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A system in crisis with the worst yet to come:

Social security spending in Finland 1980-2018 and some gloomy forecasts for the near-future (2019-2030)

by

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Abstract

Finland's social security spending has been increasing rapidly over the past four decades, and is expected to continue increasing in the decades to come. The increase has been largely driven by population ageing resulting in increased old-age spending. Finland's social security system is however more than just old-age social security; which warrants a more detailed analysis of the different types of social security spending. This paper analysed the historical development (1980-2018) of Finland's social security spending using ordinary least squares regression models, theoretical-, and empirical literature to determine the main influences on social security spending. In order of magnitude: the old-age dependency ratio, labour productivity growth, the poverty rate, the unemployment rate, low-skilled migration, and adult obesity were found to be the main determinants of social security spending. Short-term (2019-2030) time-series forecasts were also performed in order to predict the near-future development of social security spending in Finland. The forecasts predicted that social security spending will continue to increase at a rapid pace; reaching around 34% of GDP by 2030. Based on theoretical and empirical literature, as well as the results from the statistical analyses performed in this study; I drew a number of conclusions and presented a few policy suggestions that could help Finland deal with the current crisis in financing its social security system.

Key words: social security, population ageing, fiscal unsustainability, historical development, future forecasts

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Contents

1 Introduction

1.1 The problem

The main motivation behind the topic of this study was the rapid increase in Finland's social security spending over the past four decades. While several developed countries face similar problems as Finland when it comes to the sustainability of social security spending; Finland is a particularly concerning example in the European context due to its old population, rapid population ageing, and successive governments' mishandling of public finance particularly when it comes to social security spending.

1.2 Scope and aim of the study

The historical scope of the study is 1980-2018 based on the availability of social security expenditure data, and the scope of the future spending forecasts is 2019-2030. A fairly short time horizon was chosen for the forecasts as the sample was very small (39 observations); a longer forecast horizon would likely have made the forecasts inaccurate. The two aims of the study were to determine the main drivers behind the historical changes in social security expenditure, as well as to predict social security spending until 2030.

1.3 Research design

The study was set up as a quantitative case study of social security spending in Finland over the historical (1980-2018) and near-future (2019-2030) time-periods. The study is positivist in the sense that it is strongly guided by empirical data, and holistic in the sense that it attempts to explain the entire process and all aspects of social security spending in the Finnish context.

1.3.1 Research questions

This study has two research questions which are closely interlinked:

1. ***What were the main drivers behind the change in the different types of social security spending in Finland 1980-2018, and how did they influence social security spending?***
2. ***How do we expect the different types of social security spending to develop 2019-2030?***

The first research question will be answered using Ordinary Least Squares (OLS) regressions on the historical data as well as with theoretical and empirical literature. The second research question will

be answered with time-series forecast models as well as information on the historical (1980-2018) time-period. In a sense the answer to the first research question serves as a partial answer to the second research question.

1.4 Relevance and contribution

The sustainability of social security systems; particularly old-age pensions, elderly care, and healthcare; is a very pressing topic in many developed and developing countries across the globe. Many developed countries who have been putting off reform of their pension and healthcare systems (including Finland) are now at a point where they are forced to reform them due to the old systems no longer being economically sustainable; largely due to population ageing. Population ageing is a process occurring across the developed, and to some extent developing world. Finland could serve as a useful example of a country that has reached an advanced stage in this process.

While there have been several forecasts done on social security spending in Finland; I am not aware of any previous study that has attempted to not only forecast the main types of social security spending, but also aimed to explain the historical development in each individual type of social security spending. Forecasts have also usually been done with very long time horizons, whereas this study has a much shorter time horizon; which should increase its accuracy compared to longer forecasts. Lastly this study aims to provide some policy suggestions based on theoretical and empirical literature, regression analysis of the historical time-period, and short-term time-series forecasting.

1.5 Outline of the study

Following this introduction some relevant social security theories will be considered (and presented in an appendix), as well as two models that have been developed for forecasting social security spending in the Finnish context. Based on these theories and models, I have compiled my own ”theoretical model”; which would more correctly be described as a set of assumptions about the development of social security spending in the Finnish context.

After the theory section, the social security system in Finland will be described, with a few additional comments on residency and citizenship as well as voting in Finnish parliamentary elections.

The next section briefly presents some previous forecast studies on social security spending in Finland.

After that the data and methodology sections where the sources of the data, the dependent variables, and the independent variables with respective hypotheses are presented.

Finally, in section 8 the data analysis process is presented; followed by a brief discussion of the

limitations and biases of this study, as well as the concluding discussion that ends with some policy suggestions.

There are two appendix sections: one containing information on the the old-age asocial security theories that were considered, and another appendix for containing information on the equations for the different statistical tests and methods used in the study.

2 (Old-age) Social security theory

2.1 General theory and characteristics of (old-age) social security

As far as I know, there are no holistic theories on complex social security systems such as Finland's. Rather, theories have focused on old-age social security; mainly the pension system. In this section I will give a brief overview of the old-age social security theory literature; a more detailed account of the different theoretical models considered when compiling my own theory for Finland's social security spending can be found in the appendix section beginning **here**

Mulligan and Sala-i-Martin (1999) in their study on social security in theory and practice divide old-age social security theories into three groups: "efficiency", "political", and "narrative". Efficiency theories identify market inefficiencies and explain how social security programmes may be created to alleviate them. Usually these theories explain why it is governments who should administer social security programmes. Political theories see social security as redistribution that is an outcome of political struggle. A common characteristic for political social security models is that the outcomes of political struggles are assumed to be economically inefficient, and that there are social security reforms that may increase welfare. Political models also assume that social security systems favour the elderly; since they have managed to influence government policy enough to get a social security programme in the first place, they ought to be able to gain other political benefits such as regulation favouring their age-group. The elderly are therefore usually considered the winners in political models; which is consistent with higher consumption in older ages, old-age social security crowding out other government of spending, and redistribution of public resources from the young (working-age) to the old. Narrative theories are neither political nor efficiency theories, and they do not have any mathematical components as the previous two do. One way to look at narrative theories is as thought-provoking concepts into which systematic mathematical analysis has not yet been incorporated (Mulligan and X. Sala-i-Martin 1999b).

What most of these theories have in common is that they build on Paul Samuelson's (1958) overlapping generations model, and more specifically on Diamond's (1965) modification of the model.

Diamond's overlapping generations model has the following characteristics:

1. Individuals live for two periods, when they are young and when they are old; so 2 generations are alive at any point in time
2. In every time-period a number of individuals are born
3. The economy begins in period 1 when there is already a group of old, these are the initial old
4. Individuals work only when they are young and earn no income when they are old
5. A part of an individual's earnings are consumed when young, the rest is saved for old age
6. The assets accumulated by the young at the end of a period are the source for capital used in aggregate production in the following period
7. The old own the entire capital stock in every period starting from period 1, and they consume all of it over their old-age life (they also receive interest on their capital)
8. Capital and labour markets are assumed to be perfectly competitive, and there is a constant return to scale so that technology is a function of capital and labour

(Samuelson 1958; P. A. Diamond 1965; Carroll 2021)

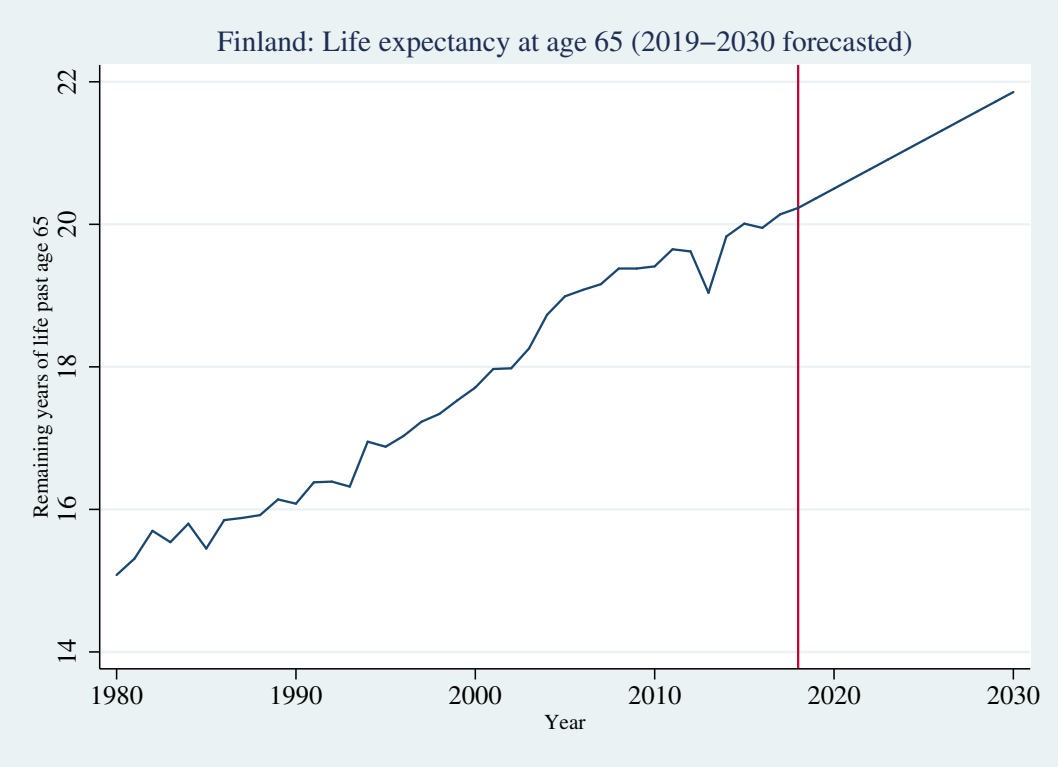
A more or less universal characteristic of old-age social security systems across the globe is that benefits are based on the beneficiary's labour income, but not the his or her non-labour income; with some 97% of countries earmarking payroll taxes for social security. In some countries, including Finland, the government also pays a share of social security.

In most countries, including Finland, old-age pension is paid as a life annuity. This means that the recipient receives their pension in regular (usually monthly) instalments after retiring, and up until their death.

Another common feature for most old-age social security systems is that they are administered by the government, and the administering and financing of social security is politically determined. In other words; social security is intricately linked to political decision making. Any theory that aims to explain social security systems and their changes therefore needs to incorporate this political element. Indeed politics and voter behaviour become very important when addressing old-age social security; as the primary concern among elderly voters is maintaining the old-age benefits they are entitled to, and they are quite single-minded in their voting in this regard.

One issue mentioned by Mulligan and Sala-i-Martin is that official retirement ages have not risen with life expectancy. This is of course problematic as life expectancy has been increasing rapidly, with increases occurring mainly at advanced ages since the end of the Second World War in developed countries like Finland (Figure 1). This means that individuals have become net consumers for larger periods of their lifespans; which in countries with publicly provided social security leads to increasing social security expenditure. As we will see later on, Finland is only now beginning a process of integrating life expectancy into retirement ages. One should also view the economic impact of such measures with an ounce of scepticism; as the underlying problems of population ageing and public health issues remain unaddressed. This will be further discussed in the 'Social security in Finland' section (Mulligan and X. Sala-i-Martin 1999b).

Figure 1: Life expectancy at age 65



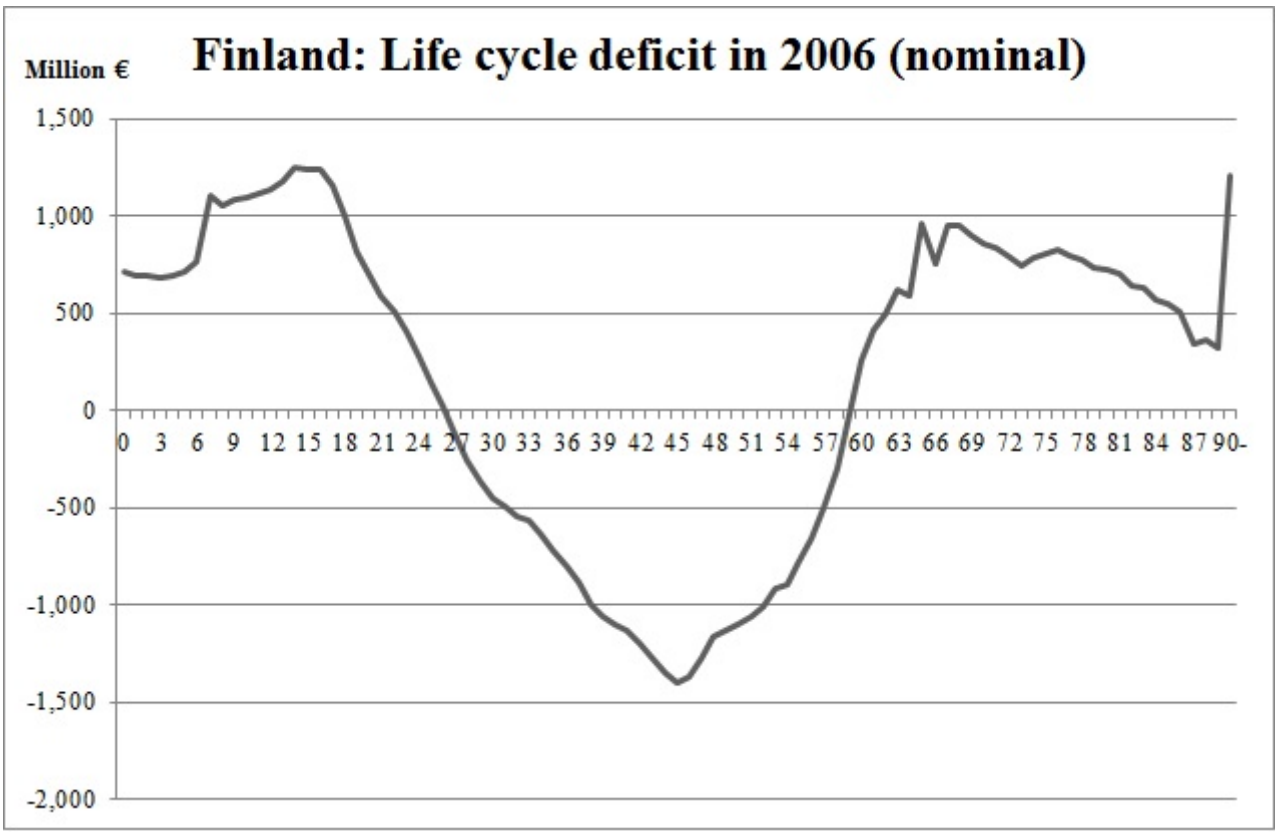
Source: Data from: (Human Mortality Database 2021)

Almost all old-age pension systems have been pay-as-you-go (PAYG) systems up until very recently. PAYG means that the current working-age population finances the pensions of the current retired population. This means that all old-age pension systems have up until now been redistributive across generations, and from the working-age population to the old. The volume of these transfers has also increased with population ageing.

The ageing of societies has led to old-age public spending increasingly dominating government

budgets. Furthermore, the elderly have been favoured in many other spending and tax policies, for instance in receiving government benefits for early retirement in order to deal with increasing unemployment in younger age groups, or through old-age discrimination regulations. We also know that pensioners are now consuming similar amounts or even more public resources than the young; and this does not seem to be explainable by demographics alone (Mulligan and X. Sala-i-Martin 1999b). Figure 2 shows the life cycle deficit for different ages in Finland in 2006. The life cycle deficit is the difference between consumption and production of public resources, so that a positive life cycle deficit entails higher consumption than production; in other words a net-negative impact on public finance. We see that the life cycle deficit is at similar levels for both advanced and young ages; with the spike at 90+ years capturing the sharp increase in consumption during the last years of life (due to health- and elderly care costs). This is of course worrying when we note that Finns on average became net producers only by age 27 and were net producers only until age 59 in 2006; and that the total net life cycle deficit totalled at around 16 billion € (Vaittinen 2017).

Figure 2: Life Cycle Deficit 2006



Source: Data from: (Vaittinen 2017)

All countries will sooner or later have to reform their pension systems due to population ageing and unemployment rendering the PAYG system economically unsustainable, and many have already

reformed their systems. Finland's pension system reform will be discussed later on.

Linked to the increasing share of government budgets being spent on old-age social security is the question of whether this leads to a crowding out of other government spending. This question is particularly relevant in countries with rapidly ageing populations and stagnant economic growth; as the only two ways to increase old-age related spending in such cases is either to cut other types of social spending, or increase public debt. Finnish governments have so far opted mainly for the latter; with Finland's Excessive Deficit Procedure (EDP) debt ratio to GDP growing more than 10-fold from around 6.5% in 1975 to 69.2% in 2020. While the Covid-19 pandemic explains the jump in spending for 2020; the debt ratio was around 60% 2014-2019 (Statistics Finland 2021b). This leaves pre-Covid-19 Finland at a sustainability gap in public finances of around 5%. Fiscal sustainability is the government's ability to sustain the current level of expenditure and public revenue without jeopardising fiscal solvency or defaulting on the costs of servicing public debt; so the gap is the fiscal adjustment that is needed to balance out the inter-temporal budget constraint. (Jalasjoki et al. 2020).

Continuing to finance future budget deficits with loans will not be sustainable in the long run; as Finland has already exceeded the EU public debt limit of 60%. In order to balance future budgets, spending will inevitably have to be cut. Whether this will result in old-age spending crowding out other spending depends on the voting behaviour of Finland's ageing electorate.

For those readers who are interested in the details of the different old-age social security theories considered in this paper, this is where the theoretical models discussed in the appendix would be inserted; beginning from **here**.

Important to note is that all the theoretical models discussed in the appendix section are described very briefly in an oversimplified manner; the actual models are much more complex equations. As Finland has had a fully developed old-age social security system throughout the time-period that is analysed, the theories mentioned served the purpose of better understanding and explaining some of the features and changes (or persistence) observed in the Finnish social security system.

Mulligan and Sala-i-Martin, who extensively analysed the theoretical models considered in this paper, concluded that simply changing expenditure and tax policies are unlikely to be enough for a pension reform. Rather a thorough political reform is necessary in order to achieve an effective pension reform; which gives stronger credence to the political theories (Mulligan and X. Sala-i-Martin 1999c). Based on the information I have gathered on the Finnish pension system and its development since the 1980s, I would agree with this conclusion. The political model therefore provide the main basis for the theoretical model I developed for the Finnish context.

Before going on to the model I developed for this study, I will briefly discuss two models that have been developed specifically for forecasting social security spending in the Finnish context; as they are

relevant to consider particularly for the forecasting part of this paper.

2.2 The Finnish Overlapping Generations (FOG) model

There is one overlapping generations model that has been specifically designed for the Finnish context. It is a modified version of Auerbach and Kotlikoff's (1987) dynamic simulation model designed to describe a small open economy and is calibrated to the Finnish economy (Auerbach and Kotlikoff 1987). As the model is a fairly complex dynamic forecasting model, it is unfortunately beyond the statistical abilities of a beginner to time-series forecasts such as myself; and will hence be described quite briefly based on its utility to the analyses I am performing in this study.

The FOG model is run under the assumption of perfect foresight; where firms and households have full information on future wages, taxes, prices, and the values of any other variables necessary for decision making. An alternative assumption used by Lassila et al. (2011, 2014) and Lassila (2018) is that households base their decisions on population forecasts in the belief that these are always true. The model contains neither money nor inflation. The main driving forces in the model are demographic change, educational change, and labour productivity growth. The demographic change, in Finland's case population ageing; is driven by increases in life expectancy, the retirement of baby boomer generations (1950s cohorts), and low fertility. Educational attainment increases somewhat with younger generations, and this is assumed to increase labour productivity as well. Growth in labour productivity, increases in educational attainment, and the unemployment rate are assumed to be exogenous factors. The increasing share of elderly in the population is expected to increase the demand for healthcare- and old-age care; both are assumed to be entirely publicly funded. Public expenditure is allocated mainly to the young (day care and education) and the old (health-, and old-age care); so changes in the age structure strongly impact public expenditure. Except for age-related expenditure; all other forms of public spending is expected to grow at the same rate as GDP (Lassila 2018; Lassila, Valkonen, and Alho 2011; Lassila, Valkonen, and Alho 2014).

