed to be constant. The T-period-ahead sustainability gap *s2*, calculated in period $t(0)$ is then

[1] $$s2(i,t(0),T)=\frac{\sum_{t=t(0)}^{t(0)+T}\left[\tau(i,t)-\tau(t(0))\right]Y(i,t)D(i,t)\;+\left[V(i,t(0)+T)-V(i,t(0)-1)\frac{Y(i,t(0)+T)}{Y(i,t(0))}\right]D(i,t(0)+T)}{\sum_{t=t(0)}^{t(0)+T}Y(i,t)D(i,t)}$$

where $D(i,t)$ is the discount factor

[2] $$D(i,t)=(1+r)^{-(t-t(0))}$$

The first part in the numerator shows how much future changes in pension contributions and municipal taxes contribute to the gap. The second part is the contribution of the change in public debt. The desired level of the debt here is such that the debt/GDP ratio remains the same.

Policy rule 1: if the expected sustainability gap *s2*, over a 50-year horizon, exceeds three percentage points, then the VAT rate is increased permanently by two percentage points.

Policy rule 2: if public debt/GDP is forecasted to exceed 90 % within 50 years, then the VAT rate is increased permanently by two percentage points.

Policy rule 3: if the expected sustainability gap, over a 50-year horizon, exceeds three percentage points, or public debt/GDP is forecasted to exceed 90 % within 50 years, then the VAT rate is increased permanently by two percentage points.

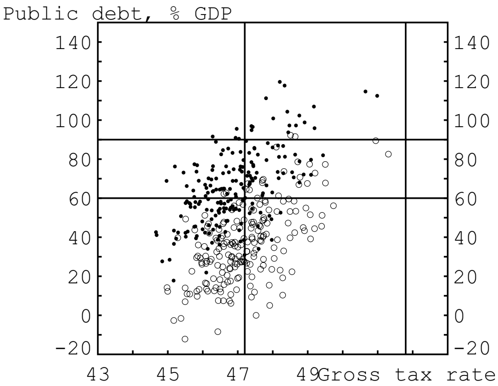
The 2060 outcomes of these policy rules are in Figure 7 below. The base policy outcomes are denoted by small dots, and other policy outcomes by circles. The bigger dark dots are combinations of small dots and circles, and occur when the economic development on the demographic path in question does not warrant any policy changes due to the criteria of policy rules 1, 2 or 3.

For comparison, the top-left corner (Fig. 7a) presents the outcomes with a simpler policy: the VAT rate is increased by 2 %-points in all paths in 2015. This unconditional VAT rise seems like a good policy with respect to expected indebtedness, compared to the base policy plan. The debt ratio is much less likely to rise over the Maastricht limit and the Reinhart-Rogoff limit. There is only about 10 % chance of both taxes and debt to end outside the normal area. Furthermore, the chance of the very difficult outcome that indebtedness exceeds 90 % and at the same time taxes exceed the current record level of 2000 has declined from 8,5 % to 1 %.

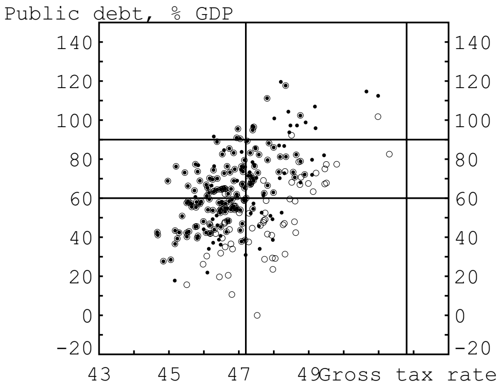
The downside of the unconditional VAT rise is that tax ratios are higher in all paths. The VAT increase could be considered unnecessary for those population paths where the base outcome stayed in the normal tax-debt region, and that group consists of over a third of all paths.