2.3 The Ministry of Social Affairs and Health: Social security Expenditure long-term Forecast (SOME) model

The SOME model is another forecast model similar to the FOG, but developed to forecast all forms of social security expenditure; not just old-age pension and/or health spending. The SOME model is a static calculation framework in which forecasts are based on the current development of social security expenditure, index choices, and changes in the population structure. Static in this case means that the model does not measure the impact of changes in social security policies, rather the forecasts are

based on the current legislation. The forecasts are done up until 2070. Population structure forecasts make up the basis of the model. Information on the age specific consumption of different forms of social security are linked to these forecasts, whereby an estimated total social security consumption is reached. Furthermore the model incorporates information on the sizes of benefits or the per-unit expenditures for services. This information is linked to assumptions about the development of the economy, public health, and , if needed, social security legislation. The forecasts of social security expenditure are therefore determined by how the number of service users and benefit receivers, as well as how the unit expenditures of services and benefits change over time. The base values on which each projected time-period are forecasted are taken from the first year of the forecast time-period, more simply put: the last year for which complete historical data is available (Sirviö 2020).

2.4 Theoretical model for the development of Finland's social security system

I want to stress once more that my model is not a full-fledged theory in any sense of the word; rather a smorgasbord I have assembled based on the theoretical models discussed in this paper and the information I have gathered on the Finnish social security system. The model is more strongly linked to the OLS regressions performed on the historical data; as theory is not as central in predictive analysis, and sometimes the best model in theory may not be the best predictive model in practice (Shmueli et al. 2010). The other thing to note is that the above described theories all relate to old-age social security; whereas Finland has a complex social security system including healthcare, family, housing, disability, unemployment, widowhood, and other benefits.

Simple correlations using the Finnish data on different forms of social security spending 1980-2018 (described in more detail in the data section) indicated very strong relationships (correlation > 0.9) between spending on:

1. Inability to work & disability spending, widowhood & orphanhood spending
2. Family spending, unemployment spending
3. Old-age spending, housing spending, other spending

Health spending was the only type of spending that was not strongly correlated with any other form of spending. We need however be careful in drawing any conclusions about this information, as these correlations may be spurious.

To simplify matters somewhat we could assume that old-age-, unemployment-, (work-related) disability-, and to some extent housing social security were determined by similar political and

individual motives. This is because the political models described above all expect the old to form political coalitions, most likely with the poor; so it seems intuitive to expect that coalition governments would be likely to represent proponents for either increase or decrease in all or several of these benefits. As the data indicated, we may also expect family-related and unemployment social security to at least to a certain extent be important political issues for similar interest groups; namely the young and the poor (who often overlap). The connection between disability-related- and widowhood-related social security is more likely to be spurious for a couple of reasons. Firstly, disability-related spending encompasses not only work-related disability (making up the largest share), but also all other types of societal costs related to any form of disability. It therefore encompasses a very broad and diverse segment of society. Secondly, we can expect widowhood-related spending to be mainly related to widows and not orphans; as (working-age) adult mortality rates are at a very low level in a highly developed country such as Finland. We would therefore not expect a real relationship between interest groups concerned by these two topics. Lastly, health spending is more related to public health and population ageing than any particular interest group; although it could be argued that the elderly and the poor have the highest vested interest in maintaining highly subsidised publicly provided healthcare, as they are the most active users of the public healthcare system. The actual political process is more complicated with different emphases on each type of benefit depending on the influence of each interest group.

As old-age social security spending is the type of spending that has increased the most and is affected the strongest by Finland's rapid population ageing, making up some 40% of total social security spending in 2018 (The Finnish Institute of Health and Welfare 2021), and because it is the most studied form of social security; it seems to be the most straightforward to build a theory around. Apart from the theoretical model I construct, each type of spending will have its separate set of hypotheses based on empirical literature and the data; which will be discussed in the 'variables and hypotheses' section.

2.4.1 The theoretical model

The model is structured as a set of guiding assumptions that form a framework for understanding how (old-age) social security has developed in Finland, and how we may expect it to develop in the near-future.

- Life expectancy and the length of (productive) working life are to some extent linked, difficult to predict for each individual, but a key part of the pension system equation.
- Linked to life expectancy is the share of old individuals in the total population, which increases

with declines in fertility and increases in life expectancy, and is an important determinant for the size of the (old-age) social security system.

- Individuals are expected to save inadequately for their retirement, so there is need for forced savings. This is because individuals tend to be short-sighted and to some extent oblivious to the fact that they at some point will retire. Due to the generosity and size of the Finnish welfare system, individuals are likely to assume that whatever happens, society will support them even if their plight is self-induced.

- Redistribution in the Finnish pension systems has been from the young to the old as well as from the rich to the poor. The amount of redistribution (and size of the pension system) has also increased over time.

- Particularly in the case of old-age related social security, a key factor behind the increase in size and generosity of the system has been that the political parties representing the old and the poor have managed to form coalition governments and gain the majority vote in a large share of elections. Once increases in generosity have been implemented, it has been difficult to reverse the changes; but easier to expand them. The success of the old in achieving and expanding old-age social security likely relates to two factors pointed out in the theoretical literature. First, the elderly have more time to allocate on political elections; which is also supported by empirical data from Finland, where voter activity in parliamentary elections increases from under 50% at age 20 to a peak of over 80% at ages 66-74 (Fredriksson 2019). Second, elderly voters are more single-minded in their voting; as their primary concern is old-age related social security.

- The Finnish (old-age) social security system definitely has a poverty alleviating aspect, with progressivity and redistribution from the rich to the poor. The generosity of the system has however been pushed so far that it has disincentivised saving among lower-income earners in a similar way that the generosity of unemployment benefits have disincentivised gaining employment; particularly in low-income occupations.

- Transition to a fully-funded private earnings-based pension system is unlikely to be implemented in Finland due to the fierce resistance it would meet from the old and the poor.

- The development of old-age social security in Finland resembles a kind of Ponzi scheme proposed by the narrative chain letter model, but in the Finnish case rapid population ageing will cause the pension funds to run out so quickly that the main winners are the first generations (born during the post-war period). This is of course unless the elderly manage to gain the majority vote and

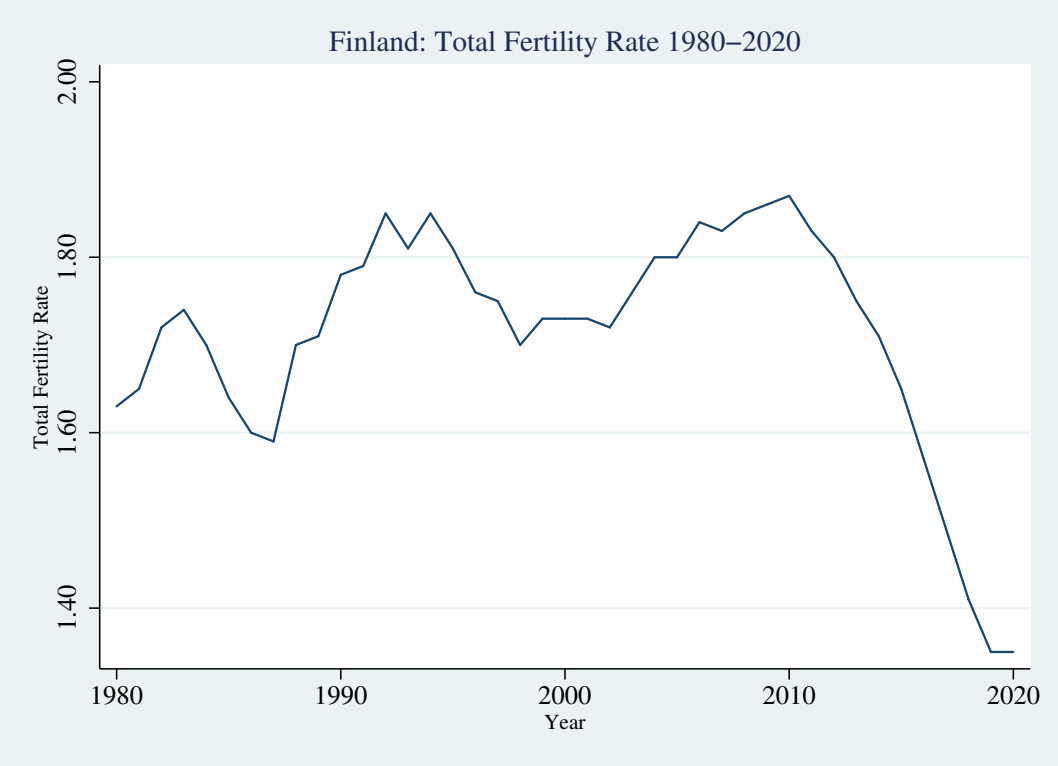
maintain the system's generosity until the bitter end, forcing continuing increases in national debt.

I will attempt to substantiate these assumptions using data and empirical literature in the following sections.

3 Social security in Finland

Finland's social security system could be described as a mix between a basic social security model with universal entitlements paid at flat rates, and a corporatist model where entitlements are earnings-related and based on contributions and membership in a particular occupational group. The Finnish governments have generally used incentives rather than obligations when it comes to social security; for instance when urging unemployed individuals to work, but the latter has recently received more attention due to the deteriorating situation on the Finnish labour market. Social security expenditure was still expanded during the 1980s in Finland, with cuts only starting to take place in the late 1990s as a consequence of the early-1990s depression. The cuts have mainly been slight reductions in benefit generosity by increasing waiting periods, closing early exit routes (i.e. for pensions), increasing incentives to work and remain in employment, making benefits more targeted, and suspension of indexation (Van Gerven 2008). The social security system remains very generous from an international perspective, with Finland's social spending as a percentage of GDP being only second to France among OECD countries in 2019 at 29.1% (OECD 2021d). With the retired share of the Finnish population already being at an internationally high level, ranking 5th among OECD countries at 21.6% in 2018 (OECD 2021a) and increasing rapidly due to long-term below-replacement fertility and the sharp decline in fertility since 2010 (Figure 3); any planned reductions to benefits and public provision of services linked to old-age will receive increasing opposition from the elderly electorate.

Figure 3: Total Fertility Rate 1980-2020



Source: data from (Statistics Finland 2021e)

3.1 Voting in Finnish elections

In Finland, parliamentary loyalty increases with age; where almost 50% of voters born in 1930 stated that they always vote for the same party, whereas for individuals born in the 1970s the share was only 15%. It is also well known that the Social Democratic Party (SDP), which has been the most dominant political party since the 1960s. SDP has for a long time encapsulated the alliance between the elderly and the blue collar workers (and unemployed); as both groups are net beneficiaries of the social security system. The first major upsets in recent Finnish parliamentary politics has been the rise of the Finns Party which has now become one of the major political parties due to its national focus as well as its critical stance on immigration and the EU; stances that have not been shared by any of the other major political parties in Finland. Being considered both economically and politically right-wing; the party has still managed to capture a sizeable share of particularly SDP's voter base (Pitkänen and Westinen 2019, pp. 35–36, 39–41). Whether this change in the dynamics of the Finnish parliament will somehow impact the extent and the pace of change to the Finnish social security system is difficult to tell at this point; as all major political parties will sooner or later begin competing for the vote of the burgeoning elderly voter base.

Another peculiar pattern in Finnish parliamentary voting is that during economic upturns left-wing

governments have been formed and have tended to drive expansion of the welfare state, whereas conservative governments have been formed during economic recessions and have been forced to make whatever small budget cuts have been possible due to the problem of the "received benefit (saavutettu etu)" mentality (Valtioneuvosto 2021). The "received benefit" mentality is basically that once a benefit has been implemented or increased, the beneficiaries will fight tooth and nail in order to maintain it. This is strongly linked to the self-interest of the individual voter, which is the general assumption in political social security theory.

3.2 Residence permits and citizenship

In Finland the main determinant of citizenship obtainment is the length of residence. The required length of residence is 2-6 years; for Nordic citizens 2 years, for asylum seekers and refugees as well as those who have a Finnish spouse 4 years, and for all others 6 years. Upon having resided in Finland with an A status temporary residence permit for two years, one can obtain a permanent residence permit; whereas B status temporary residence permits will not count towards permanent residence. In general economic migrants receive B status permits, whereas refugees and returnee migrants receive A status permits. Most rights and benefits in Finland are tied to permanent residence, parliamentary and presidential elections being two exceptions requiring citizenship (Hämäläinen et al. 2005; Kilpi-Jakonen 2014; Obućina and Ilmakunnas 2020). Finland's residence and naturalisation policy therefore strangely enough discourages economic migration, but incentivises asylum and refugee migration.

3.3 Finland's old-age pension system

A national pension was introduced as a fully-funded individual-savings related pension scheme in 1939; but wartime inflation and political resistance led to a reform of the system in 1957. In the reform pre-funding was abolished, pensions were equalised, and wealth- and income-tested supplementary allowance were introduced. All schemes were residence-based; as they are still today (Kotkas 2016; Valkonen 2020). The statutory private sector earnings-related pension system was established in 1962, and has since developed into the main source of pension for those who retire from the private sector. It is a defined benefit scheme (employer promises a specific pension upon retirement) that is partially collectively funded, with no individual risk-taking. Partially funded here means that from the age of retirement the retiree is paid pension benefits based on the amount they have pre-funded through their contributions, with the rest of the pension coming from the PAYG part.

During the 1970s the accrual rates of pensions were substantially increased, and initially low pensions were subject to discretionary increases. Unemployment pension was introduced for long-term

unemployed who had turned 60, and the eligibility age for unemployment pension was decreased to 55 in the 1980s with several early retirement schemes introduced in 1986. The early retirement schemes became very popular.

With the 1990s depression and increasing life expectancies, pension contributions were partially shifted to employees from having previously been solely paid by employers, and future contributions were set to increase equally for both parties. The first steps in the slow process of limiting access to early retirement were also taken. In 1996 the basic share of the national pension was removed, while the income-tested part remained. In 2005 there was a major reform of the pension system where pension accrual rates were decreased but shifted to begin at an earlier age, benefit rules of various earnings-related schemes were harmonised, flexible old-age retirement was introduced, and many early retirement schemes were set to gradually be abolished. In 2011 the guarantee pension that guarantees a minimum pension income was implemented (Valkonen 2020).

The latest pension reform was passed in 2014 and implemented in 2017 (Lassila, 2018). The perhaps most important part of the reform is that from 2017 until 2027 the retirement age is increased by 3 months annually until it reaches 65. After 2030, retirement will be linked to life expectancy. The upper limit of flexible retirement was also increased from 68 to 70 years (Valkonen 2020; European Commission 2021b). The accrual range was altered to 1.5% annually between ages 17 and 68, with benefit deferral after the earliest pension age being rewarded actuarially (related to statistical calculation of life expectancy) (Lassila 2018). Life expectancy increases are based on the **pension system life expectancy equation**.

Lassila (2018) in his working paper stated that one of the goals in the latest pension reform of keeping contribution rates smooth and sustainable in the long-run could be problematic as smoothing (removing random variation and revealing underlying trends as well as cyclical and seasonal components) is related to forecasting, and there could be some concerns about how effective smoothing is when dealing with a mix of slow-moving and more predictable demographic changes as well as highly volatile asset yields that are unpredictable (National Institute of Standards and Technology 2013a; Lassila 2018).

The statutory old-age pension payment has increased rapidly as a share of earned wage income from around 5% in the early 1970s up to 25% in 2021; a quintupling in just 50 years (Vidlund 2017; Elo Mutual Pension Insurance Company 2021). This means that the earlier birth cohorts born during the post-war decades receive a much greater rate of return on their pension contributions than more recent cohorts do, with the rate of return gradually decreasing for consecutive birth cohorts starting at around 8% for the 1940 cohort, down to 6% for the 1950 cohort, 4% for the 1960 cohort, and around 2% for current cohorts. This confirms the assumption that old-age pension in Finland has indeed

redistributed across generations from the young to the old (Lassila 2018).

The main issue with the Finnish pension reform is that it took over 50 years of an unsustainable PAYG system before the system was changed and the contribution rate set to a more sustainable level. This is an indication of just how successful the elderly have been in forming parliamentary coalitions and maintaining the generosity of the system, not to mention the incompetence of consecutive governments in handling government finance and reforming social security. This may sound like a strong statement, but the fact that the old pension system eventually ended up becoming unsustainable was not the result of a sudden or unexpected change; it was the result of long-term demographic trends that have been predictable ever since fertility permanently dropped below replacement levels in the early 1970s (Lehtonen 2008, p. 3).

The sustainability of the current reformed system can also be called into question for a few reasons. Firstly, the rapid decline in fertility since 2010 will require a corresponding increase in contribution rates due to its effect on population ageing. Second, if life expectancy increases as predicted, the replacement ratio will decline with time. The compensating effect of longer working careers is highly unlikely to be enough to offset the increase in lifespans, as it would require faster-than-predicted decline in the unemployment rate. Thirdly, low productivity-, economic-, employment-, and wage growth as well as low yields to pension funds all threaten the sustainability of the current system. Based on long-term pension projections by Tikanmäki et al. (2019), the main private pension scheme can keep contribution rates stable until the 2050s, but after that the contribution rate is predicted to increase rapidly until 2085. With the current aim of the system to smooth out the rate of growth in contributions; the contribution rate would have to be increased by 2.6% without delay. In other words the pension system is not financially sustainable. Lastly, the Covid-19 pandemic further weakened the financial sustainability of the Finnish pension system, but the basic structure of the current system is not expected to be reformed as a result of this (Valkonen 2020; Tikanmäki et al. 2019).

The current pension system comprises the national pension which is 665,29€/month (2021) for individuals living on their own, and 539,97€/month for individuals in a registered relationship (The Finnish Centre for Pensions 2021c); as well as a supplementary guarantee pension which increases the monthly pension income to at least 837,59€/month (2021) (The Social Insurance Institution of Finland 2021d). Both pensions are managed by the Social Insurance Institution of Finland (Kela). The second tier pension is the statutory employee pension that is earnings-related and administered by authorised private pension insurance companies (except for employees in the public sector whose pensions are managed by the public pension institution, Keva). If an individual living on their own receives an employee pension of more than 1343€/month (2021) or an individual in a registered relationship receives an employee pension of more than 1222€/month (2021) they no longer receive

any national pension (The Finnish Centre for Pensions 2021c). The national pension was in a sense made non-universal, and changed into an income-related pension system in 2001 with the above mentioned restrictions. National pension contributions paid by wage earners and pensioners were therefore abolished in 2001, and contributions by employers abolished in 2010; making the national pension entirely funded by tax revenues. The age limit for old-age national and guarantee pensions is 65 years (Kotkas 2016).

During 1956-1994 Finns living abroad were immediately entitled to national old-age pension upon moving back to Finland, while foreign nationals had to reside in Finland for 5 years before retirement. This changed with Finland's entry into the European Economic Area (EEA) in 1994. Firstly, the national pension was made proportional to the duration of residence in Finland. A stay of 40 years was required between ages 16 and 65 in order to receive a full national pension, so that the pension would be 50% of the total amount if the person had spent 20 years in Finland ages 16-65. Now Finnish and EEA nationals have to reside in Finland for three years after having turned 16 in order to be eligible for national pension; and the same rule was extended to all foreign nationals in 2007. The guarantee pension however annuls the year of residence requirement for everyone except for those entitled to national pension, but residing abroad; as the guarantee pension guarantees the minimum of 837,59€/month in total pension benefits (Kotkas 2016).

We can note that legislative changes over time have made the Finnish pension system more favourable towards foreign nationals, while making it more segregated for individuals legally residing in Finland.

3.4 Income support in Finland

Income support has been available in Finland since the 1950s, with some 3-5% of the population receiving income support 1957-1983. Income support has not been based on nationality in Finland; any person residing in a Finnish municipality has been eligible for the benefit. The 1997 Act of Income support, which is still in force, stipulates that income support is granted if the individual or their family are permanent residents in a municipality in Finland. The amount of the benefit depends on factors such as: age (for children), marital status, and type of residence. The benefit can be decreased for adults up to a maximum of 20% or 40% depending on a number of factors related to the behaviour of the recipient. The undiscounted monthly benefit for a childless individual living on their own is currently 504,06€/month (2021) (The Social Insurance Institution of Finland 2021a).

While the income support system may have been economically sustainable at least until the 1980s due to the low share of the total population receiving the benefit; there are some concerns about the

permanent increase in long-term unemployment rates, and therefore also recipients of income support, induced by the early 1990s Finnish depression (Kotkas 2016). Another issue of concern has been the high immigration rates Finland has had since the 1990s, with a large share of immigrants arriving from low- and medium Human Development Index (HDI) countries having lower educational attainment as well as lower levels of host country specific human capita than natives (Eurostat 2021b; Chiswick, Lee, and Miller 2005; K. Laitinen, Jukarainen, and Boberg 2016; Harju-Luukkainen et al. 2014). Data and studies from Finland have shown that individuals from non-EU countries, and particularly those arriving from poorer Middle Eastern and North African (MENA) countries have had substantially lower employment and income levels than native Finns; and therefore also much higher social welfare benefit consumption (Sarvimäki 2017; Sarvimäki 2011; Salminen 2020a; Jauhiainen and Raivonen 2020; Salminen 2015). What is even more worrying is that the poor integration outcomes of these immigrants appear to transfer strongly to their offspring; which in the worst cases leads to two lost generations (Ansala, Hamalainen, and Sarvimäki 2016; Kirjavainen and Pulkkinen 2015; Tiilikainen, Ismail, and Tuusa 2013; Malin and Kilpi-Jakonen 2019). There has been a steady increase in the number of recipient individuals and households, as well as in the total gross expenditure on income support in Finland since the mid-2000s. In 2019, 8.2% of all individuals and 9.5% of all households in Finland received income support; resulting in a total gross expenditure of some 780 million € (Tanhua and Sirkka 2020).

3.5 Health care and health insurance

The framework for Finland's current healthcare system was developed by the 1970s. Up until today municipalities have held the responsibility of providing primary healthcare as well as basic mental health services. Specialised medical care, including psychiatric care, has been provided by hospital districts that groups of municipalities are jointly responsible for.

The 1972 National Health Act stipulated that municipalities were to provide health care for their residents; a resident being someone who was registered as a resident of a particular municipality in the population register. Any person who is permanently residing in a municipality in Finland is entitled to healthcare services. Therefore, as with income support and pensions; the act does not distinguish between Finnish and foreign nationals. Since the 1980s municipalities have also been able to outsource healthcare services to private service providers. The great majority of healthcare services are publicly funded by municipalities and the Finnish state; with only a tenth of the expenditure being funded by user charges. The section concerning municipal provision of healthcare is still in use today, but since 2014 patients have had the right to choose at which healthcare centre and in which municipality they

wish to obtain non-urgent basic healthcare services. The choice of healthcare centre can be changed once a year. A recent amendment (2011) to the National Health Act also entitled foreign nationals holding worker's residence permits and a job, as well as those who have registered as unemployed after six months of employment, the right to healthcare services.

As a part of the Finnish public healthcare system, there is also an insurance reimbursement where patients are reimbursed around 20-30% of their payments for treatment at private healthcare institutions (CPCBH, 2021). As with access to public healthcare, the requirement for public health insurance is permanent residence; which usually entails a stay of at least 6 months per year. For workers from EU and non-EU countries residing in Finland, the requirement of receiving public health insurance is holding an employment contract of at least four months. The four month requirement for foreign workers was only introduced in 2004 in order to prevent temporary workers with very short contracts from receiving residence-based benefits (Kotkas 2016). Kela also provides reimbursement for medicinal expenses. The patient pays the first 50€ for each year, after which the reimbursement percentage increases progressively up 100% (fixed cost of 4,5€ per medicine) with a maximum annual limitation for medicinal expenses of 579,78€; after which the patient pays 2,5€ for each medicine purchased. Children and adolescents up until the age of 19 are exempted from the 50€ initial deduction (The Social Insurance Institution of Finland 2021c).

From the amendments of the National Health Act we can see that as with the old-age pension system, the healthcare system has been made more favourable towards foreign nationals over time. The public health insurance system has also set very low requirements for receiving insurance benefits. This is problematic for two reasons. First, as previously mentioned Finland has admitted a large number of humanitarian immigrants since the 1990s; and we know that they have had lower levels of educational attainment and income. It is widely accepted that lower levels of educational attainment and income are related to worse health outcomes (Ecob and Smith 1999; Ettner 1996; Fritzell, Nermo, and Lundberg 2004; Laaksonen et al. 2003; Ross and Wu 1995; Cutler and Lleras-Muney 2012). Studies on native Finns have also shown fairly strong intergenerational transmission of health behaviour and –outcomes; particularly at the top and bottom income and educational groups (Komulainen et al. 2019; Paalanen et al. 2020). Moreover, unemployment has been found to have a negative association with the health outcomes of young men in particular (Uggla and Billingsley 2018). Second, with free movement within the EU; the generosity of Finland's healthcare system is one pull factor for economic migrants (Eurostat 2021a) utilizing smuggling services of criminal organisations to cross the EU border (Europol 2016; Europol 2020) under the guise of need for asylum to choose Finland as their final destination.

3.6 Unemployment insurance and disability pension

Finland's unemployment insurance essentially consists of three parts; the basic unemployment allowance, the earnings-related unemployment allowance, and labour market support. The basic unemployment allowance and labour market support are both provided by Kela to those individuals who are not entitled to earnings-related unemployment allowance (The Social Insurance Institution of Finland 2021e). The basic unemployment allowance is given to unemployed individuals who have previously been employed, and is paid for a maximum of 400 days (300 if the individual's employment history is shorter than 3 years, 500 for individuals ages 58 and above). Labour market support is intended for individuals who either have not yet entered the labour market or for an unemployed individual who is no longer entitled to basic unemployment allowance. Both benefits are identical in the amount paid; 33.78€/day for five days a week, with a 5.3-10.03€/day addition depending on the number of children the individual has. Without the additions for children the total benefit received is 726€/month. Both benefits are taxed, and the individual's income and other received benefits affect the total amount received (The Social Insurance Institution of Finland 2021b). The third unemployment benefit is the earnings-related unemployment allowance, which the unemployed individual receives from the trade union he or she is a member of. The allowance is subject to the same maximum payment periods as the basic unemployment allowance (The Social Insurance Institution of Finland 2021e).

Disability pension is received by an individual who is not capable of working for at least one year due to illness or injury; while still not having reached retirement age. Sickness allowance may be provided by Kela if the disability period is shorter than one year. Vocational rehabilitation is the main alternative before disability pension. A recent (2019) study on the difference in social security costs for part-time and full-time sickness allowance beneficiaries was conducted on a 70% random sample of Finland's working-age population in 2010. The study found a cost reduction of almost 2,400€ per person per year for the first two years; with most of the savings being attributable to cost differences in retirement and vocational rehabilitation (Viikari-Juntura et al. 2019). An issue with sick leave is that there is no standardised prescription practice among health care professionals in Finland; meaning that patients with similar ailments may not receive equal benefits (Kankaanpää 2014). Due to the predicted savings from having individuals of older ages being on part-time sickness allowance and the continuing increase in the official retirement age; part-time employment and vocational rehabilitation have been encouraged as a measure to reduce early retirement (Viikari-Juntura et al. 2019).

There are however two major caveats to this approach. One is that there are underlying reasons related to health, cognitive-, and motor ability decline to why there is a high rate of early retirement. It is well established that the risk of cardiovascular disease rises dramatically in older adult ages, with

incidences among US men and women increasing from around 40% at ages 40-59 to 75% at ages 60-79, and up to 86% for those above age 80 (Rodgers et al. 2019). While we know with a fair amount of certainty that cognitive abilities begin declining at an increasing rate in late working-ages (60-), recent empirical evidence suggests that several measures of cognitive ability for healthy adults ages 18-60 show significant declines already by age 60. The data would therefore suggest that cognitive decline already begins in early adulthood. This does not apply to all measures of cognitive ability; measures based on accumulated knowledge such as vocabulary or general information tests consistently show increases at least until age 60. Nevertheless the data on cognitive ability should make us critical of the effectiveness and utility in increasing retirement ages (Salthouse 2009).

Without tackling the public health related root causes; part-time employment is unlikely to lead to major savings due to labour inefficiency. It is also important to remember that even part-time sick leave constitutes a major economic burden on the public economy (Kankaanpää 2014). Perhaps the greatest public health concern regarding early retirement and sick leave is the rapidly increasing prevalence of obesity among working-age adults, which in Finland increased from 8% in 1980 to 20.5% in 2018 (Statistics Finland 2021a). Another thing to note is that keeping older employees working part-time may induce inefficiency in the hiring and training of new employees, as high employer costs and strong trade unions make increasing personnel expensive and risky particularly for smaller businesses.

The data on employment at older ages also gives quite a clear picture of how unlikely it is that extending the official retirement age would be an effective measure in reducing social security spending; while around 80% of workers ages 55-59 were employed in 2018, only 50% of 60-64 year-olds were employed, and less than 15% were employed at ages 65-69 (OECD Publishing 2020).

The minimum age for receiving disability pension is 17. Partial disability pension is offered when the disabled individual has lost at least 40% of their working capacity, whereas full disability pension is offered to a person that has lost at least 60% of their working capacity. Assessment of reduced working capacity depends not only on medical factors, but also socio-economic factors like age, education, and work experience. Individuals aged 60 and above are assessed under more lenient conditions. The amount paid depends both on the pension earned by the individual up until the point of disability, and on a projected pension component. The projected pension component is received only by those who have worked at least 10 calendar years before disability and earned a minimum total of 18,410.22€ during that time-period, as well as paid earnings-related pension insurance on that income. For disability pensions beginning after 2010, the accrued pension received is adjusted by a life expectancy coefficient for the year that the disability began (The Finnish Centre for Pensions 2021a).

As with most other social security benefits, both unemployment insurance and disability pension are residence-based. The generosity of unemployment insurance and disability pension both share similar

concerns as previously mentioned benefits; not only has Finland had a high long-term unemployment rate since the great depression in the early 1990s in the native population, the increasing share of foreign-born individuals in Finland has further increased unemployment. Another issue has been the leniency of family reunification policies in Finland, which has increased not only health and old-age expenditure; but also unemployment insurance expenditure as well as family and housing expenditure as will be discussed later.

3.7 Surviving spouse's- and orphan's pension

Survivor's pension consists of two different benefits: the surviving spouse's pension and the orphan's pension. Surviving spouse's pension is paid to widows in Finland under certain conditions:

1. Indefinitely if the survivor had a child with the spouse, they married before the death of the spouse and before the spouse turned 65.

2. In the case of the married couple having had no children the widow must have been younger than 50 years old and the spouse under 65, they must have been married for at least 5 years, or the widow was at least 50 years old and had received disability pension for at least 3 years

Orphan's pension is paid to a child under the age of 18 if either their parent dies or the step-parent they live with dies. It ends at age 18 or at adoption.

The surviving spouse's pension is based on the old-age pension that the spouse that died had accumulated, or if the spouse was in paid employment based on the amount of disability pension they would have gotten at the date of their death. The widow can receive up to 50% of the deceased spouse's pension, but the amount is reduced based on the widow's pension as well as the number of children the registered couple had together. The orphan's pension is 33% for a single child and progressively increases up to 83% when there are 4 or more siblings. The share of the deceased parent's or step parent's pension is split evenly among the children (i.e. roughly 20% per child if there are 4 siblings) (The Finnish Centre for Pensions 2021d).

3.8 Housing support and state-subsidised rental housing

The Housing Financing and Development Centre of Finland (ARA) was established at the end of the 1940s to coordinate the massive undertaking of providing financing for the housing of the 400,000 displaced Finnish-Karelians after the Second World War. ARA is a branch of Finland's Ministry of the Environment. Ever since its establishment, but particularly from the 1960s, ARA has been heavily involved in financing the building of new apartment complexes as well as providing housing loans.

Of Finland's 3 million houses and apartments, a third have been financed with ARA loans. ARA also supports improvement in low- and middle-income households' housing conditions (The Housing Finance and Development Centre of Finland 2021).

In 2007 the Finnish Housing First approach was introduced; which is an ambitious social housing programme with the aim of eradicating homelessness in Finland by 2027. The first PAAVO programme (2008-2015) focused on long-term homeless, the AUNE (2016-2019) on preventing homelessness, and the current Government programme (2020-) has the goal of halving homelessness in four years, and ending homelessness in the following four years. Finland's fourth largest landlord, Y-Foundation, has been intricately involved in the programme; offering homeless, those who have lost their credit rating, or other displaced individuals subsidised rental housing (Housing First Europe Hub 2021). This programme has naturally led to a rapid increase in housing spending since 2008 as we will see in the data section.

3.9 Family and child support

Universal right to paid leave during birth weeks was implemented in 1964, with a duration of 9 weeks. Income compensation was quite low at 45%, and benefits were non-taxable. In the 1970s-1980s extensions were made to the leave, which increased the duration to 263 weekdays by 1987 (with a temporary further increase by 2 weeks 1991-1992). Father's leave has been available from 1978, first limited to 2 weeks, but later on increased. From 1987 Finnish fathers have been able to share all except the first 105 days of the parental leave with their partner. In 1982 the compensation was increased to 80% during the mother's leave and 70% during the rest of the leave, and benefits were made taxable. Since 1983 an earnings ceiling has been in place that reduces compensation once reached. Since 2005 if a woman has another child within three years from her previous birth, she gets to keep the same level of parental allowances she received for her previous child (Haataja and Juutilainen 2014).

A father's quota was introduced in 2003, and extended to a maximum of 36 workdays in 2010 . Before 2003 only 2-3 percent of fathers took parental leave; this increased to around one-third of fathers using their 'daddy month' in 2012 . Both parents have the legal right to return to their workplace after the home-care period (Aholainen 2010; Lammi-Taskula 2017, pp. 92–93).

In 1985 a home care allowance scheme was introduced; whereby parents had the option to choose between public day-care or an extra income transfer for taking care of their child at home. Since 1990 all Finnish parents have been entitled to the home-care allowance until their child is three years old. Almost 90 percent of families having a child in the 2000s utilised the home-care allowance (Haataja and Juutilainen, 2014). The allowance is 342.95€/month for the first child below three years

of age, 102.67€/month for each additional child below three years of age, and 65.97€/month for each child over three years of age until they reach school age. There is also a care supplement of up to 183.53€/month that is reduced if the family income exceeds a certain family-size-dependent limit. An additional municipal supplement may also be available which varies between municipalities (Kela, 2021b).

In 1973 about 10% of Finnish pre-school children were in public day-care. This has since increased and plateaued at around 50%. Public day-care has been in short supply due to its popularity; excess demand has been met by private forms of child care (Rønsen 2004). In addition to paid parental leave and home care allowance, families in Finland also receive a child benefit. The benefit is a monthly tax-free sum paid for each child until they reach 17 years of age. For the first child the amount is 94.88€/month and progressively increases until the fifth and each additional child to 182.69€/ month. Single parents receive an additional 63.30€/ month per child (Kela, 2021a). Finally, mothers receive a one-time 170€ (2018) maternity grant either in the form of a 'baby box' or in cash for each child they give birth to (The Social Insurance Institution of Finland 2018).

Despite below-replacement fertility since the 1970s and the rapid decline since 2010, social security spending on families and children increased from below 2% to around 3% of GDP 1980-2018. One reason behind the increase could be the increasing generosity of benefits and expansion of public daycare. Another reason could be the increasing share of immigrant families in the Finnish population, of which some (mainly poorer MENA) nationalities have much higher total fertility rates (TFR's) than native Finns and on average much lower income, as was mentioned previously (Statistics Finland 2021d; Statistics Finland 2021i).

4 Previous studies on the development of social security spending in Finland

Lassila et al. (2011, 2014) did forecasts using the FOG model on the long-term sustainability of health and long-term care spending in Finland using data up to 2009. As with other forecasts they acknowledged the main threat to sustainability in population ageing. Unfortunately for them their forecasts are now largely inaccurate as they could not foresee the extremely rapid decline in fertility since 2010, the immigration crisis in 2015, and the Covid-19 pandemic 2019-.

One potential way of dealing with the fiscal sustainability gap in Finand's public finance that the authors suggested was an increase in the Value Added Tax (VAT) that is conditioned on the real or forecasted development of public debt. Based on their forecasts this would substantially reduce

government debt from their baseline 65% of GDP to 45% of GDP by 2060, with only a minor increase in the tax rate. This approach would however require, or perhaps better put have required, the tax increase to be implemented at an early stage in order to prevent excessive indebtedness. As we saw from the debt data, Finland has already passed this early stage. The required increase in VAT will at this point be much higher than they had predicted; and would face a major backlash from Finnish consumers (Lassila, Valkonen, and Alho 2011; Lassila, Valkonen, and Alho 2014).

Lassila (2018) also used the FOG model for the forecasts he did on the Finnish earnings-related pension system. His forecasts predicted a levelling out of pension expenditure and contribution rates at just below 30% and around 25-30% of wages respectively 2020-2060, after a rapid increase since the 1960s, due to the 2017 pension reform. There are however a few issues with his forecasting model. Firstly, he assumed that migrants are identical to natives in all economic aspects upon arrival. We know from the empirical data and studies mentioned earlier that this is assumption is very unrealistic, and will severely overestimate the average earnings and pension contributions of immigrants arriving in Finland. Secondly, the model assumed a 1.75% annual growth rate in labour productivity in private goods production (Lassila, Valkonen, and Alho 2014). This seems overly optimistic considering that the average growth rate in labour productivity in non-financial corporations has declined over time from 2.59% for the 1980-2018 time-period, to 2.23% 1990-2018, to 1.36% 2000-2018, and down to 0.86% 2010-2018 (Statistics Finland 2021g). Overestimating labour productivity growth would in turn underestimate the pension expenditure and contribution rates.

Sirviö (2020) performed forecasts on the overall social security spending as a share of GDP in Finland using the SOME model. Statistics Finland's 2018 population forecasts formed the basis of his model, so his point of departure was essentially the same as the one used in this study. The demographic and economic calculation framework for his forecasts included: live births, net immigration, employment- and unemployment rates, inflation, GDP growth, and growth in labour productivity. Income-related pension was indexed 80% to the consumer price index (CPI) and 20% to wage levels. National pension, as well as the majority of other benefits paid by the Social Security Institution of Finland were indexed 50% to CPI and 50% to wage levels.

Overall Sirviö's assumptions about the development of the demographic and economic variables in his base framework were quite similar to those of this study. The main differences were that he was somewhat more optimistic in his assumptions about the annual growth in GDP, labour productivity, and the unemployment rate which he set to 1.4%, 1.4%, and 7% respectively for 2040 compared to my assumptions of 1%(GDP per capita growth), 0.4%, and 7.4% respectively for 2030. On the other hand, he assumed a faster growth in CPI at 2%/year compared to my 1.4%/year. Since Sirviö used very similar data to what I used in my forecasts, we could essentially view his model as a more complex and

slightly more optimistic approach compared to the forecasts I performed in this study. Just as I did in my forecasts, Sirviö also found that the main increases in social security spending were due to increases in old-age related spending (pensions and elderly care). Due to his more optimistic assumptions and a different approach his total social security spending forecast reached the 2030 level of around 34% of GDP in my forecast 30 years later in 2060 (Sirviö 2020).

Sirviö also included previous forecasts by the Ministry of Social Affairs and Health of social security expenditure as a share of GDP performed between 1980 and 2019 in his study. The large differences between these forecasts reveals the main weakness of long-term forecasting; the unforeseeability of future events and decisions (Sirviö 2020). The further ahead we forecast, the less likely it is that the forecast will be accurate. But, these long-term forecasts do serve an important purpose in revealing the more predictable long-term consequences of demographic change; which are the main determinants of social security spending.