Figure 7 Public debt and taxes in 2060s under different policy rules

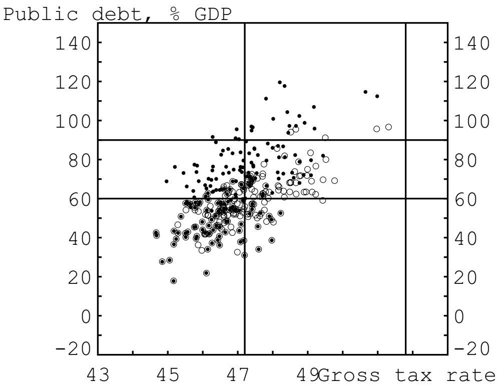
7a Unconditional VAT increase



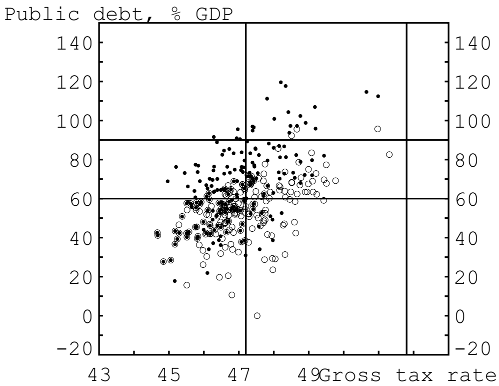
7b Policy rule 1



7c Policy rule 2



7d Policy rule 3



The three conditional policy rules avoid increasing taxes in many cases where the increases would later be deemed unnecessary. They also fail to increase taxes in some cases where increases would be needed to avoid growing indebtedness. Policy rule 2, based on forecasted indebtedness in the base policy, seems to produce a reasonable balance between the two pitfalls.

In Table 1 the 200 simulation outcomes in 2060 are divided into several categories. Normal tax rates are those below the Finnish 2000 total tax rate, 47,2 % of GDP. High is any tax rate above the normal, and very high tax rates are those above the Swedish record, 50,8 % of GDP, and thus are unprecedented. Public gross debt, as per cent of GDP, is considered normal if it is below the Maastricht treaty level of 60 %. Above that they are high, and if they exceed the 90 % level they are classified as very high. These limits are of course arbitrary but serve a purpose. The debt limits are self-evident; 60 % is based on EU policies and 90 % is based on an extensive study by Reinhart and Rogoff. Tax rate limits are more country-specific. The chosen tax limits are familiar to Nordic audiences, but analyses of sustainability in e.g. the Mediterranean countries should probably use much lower limits.

Sustainability gap does not seem to perform well as a variable on which to condition the policy. The reason is that the base policy leads to gradually increasing taxes in most simulations, and the gap diminishes in time, because it is always calculated on the tax rate that is actual at the time. Thus a fixed threshold value as in Policy rule 1 may lead to a VAT increase in the first period, but if it does not, it will do so only several decades in the future (see Figure 2A in the Appendix).

The size of the triggered VAT increase is of course important for the results. Appendix contains some results for smaller increases. It also contains figures showing the distributions of threshold variables that are used in the policy rules.

Table 1 Base policy and policy rule outcomes in 2060s
(share of cases in different debt-tax categories, %)

	Base policy	VAT increased in all cases in 2015	VAT increased when gap > 3 %	VAT increased when debt/GDP forecast to exceed 90 % within 50 years	VAT increased when either gap > 3 % and/or debt/GDP forecast to exceed 90 % within 50 years
Normal debt and normal taxes	37,5	52,0	39.0	50,5	49,5
Normal debt and high taxes	5, 0	36,0	12,0	11,5	17,0
Normal debt, total	42,5	88,0	51,0	62,0	66,5
High debt and normal taxes	26,0	1,0	22,5	8,0	8,0
High debt and high taxes	21,0	10,0	21,5	27,5	24,0
High debt, total	47,0	11,0	44,0	35,5	32,0
Very high debt and normal taxes	2,0	0,0	1,5	0,0	0,0
Very high debt and high taxes	8,5	1,0	3,5	2,5	1,5
Very high debt, total	10,5	1,0	5,0	2,5	1,5
Normal taxes, total	65,5	53,0	63,0	58,5	57,5
High taxes, total	34,5	47,0	37,0	41,5	42,5

5.2 On the length of the forecast horizon in forecast-based policy rules

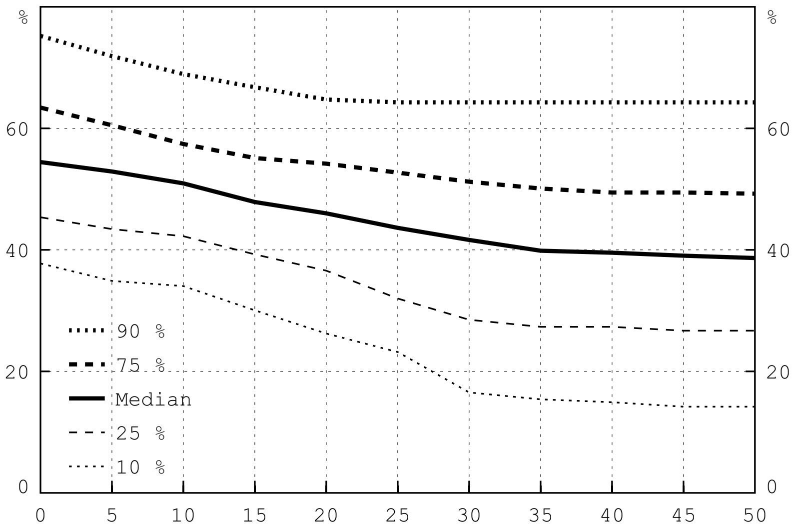
We should note that reacting to debt development certainly improves the situation, no matter what the horizon is. But just looking at forecasts 5 years ahead, compared to reacting to observed debt, markedly improves the chances to stay below the Maastricht limit. Roughly, the chances improve from two thirds to three quarters. Relying on even longer forecasts improves the chances, but after 20 years the improvement slows down.