5 Data

The country of analysis was Finland and the data for the analyses was gathered from a number of different sources. All the data was annual country-level aggregate data. Because of this the data ought to have been valid and reliable, and not subject to bias or uncertainty. The time-period of the analyses was 1980-2018, and for the future forecasts 2019-2030. The dependent variables of different kinds of social security spending as a share of GDP were accessed from an open-access dataset compiled by The Finnish Institute of Health and Welfare (The Finnish Institute of Health and Welfare 2021). Data on real GDP per capita growth was accessed from the World Bank for the years 1980-2019; for 2020 data was accessed from Statistics Finland (The World Bank 2021). The data on the share of foreign born, the old-age dependency ratio, the percentage change in CPI, the life expectancy (at birth) difference between men and women, and the percentage of households in the lowest three income deciles, and the share of obese adults ages 20-64 were all accessed from Statistics Finland's 'StatFin' open access register database (Statistics Finland 2021h). The data on unemployment was accessed from AMECO Online, which is an open access database on various socio-economic variables for different European countries managed by the European Commission (European Commission 2021a). The political leaning data for Finnish governments was gathered from the Finnish Government's own website, and based on the composition of the political parties in the respective governments (Valtioneuvosto 2021). For the forecast period (2019-2030) Statistics Finland's population forecasts were used for the old-age dependency ratio(Statistics Finland 2021h). For the years 2020-2022 forecast data by the OECD was used for unemployment, and percentage change in CPI (OECD 2021c; OECD 2021e). For all other

independent variables and remaining forecast time-periods either naive or random walk with drift forecasts were used to complete the time series. Naive forecasts simply means that the value for the last year of data was used for the entire forecast time-period. The random walk model will be explained later.

6 Methodology

The historical data (1980-2018) was analysed with OLS regressions. There were a few reasons behind this choice. Firstly, there was only a single entity that was being analysed; the type of social security spending. A fixed effects model simply was not an option. Secondly, the independent variables used in the analyses were deemed to not be endogenous; so the OLS models should not have been biased. Thirdly, the data was normally distributed. Fourthly, multicollinearity was not an issue in any of the models.

As for the time-series forecasts (2019-2030), autoregressive integrated moving average (ARIMA) modelling was the choice mainly for two reasons. Firstly, ARIMA modelling is one of the most commonly used time-series forecasting methods. Secondly, I was completely new to time-series forecasting prior to this study; so I had to start out with a method that was widely documented and fairly straightforward to understand and interpret.

6.1 Variables and hypotheses

6.1.1 Dependent variables

As has been mentioned previously the dependent variables in this study are the different types of social security spending, divided according to how the Finnish Institute of Health and Welfare divided social security in the raw data. The different types of spending are:

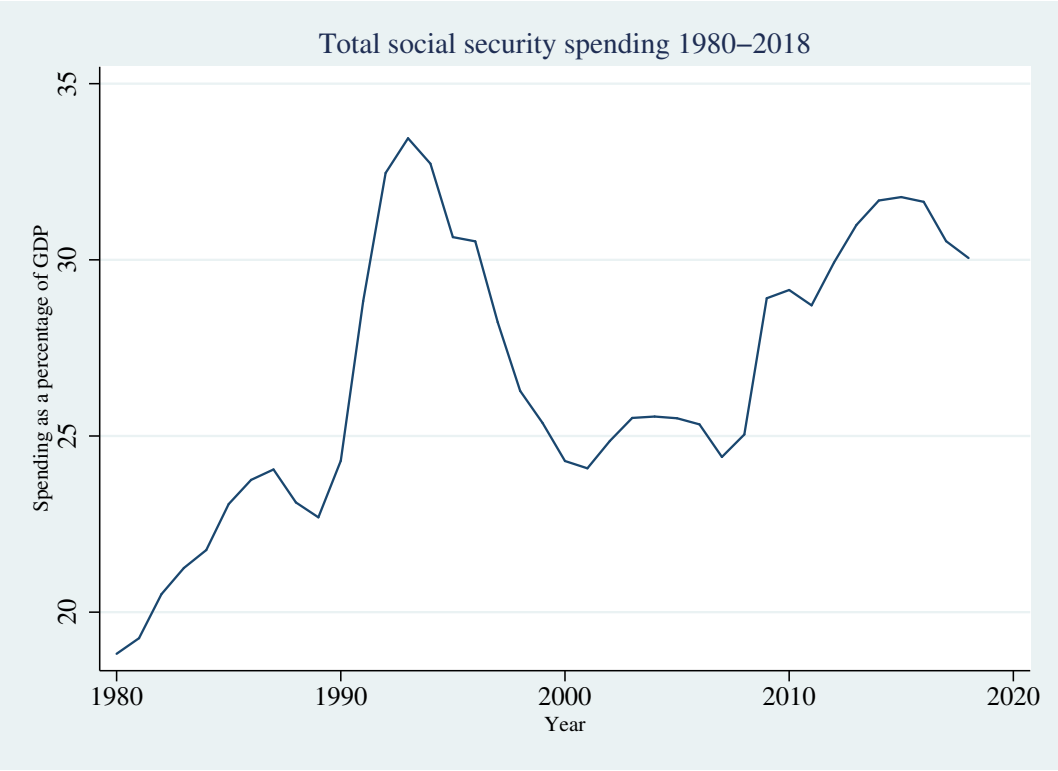
1. Health spending
2. Inability to work and disability spending
3. Old-age spending
4. Widowhood and orphanhood spending
5. Family spending
6. Unemployment spending

7. Housing spending
8. Other spending
9. administrative spending

Administrative spending was not analysed for the historical time series as these costs are difficult to connect to any particular set of variables or hypotheses. The forecast of administrative spending was a random walk without drift due the unpredictability and lack of a trend in the time series.

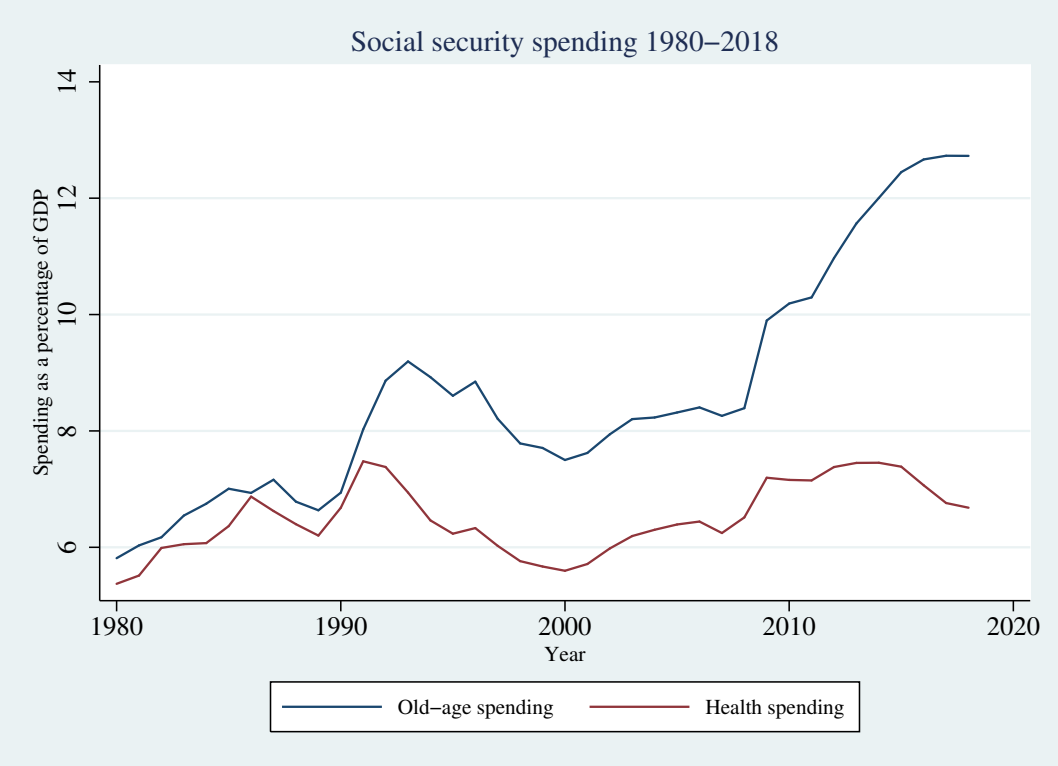
6.1.1.1 time series graphs of the dependent variables

Figure 4: Total social security spending 1980-2018



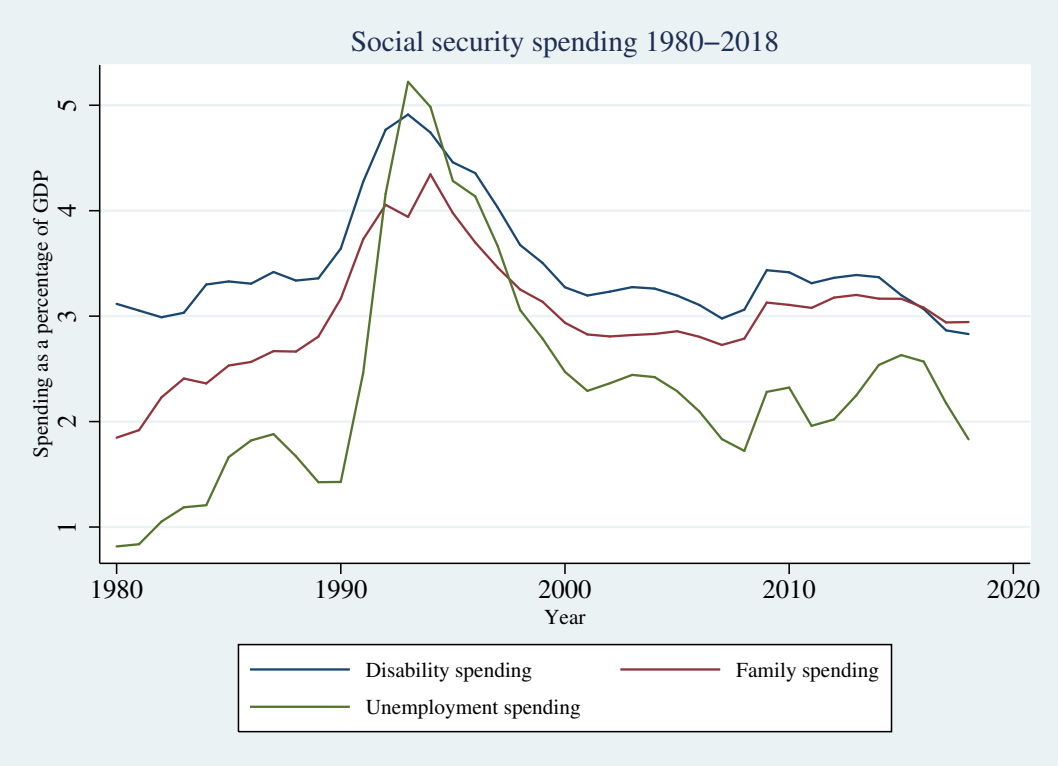
In Figure 4 we can observe that total social security spending grew from 18.2% of GDP in 1980 to 30.1% in 2018; an increase of almost 40%. The massive spike in spending in the early-1990s was due to the 1990s depression in Finland; when there was an increase in all types of social security spending, with the most pronounced increase being in unemployment spending (Figure 6). There was also a rapid increase in spending as a result of the 2007-2008 financial crisis, and there has been a sizable increase during the Covid-19 pandemic; although this data is not yet available.

Figure 5: Old-age and health spending 1980-2018



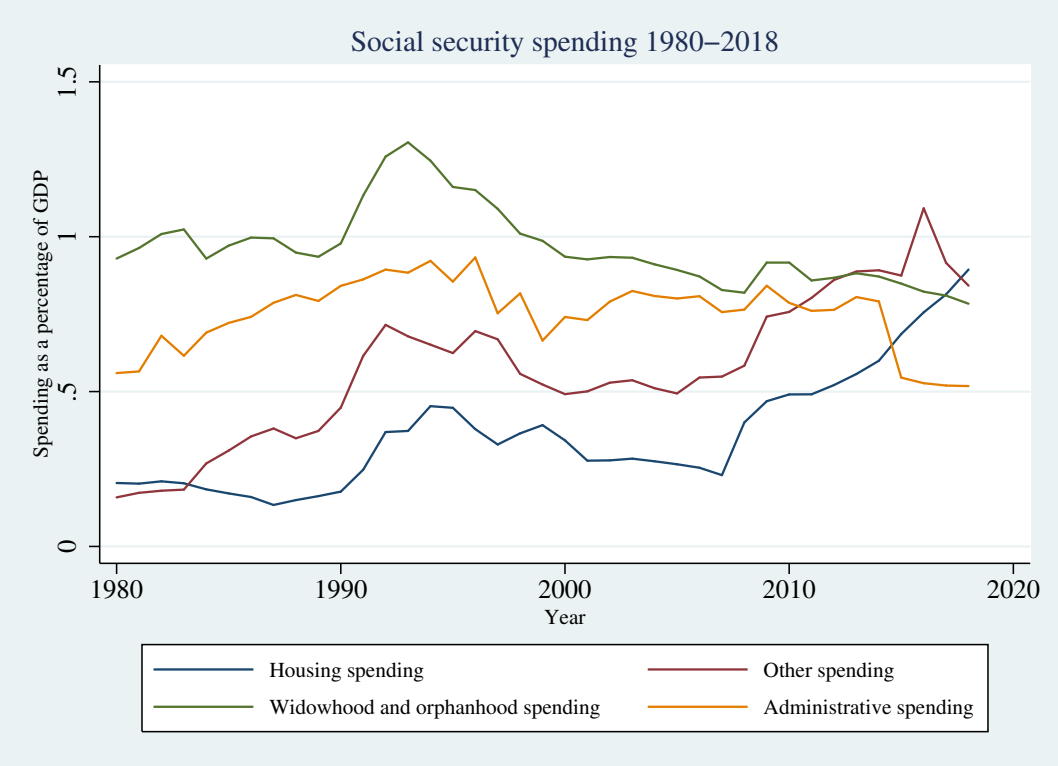
In Figure 4 we can see that old-age spending more than doubled from 5.8% of GDP in 1980 to 12.7% of GDP in 2018, whereas health spending grew by around a fifth from 5.3% to 6.7%. The old-age spending share of total social security spending grew rapidly 1980-2018, from around 32% to 42%; clearly making it the main driver of increasing social security expenditure.

Figure 6: Disability-, unemployment-, and family spending 1980-2018



While disability spending decreased slightly, both family- and unemployment spending grew by around 1%-point 1980-2018. As mentioned earlier, unemployment spending saw the largest increase in both relative and absolute terms during the 1990s depression; growing by almost 4%-points 1990-1993.

Figure 7: Housing-, other-, widowhood & orphanhood–, and administrative spending 1980-2018



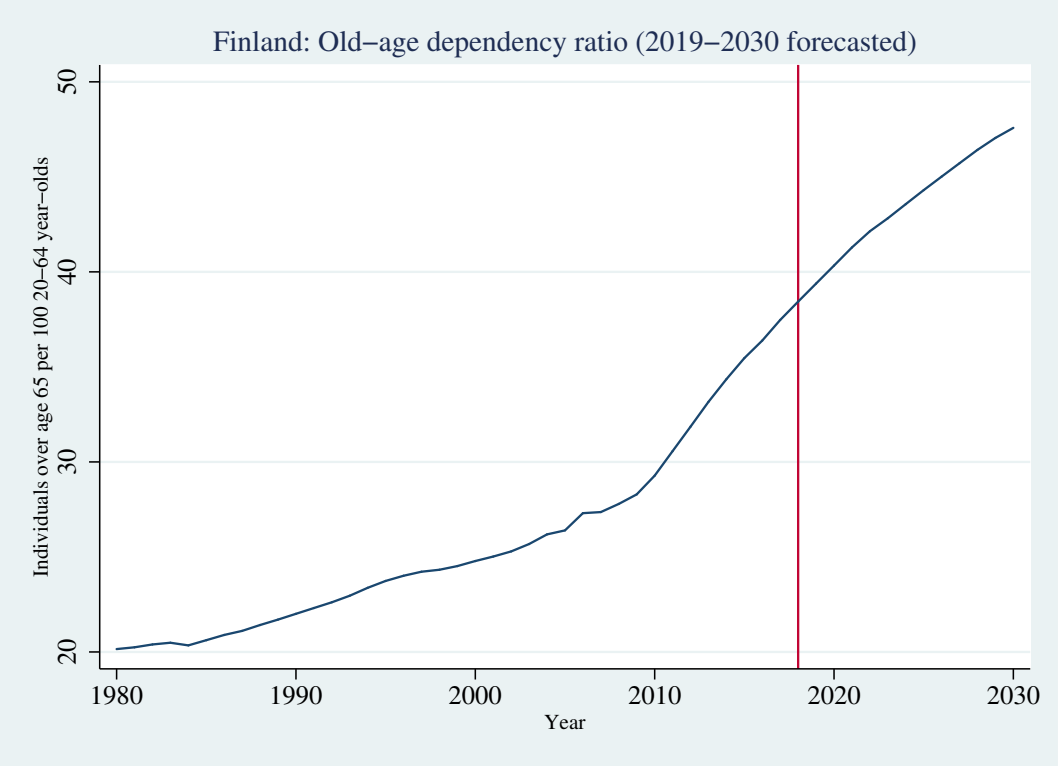
Both widowhood and orphanhood- as well as administrative spending declined somewhat 1980-2018, whereas both housing and other spending saw almost identical increases from around 0.2% to 0.8-0.9% of GDP.

6.1.2 Independent variables

6.1.2.1 Old-age dependency ratio (ratio of 65+ year olds to 20-64 year olds)

As we have noted from the theoretical and empirical literature, population ageing is one of the major factors affecting social security spending. I have chosen the old-age dependency ratio as the most appropriate measure of population ageing as it gives the ratio of retirees to the working-age population (20-64 year olds); which is the most relevant relationship to consider since these are the net main consumers of social security and the net contributors. While not relevant for all the types of social security spending, the old-age dependency ratio was used in modelling health and old-age spending. The old-age dependency ratio is expected to be positively correlated with both old-age and health spending. Endogeneity is highly unlikely to be an issue with the old-age dependency ratio, as we would not expect increases over time in social security to increase the share of elderly in the total population, as has been the case in Finland.

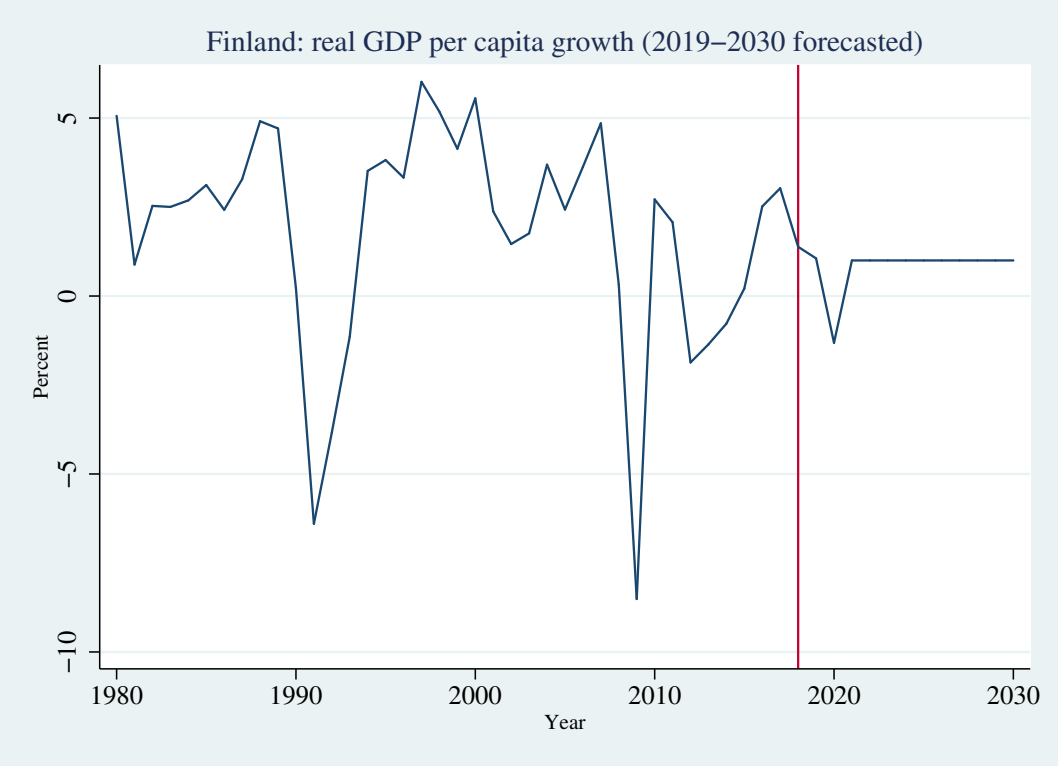
Figure 8: Old-age dependency ratio 1980-2030 (2019-2030 forecasted)



6.1.2.2 GDP per capita growth

GDP per capita growth has been used in forecasts by other authors in the Finnish contexts, and it is an important variable in this study as it captures economic cycles as well as the availability of funds for the social security system. As we have noted in the discussion on the Finnish context, social security spending policy has tended to be pro-cyclical; so we expect that GDP per capita growth is positively correlated with old-age spending and possibly also with disability spending. Previous cross-country studies on old-age social security have also found a positive relationship between GDP growth and social security spending (X. X. Sala-i-Martin 1996; Cashin 1995). On the other hand we know that poor economic performance is linked to increased unemployment and poverty; so we expect GDP per capita growth to be negatively correlated with unemployment spending in particular, but possibly also for the other types of spending except for the above mentioned, as most of these are related to either unemployment or poverty. GDP per capita growth is also unlikely to be endogenous to social security spending. Now some might argue that increased health spending has been shown to increase GDP growth, but this relates more to less developed countries with poorly developed and funded healthcare systems; whereas Finland's healthcare system was already well-developed by the 1980s (Ke, Saksena, and Holly 2011; Piabuo and Tieguhong 2017; Yang 2019).