Since the debt and tax limits in the tables above are somewhat arbitrary, we also look at the entire distributions of outcomes in 2060s under different forecast horizons, in Figure 8.

Table 2 Forecast-based policy rule outcomes in 2060s with different forecast horizons
(share of cases in different debt-tax categories, %)

	Base policy	VAT increased when debt/GDP observed to exceed 60 %	VAT increased when debt/GDP forecast to exceed 60 % within 5 years	VAT increased when debt/GDP forecast to exceed 60 % within 10 years	VAT increased when debt/GDP forecast to exceed 60 % within 20 years	VAT increased when debt/GDP forecast to exceed 60 % within 50 years
Normal debt and normal taxes	37,5	48,0	51,5	54,0	54,5	53,0
Normal debt and high taxes	5, 0	18,0	22,5	25,0	31,0	34,0
Normal debt, total	42,5	66,0	74,0	79,0	85,5	87,0
High debt and normal taxes	26,0	9,0	5,0	2,0	1,5	1,0
High debt and high taxes	21,0	22,5	19,5	17,5	11,5	11,0
High debt, total	47,0	31,5	24,5	19,5	13,0	12,0
Very high debt and normal taxes	2,0	0,0	0,0	0,0	0,0	0,0
Very high debt and high taxes	8,5	2,5	1,5	1,5	1,5	1,0
Very high debt, total	10,5	2,5	1,5	1,5	1,5	1,0
Normal taxes, total	65,5	57,0	56,5	56,0	56,0	54,0
High taxes, total	34,5	43,0	43,5	44,0	44,0	46,0

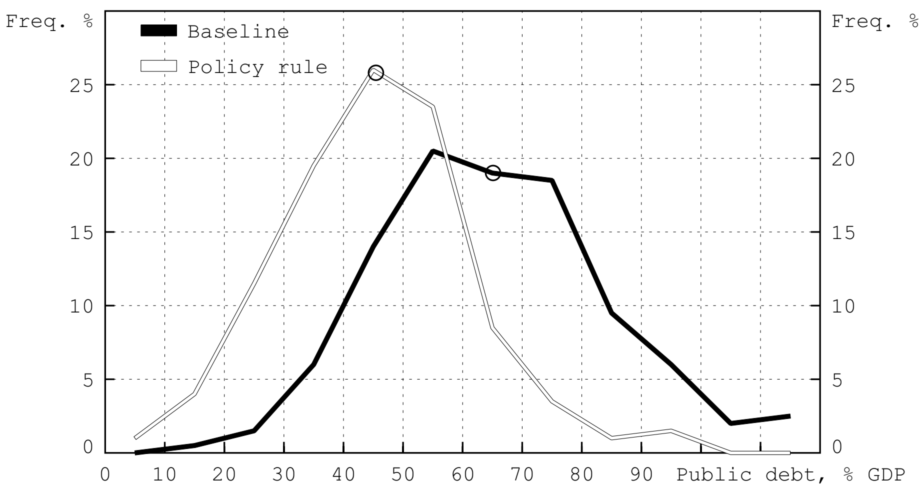
Figure 8 **Predictive distribution of public debt/GDP ratio in 2060s when VAT increases are conditioned on forecasted debt/GDP ratios with forecast horizons from 0 to 50 years**



We notice that the upmost decile limit declines up to forecast horizon of 20 years and stays roughly constant thereafter. The upper quartile and the median decline longer, but the rate of decline slows down after the 35 year horizon. The lower quartile and the lowest decile limits decline up to forecast horizon of 30 years.