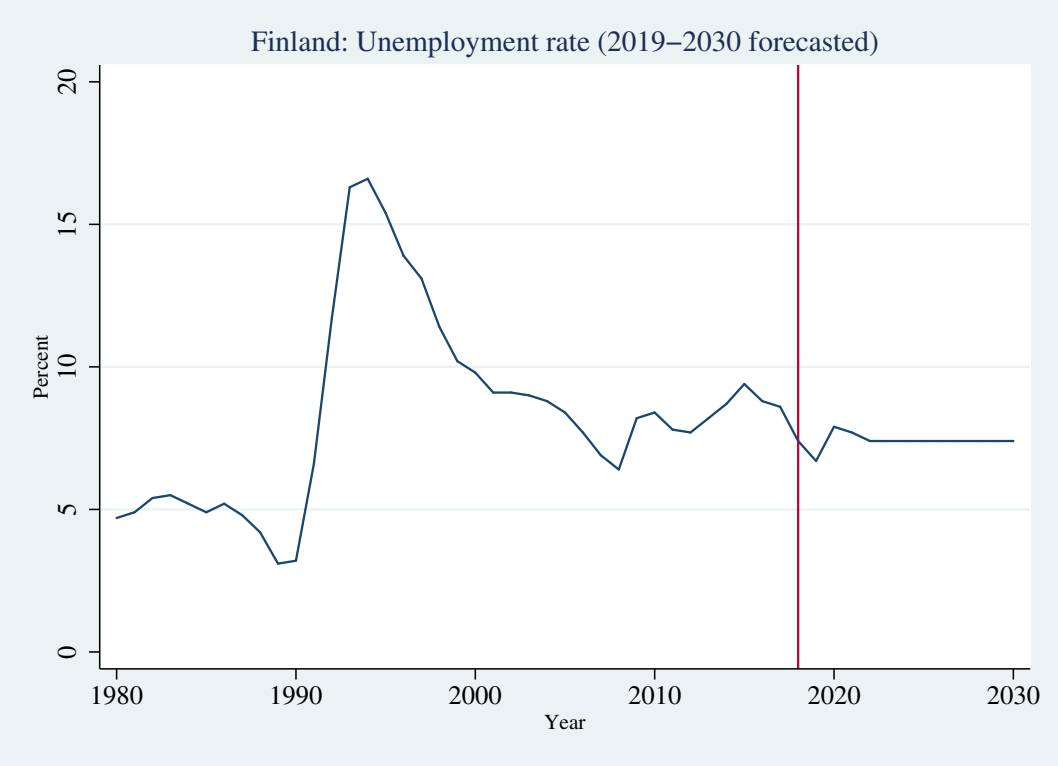
Figure 9: real GDP per capita growth 1980-2030 (2019-2030 forecasted)



6.1.2.3 Unemployment rate

Unemployment is another commonly used variable for forecasts of public expenditure, as unemployment not only reduces payroll tax revenues, but also increases unemployment related public expenditure. Obviously we expect the Unemployment rateage to be positively correlated with unemployment spending, but also with all other types of spending except for old-age spending; as unemployment is likely to divert away resources that might otherwise be spent on old-age related spending. For disability spending there is an endogeneity problem as some working-age individuals that are unable to work are also registered as unemployed, therefore the relationship would run both ways (Laiho et al. 2010).

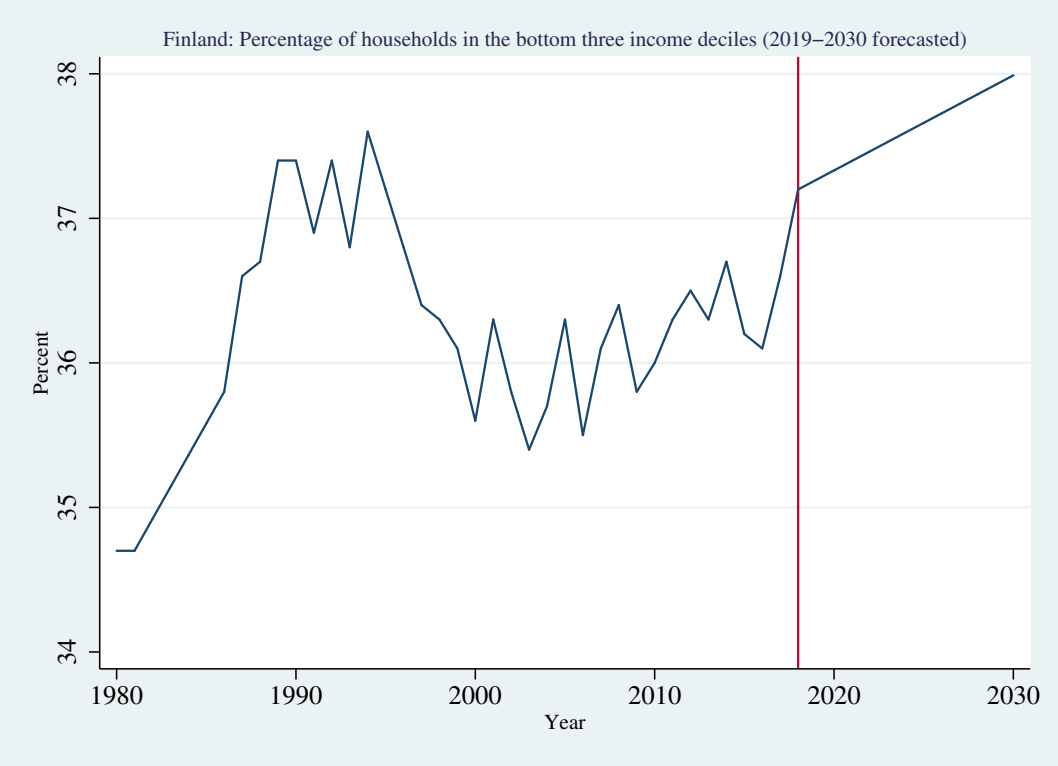
Figure 10: Unemployment rate 1980-2030 (2019-2030 forecasted)



6.1.2.4 Percentage of households in the lowest three income deciles

The percentage of households in the lowest three income deciles is used as a measure of relative poverty in Finland. One of the reasons for using only the lowest three deciles is that the more deciles that are included, the less variation there is over time. Including only the lowest three deciles also targets poverty more accurately than using more broad measures like the standard 60% of the median income as a poverty line. As social security benefits are in many cases means- or earnings-tested; a higher poverty rate is expected to increase most types of social security spending. It was used in all of the historical social security explanatory models, and expected to be positively correlated with spending. Poverty could cause an endogeneity problem if there had been major cuts in social security expenditure during the time-period of study, but this has not been the case. We therefore expect the share of households in the bottom three income quintiles to be exogenous to the different types of social security spending.

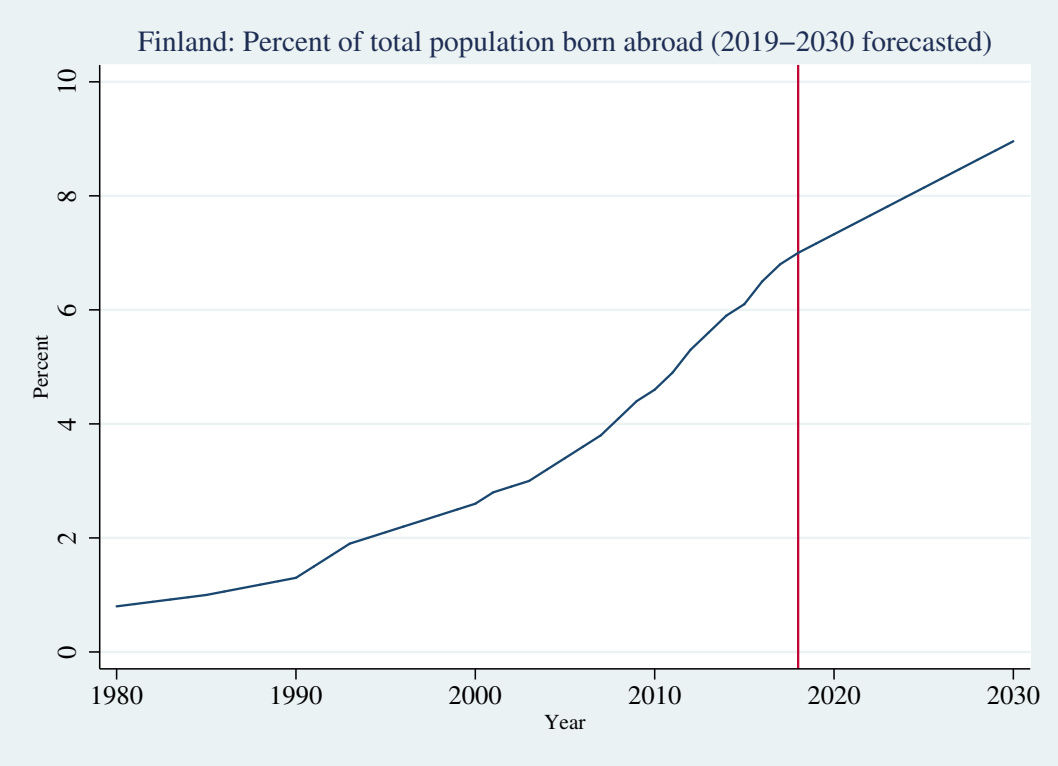
Figure 11: Percentage of households in the lowest three income deciles (2019-2030 forecasted)



6.1.2.5 Percentage of the population born abroad

The percentage of the population born abroad was used in the historical models for other- and housing spending. This relates to the kind of immigration Finland has promoted since the 1990s, namely humanitarian immigration. We know from studies on immigrant integration that immigrants from MENA countries in particular (which make up the bulk of humanitarian immigrants to Finland) have had much lower employment and income levels than native Finns; and that a large share of these immigrants lives in social housing. Housing spending is dominated by housing support for rented apartments (social housing). The other spending category consists of income support, which we know is much more frequently received by immigrants compared to natives, and to an increasing extent of public spending on immigrant integration. We therefore expect the share of foreign born to have a positive correlation with both these types of spending (Andersen, Turner, and Søholt 2013; Jauhiainen and Raivonen 2020; Salminen 2020b).

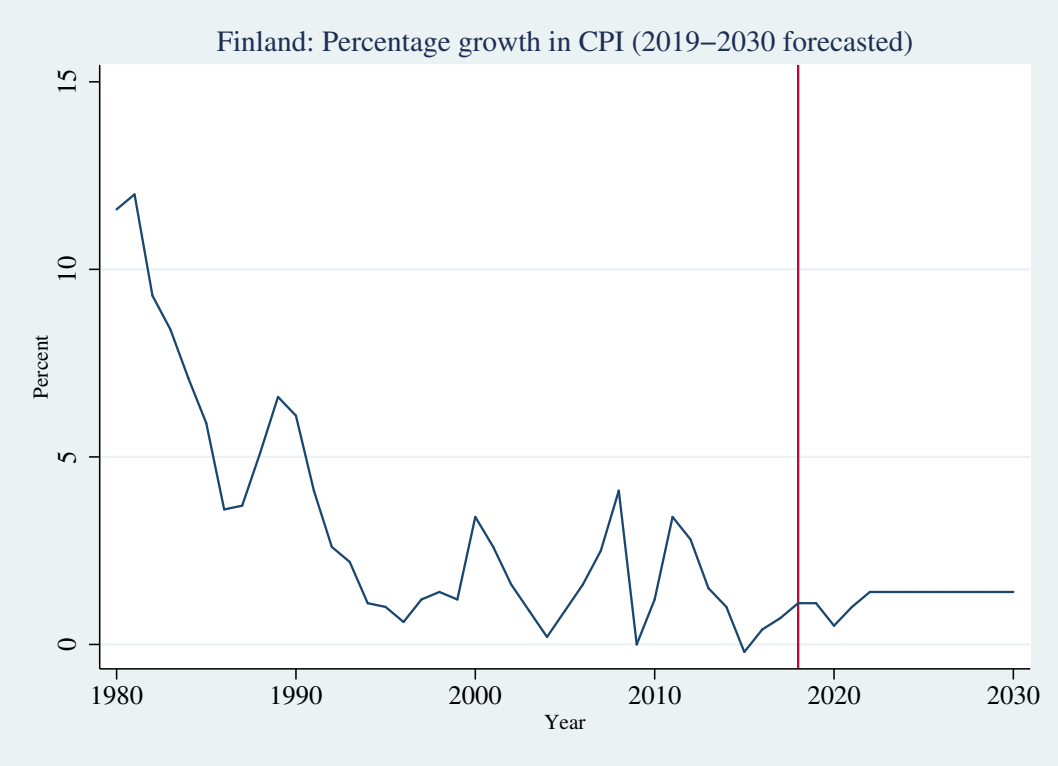
Figure 12: Percent of total population born abroad 1980-2030 (2019-2030 forecasted)



6.1.2.6 Growth in CPI

The percentage change in CPI reflects increases in consumer prices (inflation). We therefore expect CPI to be related to all kinds of private consumption, whereby increases in the consumer price index would weaken the purchasing power and negatively affect the poorest in society in particular; which could result in greater social security expenditure. CPI, like GDP per capita growth, is useful in the sense that it is unlikely to be a cause of endogeneity; as consumer prices are unlikely to be affected by expenditure in social security. We expect the percentage change in CPI to be positively correlated with all types of social security spending. We can also note that the earnings-related pension index has an 80% weight on CPI and 20% on wage income levels; so increases in CPI would result in higher pension payments (The Finnish Centre for Pensions 2021b).

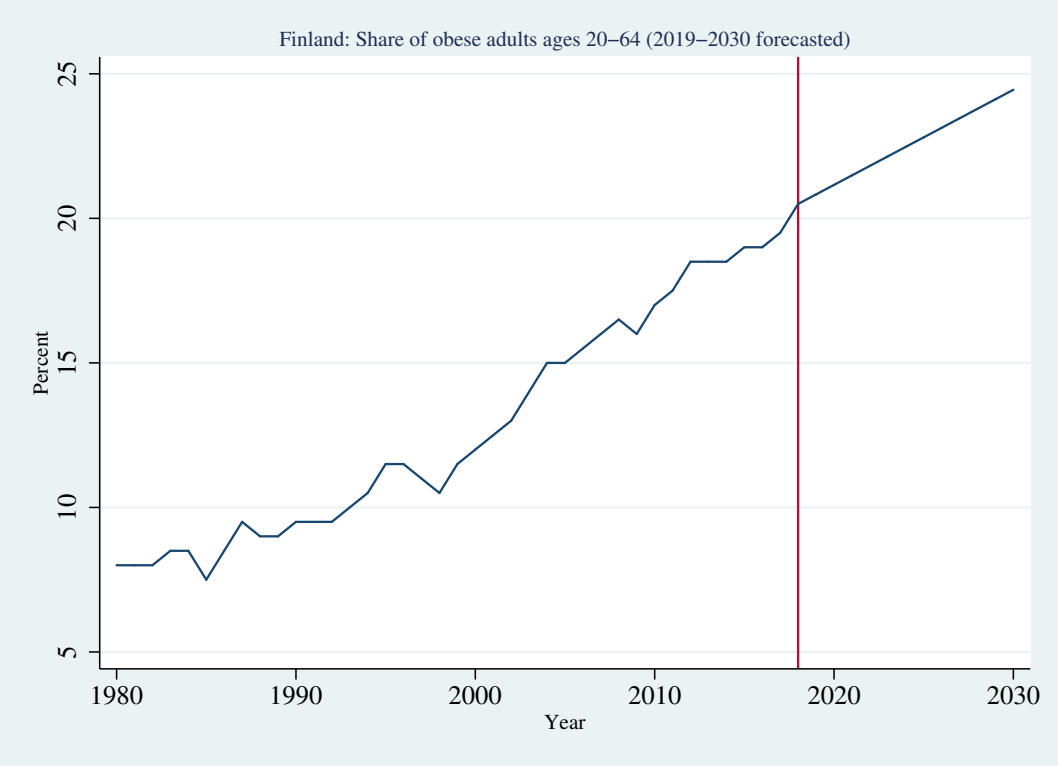
Figure 13: Growth in CPI 1980-2030 (2019-2030 forecasted)



6.1.2.7 Share of obese 20-64 year old men and women

This variable was included in the health spending equations as we know that obesity substantially increases the risk of cardiovascular disease and adult diabetes in particular, but also increases the risks of high blood pressure, osteoarthritis, gallbladder disease, sleep apnoea and some cancers. Obesity also results in functional limitations and is likely to result in psychosocial problems. The rising rates of adult obesity seen across the world have therefore become one of the most pressing public health problems of our time. Obesity puts an enormous strain on the healthcare system in countries with high prevalence in obesity; the US being the prime example (Tjepkema et al. 2006; Kissebah, Freedman, and Peiris 1989; Wellman and Friedberg 2002; Pi-Sunyer 2009).

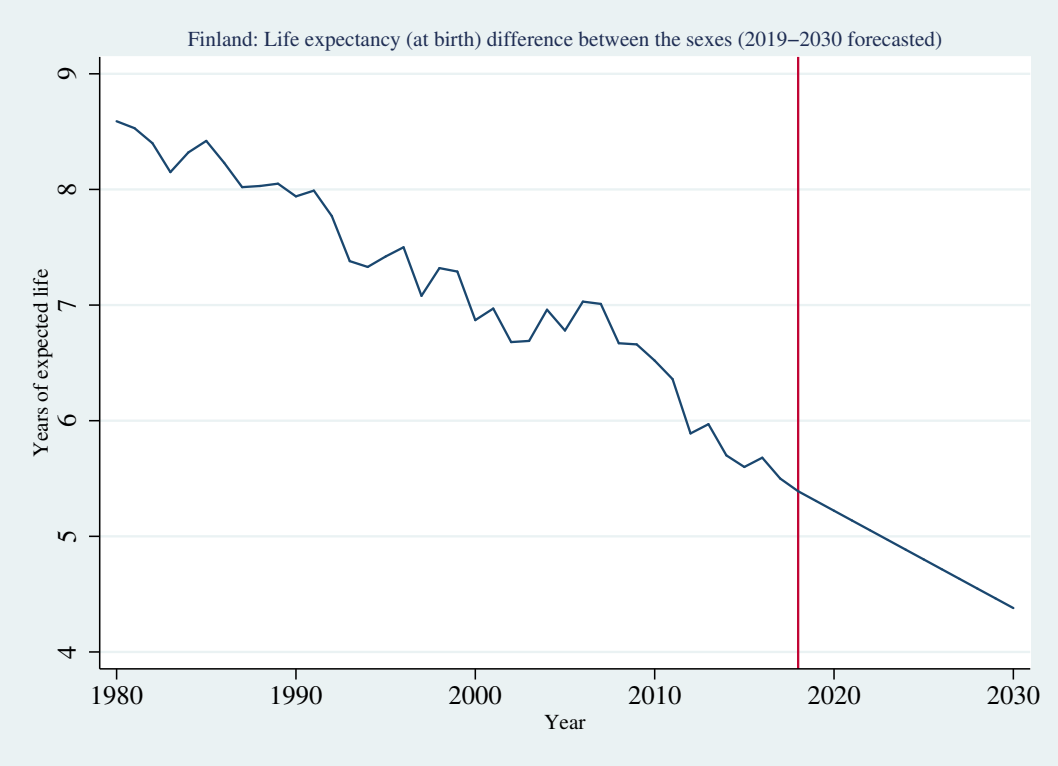
Figure 14: Share of obese adults ages 20-64 1980-2030 (2019-2030 forecasted)



6.1.2.8 Life expectancy (at birth) difference between males and females

The difference in life expectancy at birth was solely used for the widowhood and orphanhood spending regression. The intuition behind including the variable is that the majority of widows are expected to die in later ages, and they are expected to be men; as men on average have shorter life expectancies than women and are more prone to fatal diseases or -accidents. The greater the difference in life expectancy between the sexes, the longer the widow is expected to receive survivor's pension.