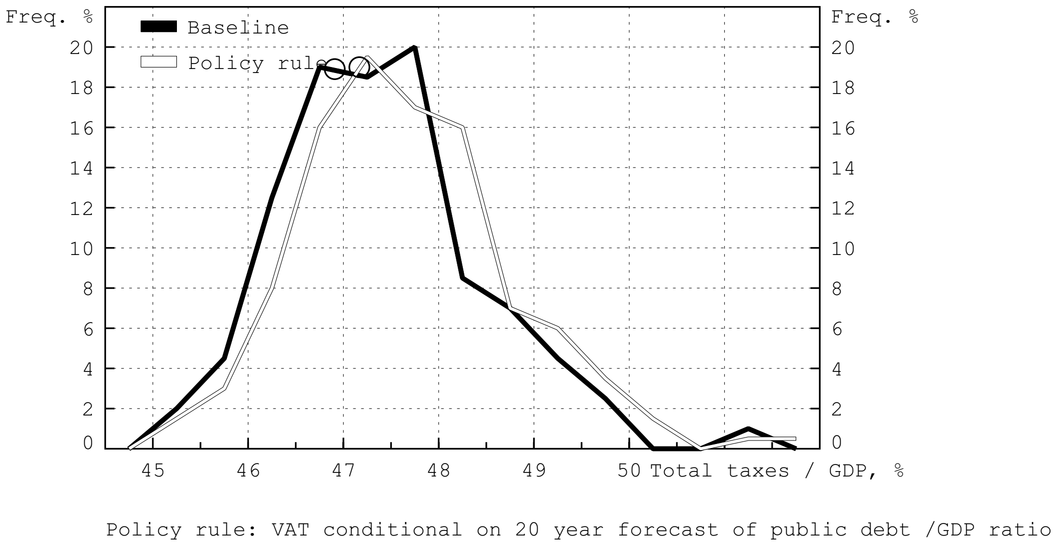
Although the effect of the forecast horizon in the policy rule varies with the exact statistic one looks at, in all cases improvement occurs up till 20 years. Using the 20-year horizon, the improvement in the debt outlook in 2060s is huge, as Figure 9 shows. The expected debt/GDP

Figure 9 **Frequency distribution of public debt, as % of GDP, in the 2060s**



Policy rule: VAT conditional on 20 year forecast of public debt /GDP ratio

Figure 10 Frequency distribution of total taxes, as % of GDP, in the 2060s



ratio, marked with a circle, falls from the baseline's 65 % to about 45 % if the VAT increase is conditioned on forecasts with 20-year horizon. The likelihood of debt ratios over 60 % has reduced dramatically.

At the same time, the likelihood of high tax rates has not risen very much. The expected tax ratio in 2060s has risen from 46,9 % to 47,2 %. The crucial thing is the timing of the tax increase: if demographics turn out to require higher taxes, to prevent excess indebtedness, it is best to make the tax increase as early as possible.

6 Tax policy effects on future sustainability outlook

We may also look at tax levels that are predicted to be sustainable at different times. These consist of two parts, the actual tax level and the sustainability gap. We think it is important to look at these sustainable tax levels especially at the end of the 50-year period that we have used in our analysis thus far. It reminds us that the far future should not go unnoticed in sustainability analysis, even though it is difficult to attach numbers to it. 50 years is too short a period to get a wider generational view of the sustainability issues in an ageing society.

Sustainable tax levels that are predicted in 2060 also reflect and summarize the policies that have been carried out before 2060. Intuitively it is clear that a better starting point in 2060, such as one with a lower debt, yields a lower sustainable tax level, if the expected future is essentially the same. If the lower debt is the result of an earlier tax increase, then the issue is whether the economic development is affected by this tax increase so much that it is not the same or even close in the forecasts, although the demographic forecast is the same. This is the Laffer issue, and our model seems to operate on the rising part of the Laffer curve.

Thus the simulated outcomes for 2060 in the debt-tax space have the structure of Figure 11: The base outcome (1) has a higher debt and lower tax rate than the outcome with a higher VAT

Figure 11 Schematic structure of tax rates, sustainable tax rates and public debt

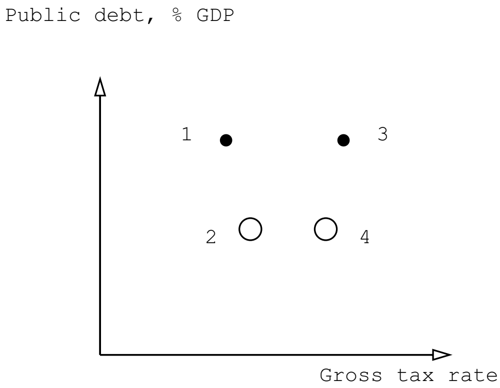
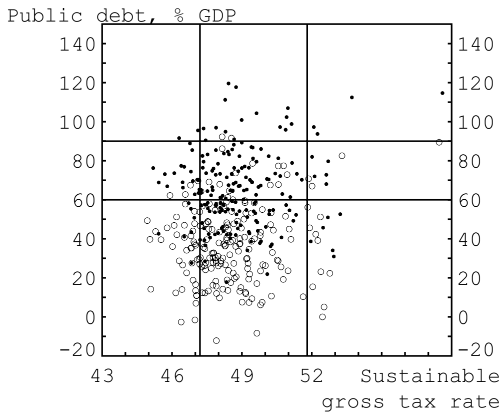
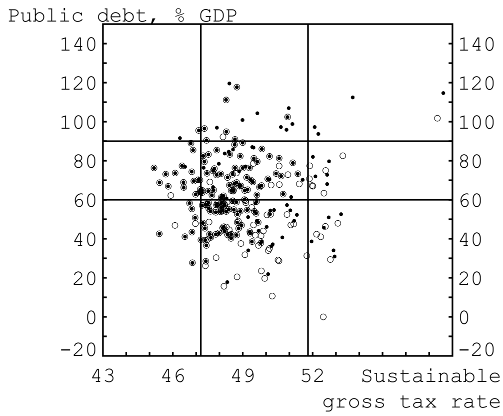


Figure 12 Sustainability outlook in 2060

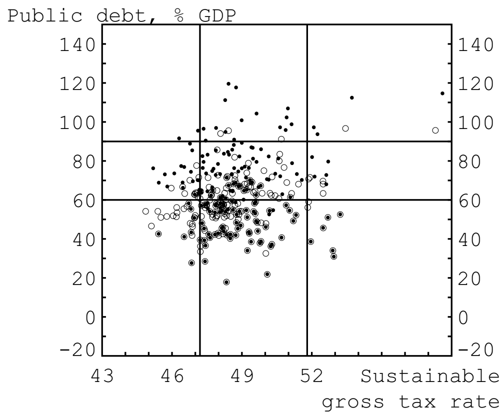
12a. Effects of unconditional VAT increase



12b. Effects of policy rule 1



12c. Effects of policy rule 2



12d. Effects of policy rule 3

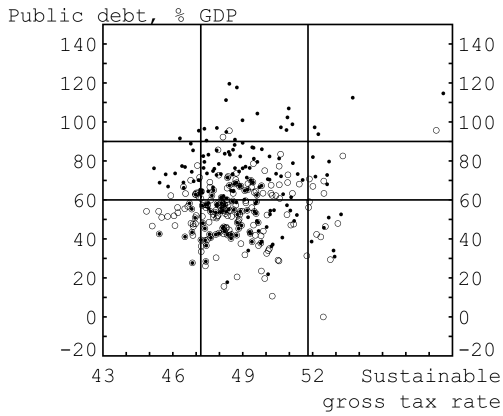


Table 3 Sustainability outlook in 2060 with different policies
(share of cases, %)

	Base policy	VAT increased in all cases in 2015	VAT increased when gap > 3 %	VAT increased when debt/GDP forecast to exceed 90 % within 50 years	VAT increased when either gap > 3 % and/or debt/GDP forecast to exceed 90 % within 50 years
Normal debt and normal sustainable taxes	3,5	20,5	4,5	12,0	12,0
Normal debt and high sustainable taxes	36,0	62,5	43,5	45,5	50,5
Normal debt and very high sustainable taxes	3,0	5,0	3,0	4,5	4,0
Normal debt, total	42,5	88,0	51,0	62,0	66,5
High debt and normal sustainable taxes	9,5	2,0	9,5	5,5	5,5
High debt and high sustainable taxes	35,0	7,0	31,0	28,0	24,0
High debt and very high sustainable taxes	2,5	2,0	3,5	2,0	2,5
High debt, total	47,0	11,0	44,0	35,5	32,0
Very high debt and normal sustainable taxes	1,0	0,0	0,5	0,0	0,0
Very high debt and high sustainable taxes	7,5	1,0	4,0	1,5	1,0
Very high debt and very high taxes	2,0	0,0	0,5	1,0	0,5
Very high debt, total	10,5	1,0	5,0	2,5	1,5
Normal sustainable taxes, total	14,0	22,5	14,5	17,5	17,5
High sustainable taxes, total	78,5	70,5	78,5	75,0	75,5
Very high sustainable taxes, total	7,5	7,0	7,0	7,5	7,0

rate (2). The sustainable tax in the base case (3) is typically higher than the actual tax rate (but not always), reflecting the fact that population ageing will continue after 2060 in most projections. The sustainable tax rate of the increased VAT case (4) is in our analysis always lower than that in the base case, because increased tax revenues have already cumulated into a lower public debt[4].