Figure 15: Life expectancy (at birth) difference between the sexes 1980-2030 (2019-2030 forecasted)



6.1.2.9 The political leaning of governments

As all social security policy is determined by government decisions, a dummy variable for the political leaning (left-wing or right-wing) of the coalition government was included in all models as a control variable. The dummy variable takes on the value 1 if there was a left-wing government during a specific year, and 0 if there was a right-wing coalition government. As has been discussed in the theory section, political competition plays an important part in determining social security spending, and we know that traditionally (economically)left-wing governments are more prone to expand public spending than (economically)right-wing governments. This is particularly true in the Finnish context where public spending has tended to be pro-cyclical as mentioned earlier. The variable should not be a bad control as governments are formed before the policy changes they enact; in other words the government alignment ought to be fixed when the ”treatment” of policy change affecting social security spending takes place (Angrist and Pischke 2008, p. 64). Finland had left-wing governments 1980-1986 and 1995-2006. 2011-2015 there was a coalition of both major left-wing and right-wing parties. The rest of the time-periods had right-wing governments.

7 Data analysis

7.1 OLS regressions on historical data (1980-2018)

OLS regressions were found to be the only viable approach for analysing the historical data in part due to the nature of the data (single entity and 39 time-units → small sample unsuitable for fixed effects modelling), and in part due to the author not being familiar with a more suitable method of analysis. A separate OLS model was constructed for each type of social security spending, except for administrative spending as was previously mentioned. Each model will be presented in turn, with a short motivation for the choice of independent variables.

Political leaning fixed effects were included in all models. The utility of adding year fixed effects seemed quite limited as both the economic crises are captured by the GDP per capita growth variable, and political decisions are controlled for by including the proxy of government political leaning. I also noted from all of the OLS regressions that adding year fixed effects radically changed the coefficients and made them insignificant. This was likely due to the year fixed effects causing extremely high Variance Inflation Factors (VIF) values for all of the independent variables. Moreover, since there is only a single entity in the analysis; adding year fixed effects for every year overspecified the models as there was only 1 observation for each year (→ more variables than observations). The models with only the political leaning fixed effects included were therefore determined to be the final (best) models.

7.1.1 The issue of endogeneity

Endogeneity tests were performed on the lists of potential regressors based on the baseline OLS models performed on the historical data. The endogeneity tests were performed by using the first lag of the dependent variable as an exogenous instrument, as we know that the present year spending cannot determine the spending of the previous year. Two stages least squares (2SLS) instrumental variable regressions were then run on the potential independent variables, with the lagged dependent variable as the instrument. **The Hausman-Wu test** was then run to test the independent variables for endogeneity.

The test results showed that several of the potential independent variables were endogenous in the different OLS models. Empirical studies, theory, and common sense are however also important in determining whether a variable is endogenous or not; so the results from the endogeneity tests have to be interpreted with some caution.

7.1.2 Normality, heteroskedasticity and multicollinearity testing

All the models were tested for normality, heteroskedasticity and multicollinearity. Normality was tested using histograms and quantile-quantile plots as well as with skewness-kurtosis and Jarqu-Bera tests. Heteroskedasticity was tested using residual-versus-fitted plots, as well as Breusch-Pagan's and White's tests for heteroskedasticity. Multicollinearity was tested by calculating the VIF values. For all of the OLS regression except for the 'Other spending' regression there was normal distribution in the residuals (Jarque-Bera 0.07, but skewness-kurtosis test 0.046; barely non-normally distributed), so non-normality deemed not to be an issue. In two of the OLS regressions (housing- and other spending) there was heteroskedasticity in the residuals, which was dealt with by using robust standard errors. Whether robust standard errors were used is written in the footnotes of the regression table. In none of the regressions multicollinearity was deemed to be a problem, as the mean VIF was below 2 for all but two of the regressions; of which the highest mean VIF was 2.83. The highest individual VIF value was 3.68.

7.1.3 The issue of non-stationarity in explanatory time-series modelling

Before presenting the OLS models, I feel that it is important for the sake of transparency to acknowledge and address the main critique that the examiner of this master's thesis pointed out. This main error relates to the fact that I, due to my lack of experience in conducting time-series modelling, neglected the requirement of stationarity in the data. As could be seen from the descriptive graphs, most of the dependent and independent variables had clear time trends. If these variables are not de-trended (made stationary) by the appropriate order of differencing; the errors of the OLS model will be biased. With non-stationary data there is also the issue of spurious correlation, but spurious correlations should not be an issue as the relationships analysed in this paper were all related to empirical literature. Either way, these two problems would lead to the OLS models no longer being the Best Linear Unbiased Estimators, and hence inappropriate to analyse the data with.

From the short reading I did between submitting the original version of this thesis and publishing the final version online; either Maximum Likelihood Estimation (i.e. logit) models or Vector Error Correction (VEC) models were suggested for time-series modelling including non-stationary variables. The problem with both of these types of modelling lies in the interpretation of the coefficients. The former gives a likelihood ratio which only tells us something about the probability, whereas coefficients in VEC models are more obscure; giving the rate at which the disequilibrium between variables in a co-integrated relationship dissipates for each time-point. Neither of them, based on my limited understanding, tell us anything about the *magnitude* of the relationships; which is the main interest

in the explanatory analysis in this study. Therefore, while a statistically sub-optimal approach, OLS models where the non-stationary variables were differenced or OLS models where the non-stationary variables were changed into or replaced by stationary variables; would have been more appropriate than the OLS models presented below.

For the published version of this thesis I have included the final OLS models where the non-stationary variables (every variable except for real GDP per capita growth, the percentage change in CPI, and the political leaning fixed effects) were differenced at the end of the thesis as **an appendix**.

Most of the coefficients lost their statistical significance, and the R^2 values were considerably lower than in the differenced final OLS models compared to the original OLS models. The interpretation of the coefficients also changed as first-differencing turns the coefficients into the rate of change; the first-difference is the difference between the present value and the value in at the previous time-point of a variable. We do however see that almost all of the variables of interest had the same coefficient signs $(+/-)$ in both the first-differenced and undifferenced OLS models; and the magnitudes seem to follow the same pattern.

So while the original models were indeed statistically incorrect; the hypotheses and reasoning behind the choices of independent variables seem to have been accurate. The fact that making the data stationary rendered the coefficients in my models largely statistically insignificant did, in my view, not invalidate the main conclusions I drew and policy suggestions I presented in this study; as these were based not only on the OLS regression, but also on theoretical and empirical literature mainly on the Finnish context.

There is also the question of whether the insignificant coefficients in the differenced OLS models might be interpretable, as all data was aggregate population data; rather than being samples of a population. But, there is also the argument that the population itself does not remain constant between years; rather each year would have a different population size. Hence, the data would not be ”real” population data; rather a sample based on an unknown process of population change.

7.1.4 Old-age spending

Table 1: Old-age spending

Dependent variable: Old-age spending	(1)	(2)	(3)	(4)
Old-age dependency ratio	0.36***	0.35***	0.34***	0.34***
	(0.02)	(0.02)	(0.02)	(0.02)
Share of households in the	–	0.43***	0.39***	0.41***
bottom three income deciles		(0.12)	(0.11)	(0.14)
Real GDP per capita growth rate	–	–	-0.08***	-0.08**
			(0.03)	(0.03)
Political leaning fixed effects	No	No	No	Yes
R^2	0.90	0.93	0.94	0.94
Number of observations	39	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

For old-age spending the Hausman-Wu test indicated that all the independent variables were endogenous. However we would not expect old-age spending to have an association with the demographics of Finland, nor would we expect old-age spending to increase or decrease poverty in part due to the fact that old-age poverty (income below 60% of median disposable income) is only 13% and the old-age pension has mostly been made more favourable over time, with significant reductions in its generosity only being implemented in the last two decades (Valkonen 2020). We also do not expect GDP per capita growth to be influenced by spending on the elderly, as they do not work.

From the regression table we can note that the old-age dependency ratio explained 90% of the change in old-age spending; which is what we would expect. Adding poverty and GDP per capita growth to the equation increases R^2 by another 0.04 points. The model therefore explained 94% of the change in old-age spending, so omitted variable bias should not have been a problem. All coefficients were statistically significant also when including the political leaning dummy. There were no major changes in the magnitude of the coefficients between the models.

The coefficients tell us that for each 1 point increase in the old-age dependency ratio (1 more elderly person per 100 20-64 year-olds), 1 %-point increase in the share of households in the bottom three income deciles, and 1 %-point increase in GDP per capita growth; old-age spending as a share of GDP were associated with increases of 0.34%-points, 0.41%-points, and a decrease of 0.08%-points respectively. We can note that the influences of population ageing and poverty have been quite strong

on old-age spending.

7.1.5 Housing spending

Table 2: Housing spending

Dependent variable: Housing spending	(1)	(2)	(3)	(4)	(5)
Percentage of population born abroad	0.09***	0.09***	0.11***	0.11***	0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Unemployment rate	–	0.01***	0.02***	0.02***	0.02***
		(0.00)	(0.00)	(0.00)	(0.00)
CPI growth rate	–	–	0.02***	0.02***	0.03***
			(0.01)	(0.01)	(0.01)
Share of households in the	–	–	0.04***	0.04***	0.05*
bottom three income deciles			(0.01)	(0.01)	(0.03)
Real GDP per capita growth rate	–	–	–	-0.00	-0.00
				(0.00)	(0.00)
Political leaning fixed effects	No	No	No	No	Yes
R^2	0.79	0.84	0.90	0.90	0.90
Number of observations	39	39	39	39	39

Notes: Robust standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

The Hausman-Wu test indicated that the share of foreign born was endogenous, whereas the other independent variables were exogenous. As immigration policy, not housing support, determines how many foreigners reside in Finland; we do not expect there to be endogeneity in the share of foreign born. As housing spending consists of housing support for apartment rents (social housing) we do not expect it to have a direct association with unemployment, but in some cases providing an apartment for a homeless individual may help them find employment. Hence there might be weak endogeneity in unemployment and poverty despite the endogeneity test indicating that they are exogenous. In the case of consumer prices, providing access to subsidised housing should not affect the consumer price index to any substantial degree, so the variable is unlikely to be endogenous to health spending. Even if we assume there is endogeneity in unemployment, CPI change, and poverty; they make up only 11% of the change in housing spending for the OLS model. That housing spending is determined to 79% by the share of foreign individuals may be somewhat of an overestimation, but we do know that immigrants

are much more likely to live in social housing than native Finns as was discussed previously. If the assumptions hold, the model explains 90% of the change in housing spending, so omitted variable bias should not be an issue. All coefficients except for the real GDP per capita growth rate were statistically significant, with the share of poor households dropping to 10% significance when including political leaning fixed effects. There were no major changes in the coefficients between the models.

Based on the final model (5) a 1 %-point increase in the share of foreign born, unemployment, CPI and the share of households in the bottom three income deciles was associated with a 0.11%-point, 0.02%-point, 0.03%-point, and 0.05%-point increase in housing spending as a share of GDP. According to the model the magnitude of the coefficients of the different independent variables seemed quite small, but we also have to remember that housing spending made up less than 1%-point of total GDP. In other words, the association between the increase in the foreign population and housing spending was actually quite strong, with the other three variables also having weaker positive associations with housing spending. The slightly stronger association of poverty among the latter three is what we would expect, as only poorer households are entitled to housing support.

7.1.6 Other spending

Table 3: Other spending

Dependent variable: Other spending	(1)	(2)	(3)	(4)	(5)	(6)
Percentage of population born abroad	0.10***	0.10***	0.09***	0.09***	0.09***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of households in the	–	0.11***	0.08***	0.07***	0.07***	0.04
bottom three income deciles		(0.02)	(0.02)	(0.01)	(0.01)	(0.03)
Unemployment rate	–	–	0.02***	0.02***	0.02***	0.02***
			(0.00)	(0.00)	(0.00)	(0.00)
Real GDP per capita growth rate	–	–	–	-0.01***	-0.01***	-0.01*
				(0.00)	(0.00)	(0.00)
CPI growth rate	–	–	–	–	-0.01	-0.01*
					(0.00)	(0.00)
Political leaning fixed effects	No	No	No	No	No	Yes
R^2	0.73	0.85	0.91	0.93	0.93	0.93
Number of observations	39	39	39	39	39	39

Notes: Robust standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

The 'other spending' category consists mainly of income support and immigrant integration expenditure, as well as other undefined expenditure. As has been mentioned, immigrants on average (particularly those originating from poorer MENA countries such as: Somalia, Afghanistan, Iraq, Syria) lift much more income support than the average native Finn (Salminen 2020b; Salminen 2019; Sarvimäki 2011; Sarvimäki 2017; Jauhiainen and Raivonen 2020). We therefore expect the share of foreign-born to be a strong predictor of other social security spending. Income support is also closely linked to poverty and to some extent to unemployment, so these were included as independent variables as well. The Hausman-Wu test indicated that only GDP per capita growth was endogenous. One could argue that generous income support and immigrant integration spending would attract low-skilled immigrants to Finland that seek to enjoy these benefits, which is likely to be the case; however Finland's immigration policy is what ultimately decides how many immigrants are received into the country. There should therefore not be endogeneity in the variable. It is unlikely that income support spending would impact poverty or unemployment as it only offers a bare minimum income to those who are already the poorest in society. It is even less likely that income support and immigrant integration spending would affect the CPI.

In the regression models all coefficients were statistically significant except for the change in CPI when fixed effects were not included. When political leaning fixed effects were included the poverty rate coefficient turned insignificant, whereas GDP growth and the change in CPI were significant only at the 0.1 level. The percentage of foreign born explained some 73% of the change in other spending according to the model, with the poverty and unemployment rate further increasing the R^2 to 0.91. The final model (6) explained 93% of other spending if the assumptions hold, so omitted variable bias should not have been an issue. The magnitude of the coefficients indicate that a 1%-point increase in the share of foreign born, the share of households in the bottom three income deciles, GDP per capita growth, and the change in CPI were associated with an increase of 0.08%-points, 0.04%-points, 0.02%-points; and a decrease of 0.01%-points, and 0.01%-points in other spending as a share of GDP. The poverty rate variable was however insignificant, while GDP per capita growth and the change in CPI were only significant at the 10% level. The magnitude of the coefficients tell us that the positive influence of the share of foreign born on other spending was quite strong, as other spending at its peak in 2016 due to the 2015 EU immigration crisis made up only 1.1% of GDP. Unemployment had a somewhat weaker positive association with other spending. The negative influence of GDP growth and CPI change is more difficult to explain, but the magnitudes are also quite small.

7.1.7 Health spending

Table 4: Health spending

Dependent variable: Health spending	(1)	(2)	(3)	(4)	(5)
Real GDP per capita growth rate	-0.13***	-0.11***	-0.11***	-0.10***	-0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Share of obese 20-64 year-olds	–	0.06***	0.05***	0.05***	0.04**
		(0.02)	(0.01)	(0.01)	(0.02)
Share of households in the	–	–	0.25***	0.28***	0.10
bottom three income deciles			(0.08)	(0.08)	(0.11)
Unemployment rate	–	–	–	-0.02	0.00
				(0.02)	(0.02)
Political leaning fixed effects	No	No	No	No	Yes
R^2	0.45	0.60	0.69	0.70	0.74
Number of observations	39	39	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

For the health spending OLS model the GDP per capita growth and unemployment were endogenous according to the Hausman-Wu test; whereas the adult obesity rate and poverty rate were exogenous. Income, usually measured as per capita GDP, has been found to be a very important explanatory variable for growth in health expenditure (Ke, Saksena, and Holly 2011); but at the same time health spending (or health more generally) has been linked to economic growth both historically in now developed countries and in present developing countries (Bhargava et al. 2001; Piabuo and Tieguhong 2017). A panel study of 21 developing countries the years 2000-2016 by Yang (2019) also showed that health expenditure has the most positive economic impact when human capital levels are higher (Yang 2019). While there is a case for arguing that GDP growth is endogenous to health spending in developing countries, Finland's healthcare system was already well developed by the 1980s and expenditure has not declined; rather it has increased over time (though mainly due to population ageing and increases in life expectancy). One also has to question whether increased health spending actually reflects better health in the population, considering that cardiovascular disease makes up almost 37-38% of all deaths, followed by cancer 24-25% (lung cancer being the most common) and nervous system related deaths (mainly Alzheimer and other forms of dementia) at 13-24% (Karanikolos 2018). Forecasts on the Finnish social security system by Lassila (2018) also assume GDP per capita

to be exogenous to social security expenditure (Lassila 2018). Based on this information I concluded that there should not be an endogeneity problem with GDP per capita growth.

The high share of cardiovascular disease deaths can be related to both the high rate of adult obesity and the old age of the Finnish population. One might argue that more investments in healthcare could reduce obesity in the adult population, but on the contrary there as been a rapid increase in obesity over the 1980-2018 time-period; which is part of a larger global phenomenon of unhealthy diets and lack of exercise. The old-age dependency ratio was not included in the model despite being a strong predictor of health spending for two reasons. Firstly, we know that the recent increases in life expectancy have been concentrated in older ages as most infant- and child diseases saw their major declines when major improvements in sanitation in urban areas were made and vaccinations against major causes of infant disease were widely administered. The increases in old-age life expectancy can largely be explained by improvements in medical treatment, which also entails higher health spending. Therefore there is most likely endogeneity in the variable. Secondly, the increase in obesity and increase in the dependency ratio are almost perfectly correlated so they induce severe multicollinearity if included in the same model.

There is a vast literature documenting that individuals with low socio-economic status on average suffer poorer health outcomes (Pampel, Krueger, and Denney 2010; Evans and Kim 2007). We also know that there is fairly strong intergenerational transmission of health behaviour in Finland (Prättälä, Karisto, and Berg 1994; Paalanen et al. 2020; Doku et al. 2020; Ruokolainen et al. 2019; Komulainen et al. 2019). Depending on the healthcare system, poorer health either leads to greater out of pocket spending or public health expenditure. In a country such as Finland with a highly subsidised healthcare system, lower public health spending would have a stronger negative association with the relatively poorer households as the resulting greater out of pocket spending would be a larger relative share of their total incomes than it would for higher income households. From the historical data we see an increasing trend in health spending despite the heavy fluctuation linked to the two economic crises. It is therefore unlikely that health spending on its own has affected poverty in Finland. Unemployment was included because unemployed individuals are expected to on average be poorer and therefore have poorer health and consuming more public healthcare.

All coefficients were significant except for unemployment until the political leaning fixed effect were included, in that model the poverty ratio also lost its statistical significance; which was also the only case where the magnitude of a coefficient was substantially altered. The magnitudes of the coefficients implied that a 1%-point increase in GDP per capita growth, the share of obese adults, and the share of households in the lowest three income deciles were associated with a decrease of 0.08%-points, and an increase of 0.04%-points and 0.10%-points respectively in health spending as a

share of GDP. Health spending seems to have been counter-cyclical during the period of analysis, which does seem intuitive as health behaviour could be expected to be negatively influenced by economic recession. That the share of obese adults had a positive association with health spending was obviously expected, although the coefficient seemed somewhat small considering how great a public health problem obesity has become. The fact that poverty ended up statistically insignificant in the final model from being highly significant with the strongest coefficient (0.28) in the previous model could be a statistical artifice as the variable was moderately (correlation: -0.60) correlated with the political leaning dummy variable. There may also be an issue of endogeneity if an increase in the share of households in the bottom three income had a significant association with election results, but this is difficult to determine. Unemployment seemingly had no association with health spending.