The sustainability outlook in 2060 is usually worse than the projected 'actual' debt-tax situation in 2060. Even though there is over a one-third chance in staying in the normal area in actual outcomes of the base policy, the sustainability outlook will stay there only with a very small probability (Table 3). On the other end, sustainable tax rates exceed the Swedish record level in 7,5 % of the cases.

The policy rules have all improved the sustainability outlook. Most of this improvement is visible in debt ratios, but due to the feature described in Figure 5, sustainable tax rates are always lower if the threshold of the policy rule has been met and an increase in VAT triggered.

7 Conclusions

Analysing fiscal sustainability and calculating sustainability gaps relies heavily on demographic projections. These projections are changed at regular or irregular intervals. These changes are not always minor – in fact they are often large. In this paper we have analysed what implications these inevitable changes have for sustainability analysis and for policy conclusions.

We have focused on the fiscal pressures that financing pensions, health and long-term care (LTC) expenditure will bring about in ageing Finland. We ask whether the system where pensions are financed by contributions and health and LTC by municipal taxes and state aid is sustainable in the specific sense that citizens can rely on receiving the services in the future. As the future is inevitably uncertain, no definite answer can be given. We can, however, quantify some uncertainties and illustrate and evaluate their effects. We can form a probabilistic view of the public debt and taxation developments that financing pensions, health and LTC will cause. This view then serves as a basis for our evaluation of the sustainability of the system, or, phrased differently, of the credibility of the promise concerning publicly financed pension and health and LTC services in the future.

We chose the time span so that it should suffice for those who are about to leave the labor market. If one is 50, then the horizon should be at least 50 years, for living up to 100 years will not be rare. If a 50-year old does not think that promises concerning future welfare services are fully credible, she or he still has 10–20 years to take individual precautionary measures while being part of the labor force.

7.1 General assessment of sustainability

Even with our assumptions of future health and LTC demand, which are low compared to those used in other fiscal projections made for Finland, difficulties in sustainability loom large.

[4] In fact, assuming that the GDP path is not affected at all by the tax increase, the decline in the sustainable tax level could be derived from equation (1).

In our baseline policy, municipal taxes adjust to health and LTC expenditures and changes in the tax base, and pension contributions adjust to pension outlays. In an ageing society, it is the nature of this baseline policy that taxes will increase. The total tax/GDP ratio has about one-third chance of exceeding the highest value thus far in Finland, 47,2 % in 2000. In all simulations the tax rate stays below that in Sweden in 2000, 51,8 % of GDP, which is the highest rate recorded in EU's tax statistics.

Despite growing tax rates, indebtedness is also likely to increase. The debt ratio is likely to rise over the Maastricht limit, and with a 10 % probability over the 90 % level that Reinhart and Rogoff (2010) consider harmful for economic growth.

Whether this policy line would be sustainable or not, is a matter of opinion. Some may find most of the outcomes generally plausible, others not. But as future pensioners and users of these welfare services we are not satisfied with the outlook. The possibility of problems is too high. There is about 30 % chance of taxes becoming higher than ever before in Finland and at the same time debt exceeding the Maastricht criterion. Furthermore, there is an 8,5 % chance for the very difficult outcome that tax rates are higher than in 2000 and indebtedness exceeds 90 %. We think that, with the baseline policy, the likelihood of cuts in welfare transfers and services in the future is too high, if these cuts will come as surprises and leave citizens little time to prepare for them in advance. Thus some policy amendments or alternatives should be considered.

7.2 Policy lessons

Can the welfare state do better? Yes. Although the magnitudes of ageing are uncertain, and forecast errors probably large, ageing policies can and must respond in advance. Uncertainty should not imply inaction. Inaction is a policy choice, and here a rather poor one. Our simulations show that forecasts contain information and can be used in policy design.

We first study alternatives where the state reacts to the sustainability gap. The action is a permanent increase in the VAT rate. Secondly, we study policies where the VAT rise is conditioned on the actual or forecasted public debt development instead of the sustainability gap. These latter policies turn out to be more effective in preventing excess indebtedness. Sustainability gap does not seem to perform well as a variable on which to condition the policy. The reason is that the base policy in our study leads to gradually increasing taxes in most simulations, and the sustainability gap diminishes in time, because it is always calculated on the tax rate that is actual at the time. Thus a policy based on a fixed threshold value of the sustainability gap may lead to a VAT increase in the first period, but if it doesn't, it will do so only after some decades.

Our simulations indicated that high indebtedness became less likely if the VAT policy was conditioned on forecasted debt development instead of observed. Although the effect of the forecast horizon in the policy rule varies with the exact statistic one looks at, in all cases improvement occurs up till 20 years. Using the 20-year horizon, the improvement of the debt outlook in 2060s is huge. The expected debt/GDP ratio falls to about 45 % from the baseline value of 65 %. At the same time, the likelihood of high tax rates does not rise very much. The expected tax ratio in 2060s has risen from 46,9 % to 47,2 %. The crucial thing is the timing of the tax increase: if demographics turn out to require higher taxes, to prevent excess indebtedness, it is best to make the tax increase as early as possible. On the other hand, demographics may also turn out to be more positive than expected, which weakens the case of any unconditional initial tax increase.

A more general policy lesson is that there should be a plan for worse than expected future developments. Actions can include postponed conditional measures. They should form a coherent program, with well-defined thresholds. They should also be credible; a requirement that may be difficult to operationalize, but as long as the situation is good or looks good, relying on future actions may be a viable option.

There is not much point in arguing about the exact size of the sustainability gap. The question is whether the policy currently on books is sustainable in the foreseeable future with a reasonable probability. Relying on expected developments, with a 50 % probability, is not reasonable. Certainty is not achievable, but the risk can be reduced.

The policy rule analysis could have been used to derive also the welfare effects of different policy choices in addressing sustainability problems. This could be especially useful when considering postponing decisions. Their costs, and whom they occur to, can be illustrated, thus avoiding one of the critical faults in using unsustainable paths described in Leeper (2010). We consider such work a necessary ingredient in future analysis.

7.3 Methodological lessons

We have amended stochastic population projections with embedded and gradually updated demographic forecasts. At each time-point on each population path considered there is also a simulated demographic forecast for the future. The agents in the economic model make their future plans based on this demographic forecast that prevails there and then. A new demographic forecast is made when the economy moves to the next period, and agents update their plans. Technically the tree-like combination of stochastic population projections with embedded demographic forecasts is obtained by joint use of computer programs *FPATH* and *PEP*. The ranges of forecast revisions seem quite relevant, when compared to the adjustments in demographic forecasts by Statistics Finland between 2002 and 2009.

Using periodically updated population projections as an input in a forward-looking economic model produces results that, we think, have strong links to decisions that are considered or actually made in the real world. Each update in the official population projections changes our conception of the future. All public policies and private behaviour contingent to the conception of the future are subject to change.

Introducing forecasts embedded in stochastic population projections allows us to analyze policies that are based on forecasts. There is an obvious way forward here. Analyze all relevant policy rules, and compare results. This is very tedious, and difficult. There are many parameters that could be changed and should be analyzed. In our rather simple policy rules such parameters are the threshold values and length of the period they are calculated from, and other specifications related to them. The size of the triggered policy measures should also be studied. For pedagogical purposes, rough examples may suffice. For quantitative policy guidelines, much more work is needed.

This type of analysis produces a vast amount of simulation results – so vast that choosing what to present is an essential part of any study. The economic model output consists of stylized national accounts for each period, added by household behavior by 5-year birth cohorts, three educational groups and a maximum age of 100 years. 50 years with a 5-year unit period and a 50-year horizon of forecasts means that the baseline consists of 100 national accounts for each of the 200 population paths used, in total 20 000 national accounts.

Appendix Policy rule effects with a one per cent VAT increase

Table A1 Public debt and taxes in 2060 with one-percent VAT increases

	Base policy	VAT increased in all cases in 2015	VAT increased when gap > 3 %	VAT increased when debt/GDP forecast to exceed 90 % within 50 years	VAT increased when either gap > 3 % and/or debt/GDP forecast to exceed 90 % within 50 years
Normal debt and normal taxes	37,5	49,0	38,5	45,0	45,0
Normal debt and high taxes	5, 0	22,5	8,0	6,5	9,0
Normal debt, total	42,5	71,5	46,5	51,5	54,0
High debt and normal taxes	26,0	8,0	24,0	17,0	16,5
High debt and high taxes	21,0	17,0	23,0	27,0	25,5
High debt, total	47,0	25,0	47,0	44,0	42,0
Very high debt and normal taxes	2,0	0,0	1,5	0,0	0,0
Very high debt and high taxes	8,5	3,5	5,0	4,5	4,0
Very high debt, total	10,5	3,5	6,5	4,5	4,0
Normal taxes, total	65,5	57,0	64,0	62,0	61,5
High taxes, total	34,5	43,0	36,0	38,0	38,5