7.1.8 Disability spending

Table 5: Disability spending

Dependent variable: Disability spending	(1)	(2)	(3)
Share of households in bottom the three income deciles	0.41***	0.39***	0.59***
	(0.10)	(0.10)	(0.11)
Real GDP per capita growth rate	–	-0.02	-0.06**
		(0.02)	(0.02)
Political leaning fixed effects	No	No	Yes
R^2	0.32	0.34	0.48
Number of observations	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

The Hausman-Wu test indicated that the poverty rate was endogenous, but GDP per capita growth exogenous to disability spending. It does however seem unlikely that the former was endogenous as individuals who receive work-related disability benefits will neither rise up from or end up in poverty as a result of these benefits; and an individual who receives disability benefits due to disability before entering the labour market has their poverty or non-poverty status determined before receiving their benefits. We do not expect GDP per capita growth to be affected by disability spending.

The poverty rate was included as poorer individuals likely include manual workers that face greater work environment hazards. They are also expected to have worse health outcomes in general. Due to endogeneity concerns with many of the independent variables as well as difficulty in explaining change

in disability spending, the model (3) ended up quite weak with an R^2 of only 0.48. Omitted variable bias is therefore quite likely to have been an issue.

The coefficients for disability spending were quite interesting as the coefficients increased in magnitude for the final (3) model. Moreover, the political leaning coefficient was statistically significant and quite strong; a left-leaning government was associated with a 0.55%-point increase in disability spending. As expected the share of poor households had a strong positive association with disability spending where a 1%-point increase in the former was associated with a 0.59%-point increase in the latter. A 1%-point increase in GDP per capita growth on the other hand was associated with a decrease of 0.06%-points in disability spending, which is difficult to explain. Due to the omitted variable bias the magnitude of the coefficients need to be interpreted with caution, although the signs of both the share of poor households and the political leaning dummy seem intuitive.

7.1.9 Widowhood and orphanhood spending

Table 6: Widowhood and orphanhood spending

Dependent variable:	(1)	(2)	(3)	(4)	(5)
Widowhood and orphanhood spending					
Unemployment rate	0.02***	0.03***	0.03***	0.03***	0.03***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Difference in life expectancy	–	0.10***	0.11***	0.11***	0.12***
at birth between the sexes		(0.01)	(0.01)	(0.01)	(0.01)
Real GDP per capita growth rate	–	–	-0.01***	-0.01***	-0.01***
			(0.00)	(0.00)	(0.00)
Share of households in the	–	–	–	0.04***	0.03**
bottom three income deciles				(0.01)	(0.01)
Political leaning fixed effects	No	No	No	No	Yes
R^2	0.33	0.83	0.90	0.94	0.94
Number of observations	39	39	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

Unemployment was included in this model as we know that especially younger Finnish men have an increased mortality risk when unemployed, and that men are the more likely in a couple to pass away first both due to having shorter life expectancies than women but also because it is more common

in marriage or registered relationships for the man to be older than the woman than the other way around (Uggla and Billingsley, 2018; Tilastokeskus, 2018). The last point relates to the inclusion of the difference in life expectancy at birth between the two sexes, as the larger the gap is; the longer the widow is expected to receive survivor's pension. The share of poor households was included as the survivor's pension is reduced depending on the pension of the surviving spouse; so a higher share of poor surviving spouses should lead to higher expenditure on widowhood and orphanhood.

The Hausman-Wu test indicated that both the life expectancy difference and GDP per capita growth were endogenous, while the unemployment- and poverty rates were exogenous. None of the variables were however likely to have been endogenous, as widowhood and orphanhood spending targets only widows and orphans; and we do not expect extreme enough fluctuations in mortality rates to affect unemployment, GDP growth, or poverty in any substantial way. There also should not have been any effect running from widowhood and orphanhood spending to the life expectancy difference between the sexes.

The coefficients were all statistically significant and their magnitudes changed very little between the models. All in all the final model (5) explained 94% of the change in widowhood spending if the assumptions made hold true; omitted variable bias therefore should not have been an issue. Unemployment and the difference in life expectancy at birth between the sexes together explained 83% of the change. The magnitude of the coefficients indicated that a 1-year increase in the life expectancy difference between the sexes, a 1%-point increase in unemployment and the share of households in the bottom three income deciles, and an increase of 1%-point in GDP per capita growth was associated with an increase of 0.03%-points, 0.12%-points, and 0.03%-point as well as a decrease of 0.01%-point in widowhood and orphanhood spending as a share of GDP respectively. The associated changes in widowhood and orphanhood spending may seem small, but the total spending was only 1.3% of GDP at its peak in 1993.

7.1.10 Family spending

Table 7: Family spending

Dependent variable: Family spending	(1)	(2)	(3)	(4)
Unemployment rate	0.13***	0.09***	0.10***	0.10***
	(0.02)	(0.01)	(0.01)	(0.01)
Share of households in the	–	0.40***	0.37***	0.37***
bottom three income deciles		(0.04)	(0.04)	(0.05)
Real GDP per capita growth rate	–	–	-0.04***	-0.04***
			(0.01)	(0.01)
Political leaning fixed effects	No	No	No	Yes
R^2	0.63	0.89	0.93	0.93
Number of observations	39	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

Including the unemployment rate in the family spending model was due to the fact that for instance during the 1990s depression many couples decided to have children due the very poor labour market situation at the time, and the introduction of child allowance in the mid-1980s (Sobotka, Skirbekk, and Philipov 2011; Vikat 2004). This is reflected in the family spending spike we see during the early 1990s. The share of households in the bottom three income deciles was included as we know that income is closely linked to fertility, and hence with family spending. In Finland we know from previous studies that fertility increases with income and employment for both sexes (Jalovaara and Miettinen 2013; Rotkirch and Miettinen 2017; Jalovaara and Fasang 2017). Lastly, GDP per capita growth is linked to future outlooks about the society's and one's own economic situation; which has been found to be an important determinant of fertility in Finland as in many other countries (Sobotka, Skirbekk, and Philipov 2011; Hiilamo 2017).

While TFR would have been a strong predictor for family spending, it is quite certain that family spending has an effect on fertility; so the variable would be endogenous and was therefore not included in the model. We do not however expect family spending to have any direct significant effect on unemployment, poverty, or economic growth; while one could argue that family spending might possibly affect the three variables indirectly through fertility to some extent. Determining this indirect effect would however be quite difficult, and the magnitude of it would likely be quite small. I therefore

concluded that there should not have been an endogeneity problem in these three variables.

From the models we see that including the three aforementioned independent variables yields an R^2 of 0.93, which means that the model should explain most of the change in family spending and the risk of omitted variable bias should be small. The magnitude of the coefficients in the final (4) model indicated that a 1%-point increase in unemployment, poverty, and the GDP per capita growth rate were associated with a 0.10%-point and 0.37%-point increase, and a 0.04%-point decrease respectively in family spending as a share of GDP. The magnitude of the coefficients changed very little between the models, so there should not have been an issue of bad controls.

The coefficients ran counter to what studies on fertility behaviour in Finland lead us to expect. There are a few plausible reasons for this. Firstly, we have the issue of ecological fallacy; all the measures are used on the aggregate level so we cannot link unemployment or poverty with individual fertility behaviour. Secondly, we have the spike in fertility during the 1990s depression that coincided with an increase in the poverty and unemployment rates, likely due to family building offering an attractive alternative to employment during that time-period particularly for less educated (lower-income) mothers that were likely to have been among those hit the hardest by the depression. The only conclusion I would dare draw from the coefficients is that poverty in particular, but also unemployment, were strongly associated with family spending; which seems intuitive as poorer families receive more family support from the state.

7.1.11 Unemployment spending

Table 8: Unemployment spending

Dependent variable: Unemployment spending	(1)	(2)	(3)	(4)
Unemployment rate	0.29***	0.27***	0.27***	0.26***
	(0.02)	(0.01)	(0.01)	(0.01)
Share of households in the	–	0.34***	0.32***	0.35***
bottom three income deciles		(0.06)	(0.06)	(0.08)
Real GDP per capita growth rate	–	–	-0.02	-0.02
			(0.01)	(0.02)
Political leaning fixed effects	No	No	No	Yes
R^2	0.89	0.94	0.95	0.95
Number of observations	39	39	39	39

Notes: Standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels.

For the unemployment spending time series the most obvious variable to include was of course the unemployment rate, which unsurprisingly ended up explaining 89% of the change in unemployment spending. The poverty rate was included as the poorest unemployed individuals are likely to be long-term unemployed and hence receive their unemployment benefits directly from the Social Insurance Institution of Finland; which would be directly reflected in unemployment spending. Members of trade unions on the other hand receive their initial unemployment benefits from the unions, funded by union membership fees. The GDP per capita growth rate was included as the general economic situation in Finland may affect how generous unemployment benefits are.

The Hausman-Wu test indicated that both the unemployment rate and the GDP per capita growth rate were endogenous to unemployment spending. Indeed, a poor economic outlook and a generous unemployment benefit system would likely disinincentivise employment especially less-educated low-income-earning individuals whose expected earnings when employed would not increase very much from the amount they receive in unemployment benefits. However, unemployment spending is highly unlikely to be the cause behind unemployment, poverty, or economic downturn. I therefore concluded that endogeneity in the independent variables should not be a problem.

The final model (4) explained 95% of the change in unemployment spending, so omitted variable bias should not have been an issue. Both the unemployment rate and poverty rate were statistically significant across the models, while GDP per capita growth was not statistically significant. The insignificance of GDP per capita growth was likely due to unemployment and poverty capturing 94% of the change in unemployment spending. The magnitude of the coefficients tell us that a 1%-point increase in unemployment and the share of households in the bottom three income deciles were associated with a 0.26%-point and 0.35%-point increase in unemployment spending as a share of GDP. As one would expect both variables had very strong associations with unemployment spending.

7.2 Time-series forecasts (2019-2030)

7.2.1 Testing for stationarity in data

7.2.1.1 Differencing

As is often the case, the first step in the process of testing for stationarity was to do graphical analysis of the data with simple time-series graphs. As stationarity, or white noise, is characterised by random distribution around a mean of 0; it is quite easy to discern whether a variable does or does not fit this pattern. In case it does not, one method to make the data more stationary is to transform the variables to their natural logarithms. This usually works when variability in the data increases over time. It

is however important to note that logging variables is not an option if the variable takes on negative values, as this will lead to missing observations. As most of the variables included in the analyses were percentages or fractions, and some of them included negative values; logging the variables was not intuitive and would only have made interpretation of the coefficients more difficult.

The most common way to make the data more stationary is to difference the variable; usually a first- or second-difference is enough to reach stationarity, and one should be careful not to over-difference variables as this may induce dependency where none exists. What *differencing* does is it removes the changes in the level of a time-series by calculating the differences between consecutive observations. The differenced time-series can be written as follows:

$$Y'_t = Y_t - Y_{t-1}$$

where the differenced time series will have $t - 1$ values as it is not possible to calculate the difference for the first observation Y'_1.

As the data was annual and non-seasonal (showing no regular pattern, which for instance quarterly data is prone to do), non-seasonal differencing was used. Based on time-series graphs of the dependent and independent variables in this study; all variables used, except for GDP per capita growth, displayed non-stationarity and were therefore differenced. First-differencing was sufficient for all variables except for the share of foreign-born which required second-differencing.

7.2.1.2 Augmented Dickey-Fuller test

Several statistical tests have been developed to determine stationarity in time-series data, often referred to as unit root tests. Stationarity means that the variance, mean, and autocorrelation structure in a data set do not change over time. **The Dickey-Fuller test is the most commonly used unit root test.**

Performing the Dickey-Fuller test on the dependent variables used in the time-series analyses of this study yielded significant ϕ parameters for all differenced dependent variables, and the test statistic values increased relative to the critical values compared to test results from the non-differenced variables. When including trend and drift terms in the tests, it seemed most likely that the time series had drifts rather than trends. *Drift*, or in this case *stochastic drift* means that the mean value of a stochastic (random) process changes over time (National Institute of Standards and Technology 2013b; Makridakis, Wheelwright, and Hyndman 2008, pp. 329–330; Hyndman and Athanasopoulos 2018, Chapter 8.1).

Based on these results the author concluded that some form of integrated moving average models would be suitable for analysing the data; so the next step was to test whether there was autoregression

in the simple time-series models.

7.2.2 ARIMA models for time series data

As with stationarity the first step was to examine the data graphically; in this case with correlograms, autocorrelation-, and partial autocorrelation functions. The autocorrelation functions indicate the suitable number of autoregressive parameters to include in the auto-regressive(AR) integrated(I) moving average(MA) (ARIMA) models, whereas the partial autocorrelation functions indicate of the suitable number of moving average parameters to include in the ARIMA model. Brief explanations of the **AR**, **I**, and **MA** components as well as **ARIMA** modelling are found in the appendix.

7.2.3 Testing for autocorrelation

7.2.3.1 Durbin-Watson and Durbin h-test

The standard **Durbin-Watson statistic** commonly used for testing autocorrelation cannot be used in cases where the regressors are lagged dependent variables, as this biases the test. Instead the Durbin h-test was used.

The Durbin h-test for all the time series including only the dependent variable, the first lag of the dependent variable, and an intercept; gave results of no autocorrelation in the first lag. This further strengthened the case that integrated moving average models may be the most appropriate for the data. As the autocorrelation functions indicated that there may still have been significant autoregressive parameters in many of the models, the author decided compare several ARIMA models with different numbers of AR and MA terms based on these functions (Makridakis, Wheelwright, and Hyndman 2008, pp. 303–304; Durbin 1970; Durbin and Watson 1992).

7.2.4 Testing model fit

7.2.4.1 Order selection criteria for ARIMA models

The two most commonly used order selection criteria for ARIMA models are the **Akaike' Information Criterion (AIC)** and the **Bayesian Information Criterion (BIC)**. Both the criteria measure the goodness of fit of a model, by taking into account the number of terms in it.

The appropriate ARIMA models were selected from a number of alternatives based on possible AR and MA parameters from autocorrelation and partial autocorrelation functions. In all cases except for the model with other spending and administrative spending ARIMA(0,1,1) models had the lowest AIC and BIC; whereas other spending and administrative spending had neither significant AR nor

MA terms. For these two time series random walk models were used, which will be described in the 'simple forecasts' sub-section.

7.2.5 Diagnostics testing

The first step of the diagnostics testing was to check if there was normality in the residuals of the chosen ARIMA models by doing histograms and quantile-quantile plots on the residuals from the ARIMA models. In all cases the residuals looked fairly normally distributed, with outliers around the two economic recessions; which is exactly what we would expect.

The second step was to check for independence in the residuals by looking at autocorrelation and partial autocorrelation functions of the ARIMA model residuals. The residuals resembled white noise in the plots, with deviation outside the confidence interval occurring only at higher-order lags which was to be expected and therefore should not have influenced the predictions. The next step was to statistically test the residuals for autocorrelation using the Ljung-Box test.

7.2.5.1 Ljung-Box Test Statistic

The **Ljung-Box (1978) test** is commonly used in ARIMA modelling. When used on ARIMA models it is the residuals of the model that are being tested for autocorrelation. In the case of this study the test was used to determine whether autocorrelation was present in the time series models including only the dependent variables, in order to determine whether the time series had autoregressive components or not.

For all of the ARIMA models, we did not reject the null hypothesis of the residuals being serially uncorrelated; hence the time series were confirmed to be white noise (Makridakis, Wheelwright, and Hyndman 2008, p. 320; Brockwell et al. 2016, p. 36; Davidson 2000, p. 162; Ljung and Box 1978).

7.2.6 Determining which exogenous independent variables to include in the final ARIMA(X) models

The last step before performing the actual ex-ante out of sample forecasts was to determine whether or not, as well as which exogenous independent variables to include in the final ARIMA(X) (X standing for exogenous) models. Before comparing ARIMA models with different sets of independent variables, cross-correlograms of the residuals from the baseline ARIMA models were plotted on the differenced independent variables to determine an appropriate number of lags for the independent variables. Multiple linear regression was then performed with the baseline ARIMA residuals as dependent variables and differenced lagged independent variables as regressors. The conclusion was

that lags of the potential independent variables were unlikely to add anything to the ARIMA forecasts (Nau 2021).

ARIMA modelling has the same requirement as OLS that the regressors must be exogenous to the dependent variable. As endogeneity tests were already performed on for the OLS models and the validity of the test results discussed; the same conclusions held for the ARIMA models.

One more thing that needed to be considered was whether or not a constant should be included in the time-series model. A constant set to zero is mandatory in case the regression line is known to go trough the origin, which would for instance be the case if the variables have been standardised. If the time series has been differenced including the constant term is optional, and would reflect the drift. As all the IMA(1,1) time series were differenced, AIC and BIC were used to determine whether or not to include the constant (Reilly and Hardy 2018).

7.2.7 The final ARIMA models

When comparing the potential ARIMA models for the number of AR and IM terms to include based on AIC and BIC values, taking endogeneity into account, comparing different sets of exogenous variables based on statistical significance in the MA terms and AIC and BIC values, and comparing AIC and BIC values to determine whether or not to include a constant term, the final ARIMA models were:

7.2.7.1 Health spending

$$\text{health spending}'_t = \beta_1 \text{GDP per capita growth}_t + \beta_2 \text{percentge change in CPI}'_t + \beta_3 \text{share of households in bottom three income deciles}'_t + e_t$$

where the error term is a MA(1) process:

$$e_t = \theta \epsilon_{t-1} + \epsilon_t$$

where θ is a smoothing coefficient between -1 and 1.

7.2.7.2 Old-age spending

$$\text{old-age spending}'_t = \beta_0 + \beta_1 \text{old-age spending}' e_{t-1} + e_t$$

7.2.7.3 Unemployment spending

$$\text{unemployment spending}'_t = \beta_0 + \text{GDP per capita growth}_t + e_t$$

where the error term is a MA(1) process:

$$e_t = \theta\epsilon_{t-1} + \epsilon_t$$

where θ is a smoothing coefficient between -1 and 1.

7.2.7.4 Disability spending

$$\text{disability spending}'_t = \beta_0 + \beta_1 \text{GDP per capita growth}_t + e_t$$

where the error term is a MA(1) process:

$$e_t = \theta\epsilon_{t-1} + \epsilon_t$$

where θ is a smoothing coefficient between -1 and 1.

7.2.7.5 Widowhood and orphanhood spending

$$\text{widowhood and orphanhood spending}'_t = \beta_1 \text{widowhood and orphanhood spending}' e_{t-1} + e_t$$

7.2.7.6 Housing spending

$$\text{housing spending}'_t = \beta_0 + \beta_1 \text{housing spending}' e_{t-1} + e_t$$

7.2.7.7 Family spending

$$\text{family spending}'_t = \beta_1 \text{family spending}' e_{t-1} + e_t$$

We can note that few exogenous variables were included in the models, as including more of them either made the MA term insignificant or increased AIC and BIC values (StataCorp 2013, pp. 93–95; Nau 2021; Makridakis, Wheelwright, and Hyndman 2008, pp. 393–399; Greene 2018, p. 276).

7.2.8 Simple forecasts for 'other spending' and independent variables

As the 'other spending' time series was found to be neither autocorrelated nor having a moving average; the best course of action was to do a simple forecast as was done with the independent variables and administrative spending. For the 'other spending' time series a **random walk** with drift was considered the most appropriate, and for administrative spending a random walk without drift; based on the AIC and BIC values.