Table A2 Sustainability outlook in 2060
(1 %-point VAT increases)

	Base policy	VAT increased in all cases in 2015	VAT increased when gap > 3 %	VAT increased when debt/GDP forecast to exceed 90 % within 50 years	VAT increased when either gap > 3 % and/or debt/GDP forecast to exceed 90 % within 50 years
Normal debt and normal sustainable taxes	3,5	13,0	3,5	7,5	7,5
Normal debt and high sustainable taxes	36,0	54,5	39,5	41,0	43,0
Normal debt and very high sustainable taxes	3,0	4,0	3,5	3,0	3,5
Normal debt, total	42,5	71,5	46,5	51,5	54,0
High debt and normal sustainable taxes	9,5	5,0	10,5	8,5	8,5
High debt and high sustainable taxes	35,0	18,0	33,5	32,0	30,5
High debt and very high sustainable taxes	2,5	2,0	3,0	3,5	3,0
High debt, total	47,0	25,0	47,0	44,0	42,0
Very high debt and normal sustainable taxes	1,0	0,0	0,5	0,0	0,0
Very high debt and high sustainable taxes	7,5	2,5	5,0	3,5	3,0
Very high debt and very high taxes	2,0	1,0	1,0	1,0	1,0
Very high debt, total	10,5	3,5	6,5	4,5	4,0
Normal sustainable taxes, total	14,0	18,0	14,5	16,0	16,0
High sustainable taxes, total	78,5	75,0	78,0	76,5	76,5
Very high sustainable taxes, total	7,5	7,0	7,5	7,5	7,5

Figure A1 Predictive distribution of sustainability gaps
(Horizontal axis shows the year the gap is evaluated)

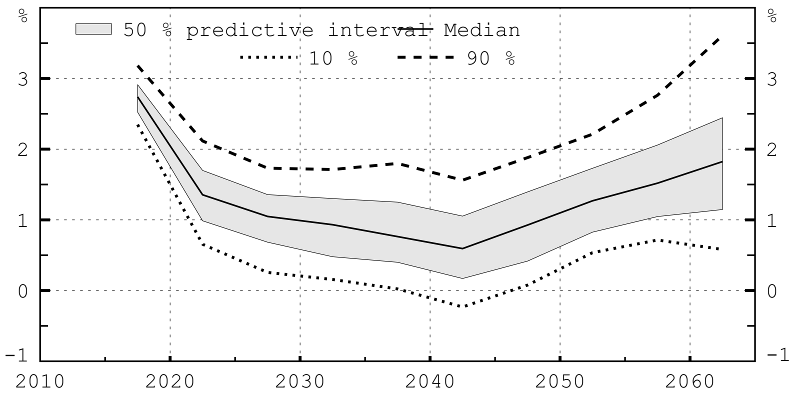
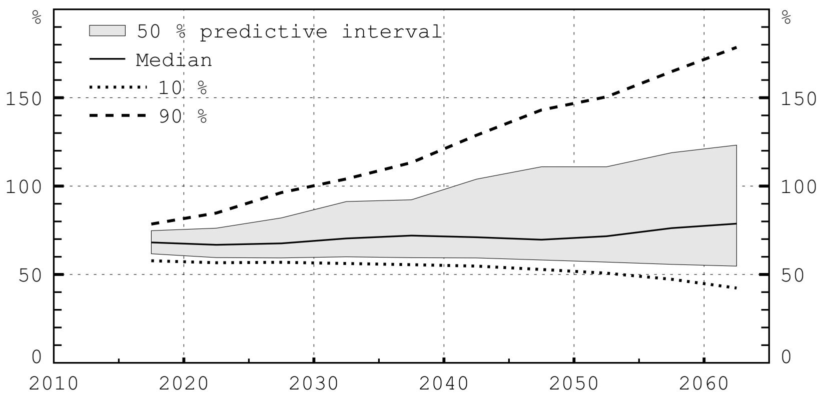


Figure A2 Predictive distribution of highest forecasted debt/GDP-ratio within 50 years
(Horizontal axis shows the year the forecast is made)



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ETLA
Elinkeinoelämän Tutkimuslaitos
The Research Institute of the Finnish Economy
Lönnrotinkatu 4 B
00120 Helsinki

Puh. 09-609 900
Fax 09-601 753
www.etla.fi
etunimi.sukunimi@etla.fi

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