7.2.8.1 Other spending

$$\text{other spending}_t = c + \text{other spending}_{t-1} + e_t$$

7.2.8.2 Administrative spending

$$\text{administrative spending}_t = \text{administrative spending}_{t-1} + e_t$$

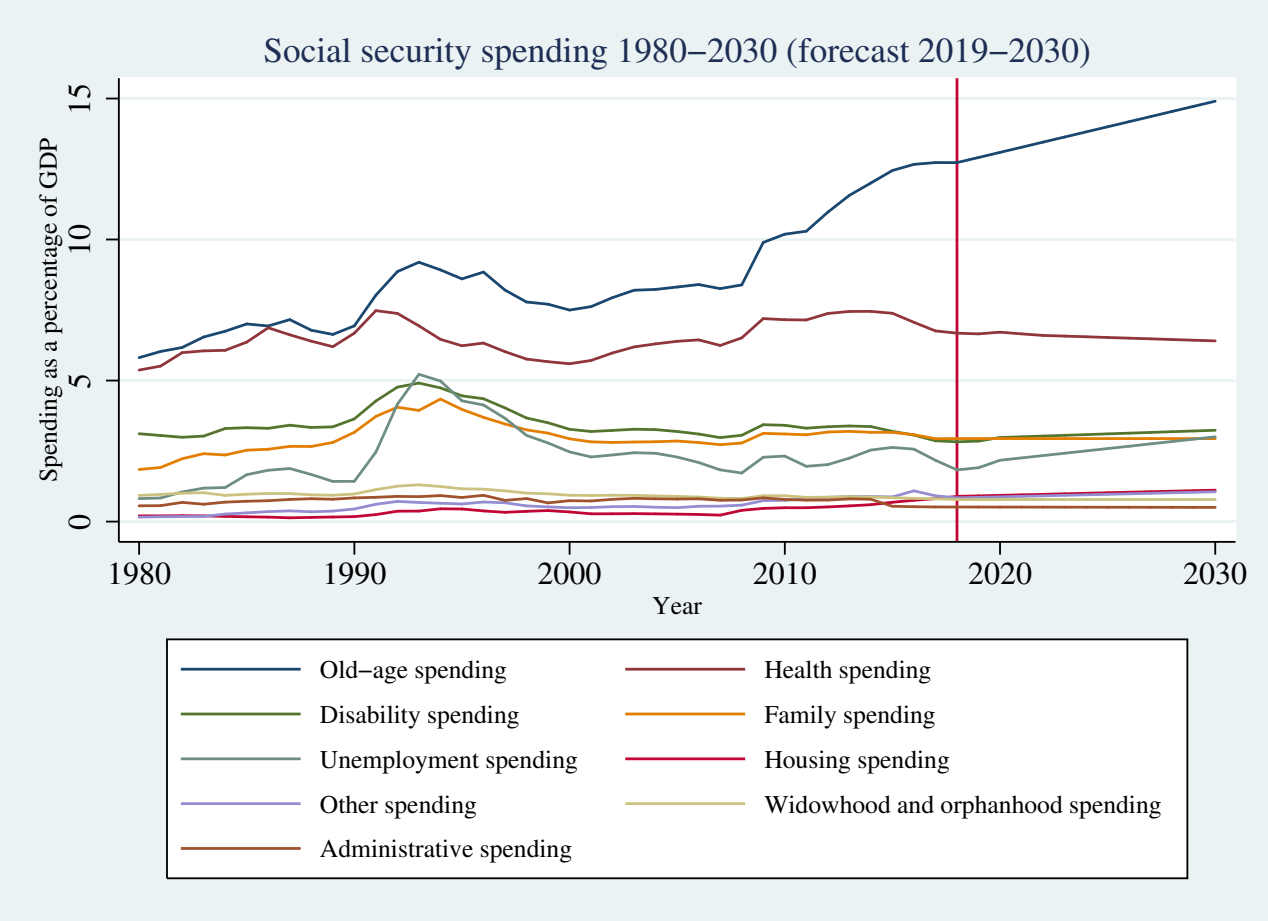
For the old-age dependency ratio Statistics Finland's forecast was used. For the unemployment rate and the growth in CPI OECD forecasts were used from 2020 to 2022, and from 2023 to 2030 naive forecasts were used; which means that the 2022 value was used for the entire (2023-2030) time-period. Due to the Covid-19 pandemic in 2020, the naive forecast for real GDP per capita growth used the value for 2019 instead. Random walks with drift were used for the share of obese 20-64 year-old, life expectancy difference between the sexes, and percent of households in the lowest three income deciles (Nau 2014; Hyndman and Athanasopoulos 2018, Chapter 3.1, 8.1).

7.2.9 Ex-ante out of sample dynamic forecasts

Dynamic forecasts were produced using the chosen ARIMA models. Dynamic here means that the next predicted value is based on the previous one. The forecasts are displayed below in the order of magnitude.

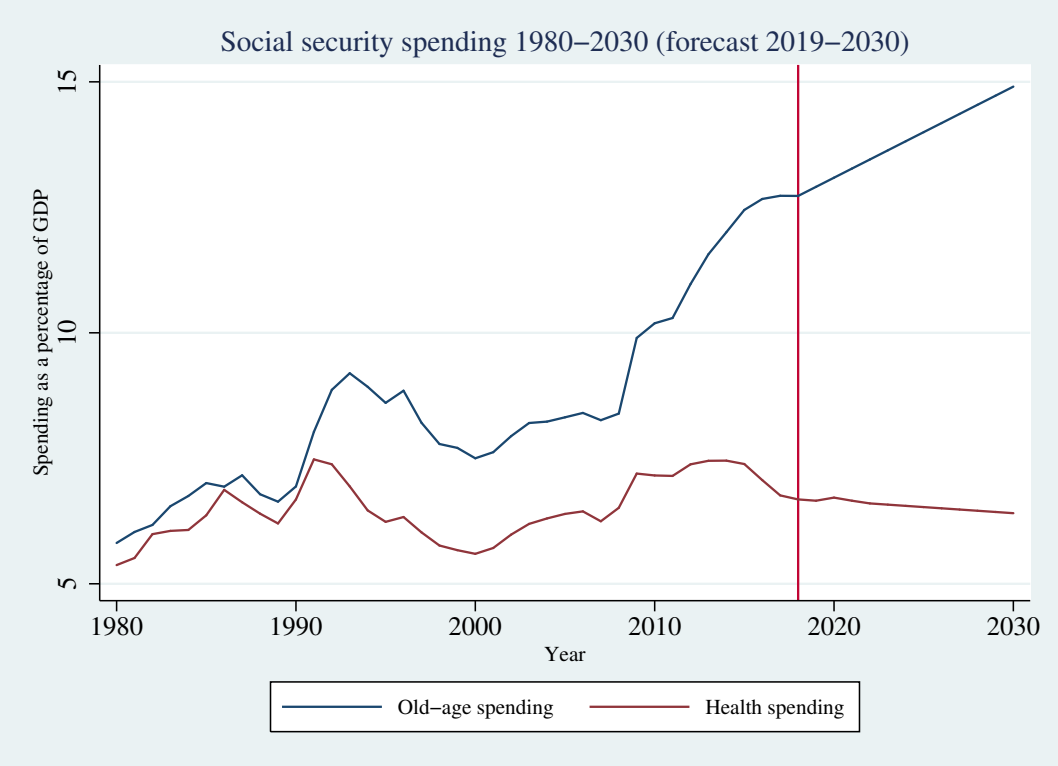
7.2.9.1 The forecasts

Figure 16: Social security spending 1980-2030



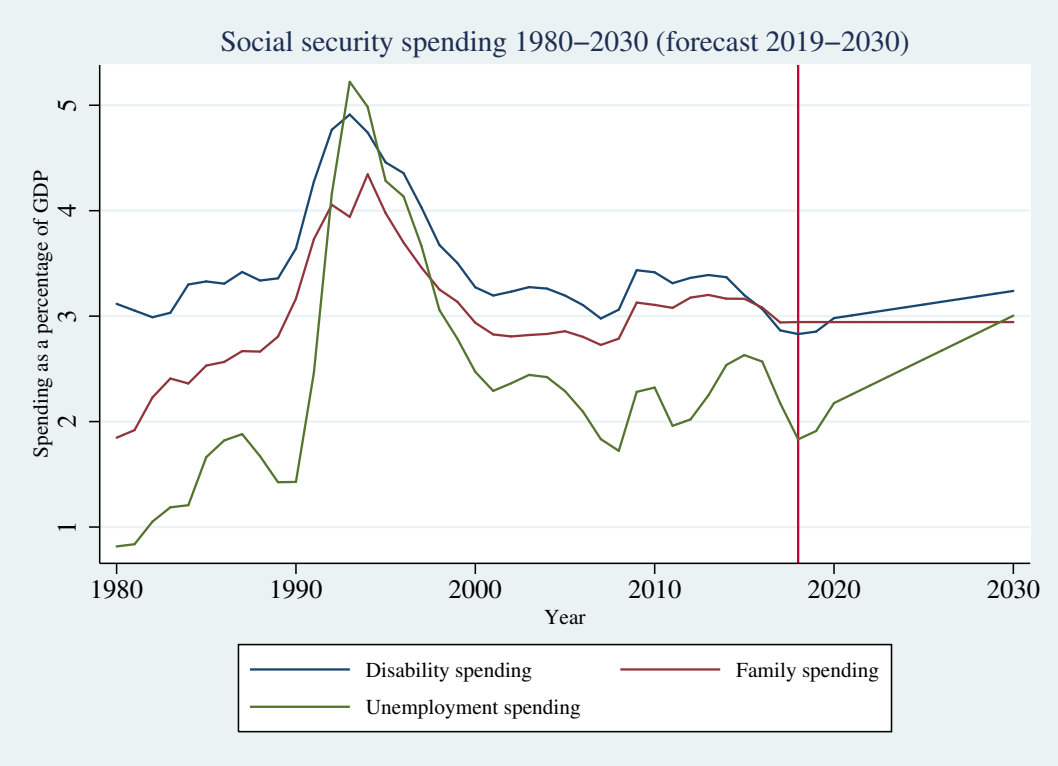
It is very clear from the graphs that the main driver of increasing social security expenditure has been and will continue to be old-age spending. This is precisely what theory and empirics would predict. Most of the other forms of social security spending are expected to see less change, at least in comparison to old-age spending.

Figure 17: Old-age- and health spending 1980-2030



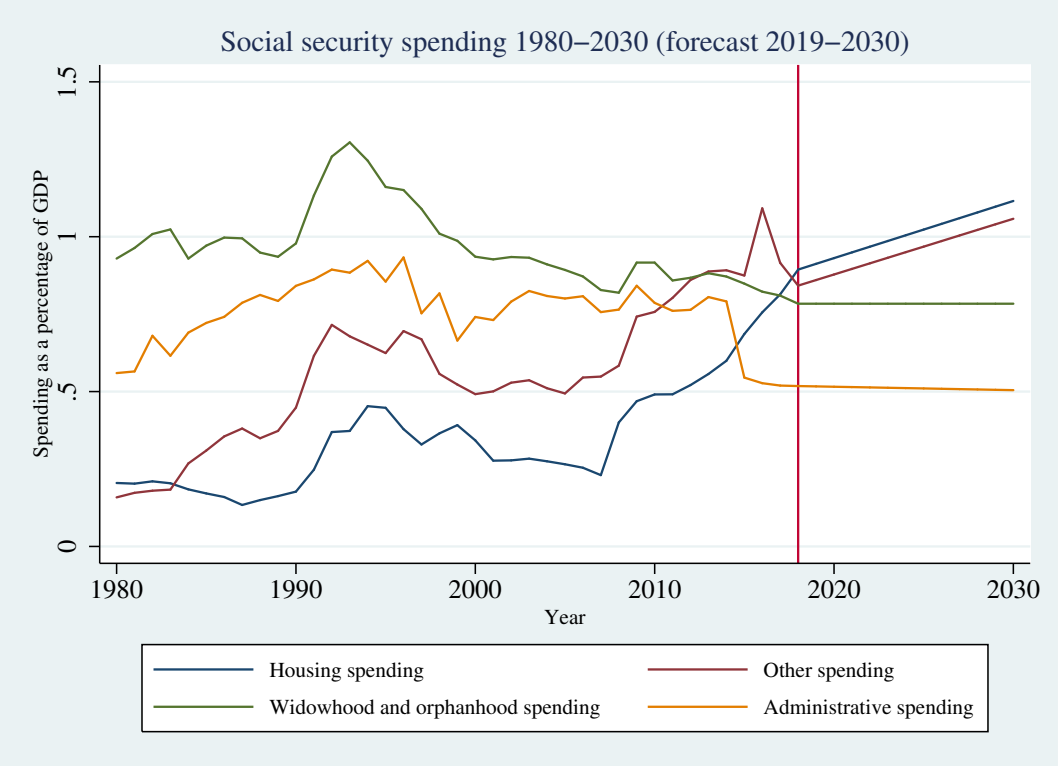
By 2030 the forecast predicts that old-age spending will account for almost 15% of GDP. On the other hand health expenditure is expected to decline somewhat by 2030 if the forecast is accurate. From an empirical perspective it does however seem more likely that health expenditure will increase in the near or long-term future due to the increasing share and total amount of elderly, as well as the rapid increase in obesity among adults. Time will tell.

Figure 18: Disability-, unemployment-, and family spending 1980-2030



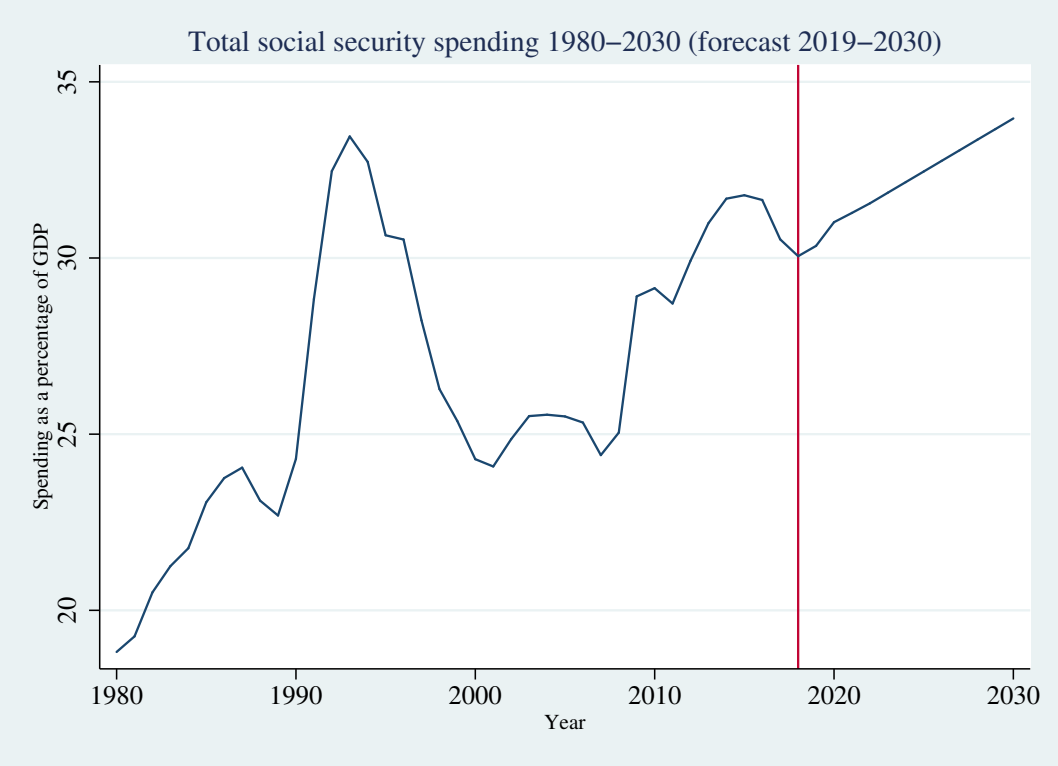
From figure 17 we see that the forecast models predict that family spending will decrease somewhat which seems intuitive due to the recent decline in fertility. The predicted slight increase in disability spending and the 1%-point increase by 2030 in unemployment spending is due to the expected low economic growth in the future; to which unemployment spending is much more responsive as we can see from the historical development. Both these predictions seem intuitive, the increase in adult obesity may even increase disability spending more than the forecast predicts.

Figure 19: Housing-, other-, widowhood & orphanhood-, and administrative spending 1980-2030



In figure 18 we can note that both widowhood and orphanhood as well as administrative spending are predicted to decline by minuscule amounts. The former could be intuitive as the life expectancy difference between the sexes has been declining rapidly, possibly leading to fewer widows even in absolute terms despite population ageing. Administrative spending is difficult to foresee, but a slight decline due to efficiency improvements in administration could be possible. In other spending and housing spending we see an identical expected increase, and both of them are expected to increase beyond 1% of GDP by 2030. Based on the data and literature this is mainly due to the fairly large-scale admission of immigrants from poorer countries in the MENA region in particular, as well as the Finnish government's ambitious goal of eliminating homelessness.

Figure 20: Total social security spending 1980-2030



Once all the types of social security spending have been summed up (Figure 19) they provide quite a gloomy answer to the second research question about how Finland's social security spending is expected to develop until 2030. Social security spending is expected to continue its increase to around 34% of GDP by 2030; which would mean that spending would almost double as a share of GDP in the span of just 50 years. Important to keep in mind with all these forecasts is of course that they are subject to a fair amount of uncertainty, despite the short forecast horizon. But, as population ageing is the main driver behind increasing social security expenditure; there should be no doubt about the continuing upward trend, only about the pace at which spending will increase.

8 Limitations and biases

The main limitation of this study was the simplicity of the data analysis, more complex regression models and dynamic forecasting might have achieved more accurate results. We saw this for instance in the issue of time-trends in the variables for the OLS models that was discussed before the models were presented. Alas, I was not confident enough in my limited statistical and econometric abilities to perform more complex analyses; and there was also the issue of time. Another limitation was the limited historical time-period, and that only annual data was available; which both limited the number of observations. A final limitation was that this case study was quite context-specific due to

the political nature of social security spending, which means that the results from this study are not fully generalisable to other contexts.

The main bias in this study relates to the libertarian conservative political and economic orientation of the author, particularly when it comes to the policy suggestions presented below. Some measure of political bias is however unavoidable when discussing a topic as tightly linked to public policy as social security; especially when policy suggestions are made.

9 Discussion

The increasing trend in social security spending over time speaks volumes about the mishandling of public finance by, and short-sightedness of, successive governments; particularly when it comes to old-age spending. As mentioned previously, population ageing was never an unforeseeable or unaddressable event; it is a slow process that began as soon as fertility reached below-replacement levels in the 1970s. What then could be done to halt, or possibly reverse the increasing social security expenditure? Let us begin by identifying the problems in their entirety by answering the first research question about what the main drivers behind the historical change in social security spending have been.

It was quite clear from the data analyses, empirical-, and theoretical literature that the main driver of social security spending in Finland has been old-age spending (making up 40% of total social security spending by 2018). From the old-age spending OLS model I found that 90% of the increase in old-age spending can be explained by population ageing (the old-age dependency ratio). Judging from the theoretical and empirical literature on old-age social security, it would seem that the elderly electorate in Finland has managed to build political coalitions with the younger poor, or the older middle-aged; in order to maintain, and even increase the generosity of old-age social security over time. Reforms are only now beginning to take place.

From the other OLS models we could note that the share of households in the bottom three income deciles was also a very strong predictor in most of the OLS models, while the unemployment rate was a strong predictor particularly for unemployment- and family spending; while being weaker in the other models it was included in. Both these results are in line with what was expected, as both of them are indications of net-welfare consumption; which would also increase the likelihood of political coalitions between the poorer and the old.

As the medical literature would predict, adult obesity did have a positive association with health spending; but the magnitude of the association was somewhat weaker than expected. It may be that the negative association of the rapid increase in obesity has not yet manifested itself in increased health

spending.

The almost identical increase in both housing and other spending seems to be most strongly associated with the increase in the share of foreign-born in Finland's total population, in combination with Finland's ambitious goal of eradicating homelessness. The empirical literature on the use of public housing and income support, as well as the low employment rates and average incomes of immigrants arriving from poorer MENA countries in particular all support this association. The fairly large immigration from these countries should also explain some of the increase in both the unemployment rate and share of households in the bottom three income deciles; although this relationship could not be analysed due to the level of aggregation in the data.

As for the difficult-to-explain widowhood and orphanhood spending, the positive correlation with the difference in life expectancy between the sexes was the best explanation I could find for the decrease in spending over time; as the gap in life expectancy declined rapidly throughout 1980-2018.

The real GDP per capita growth rate seemed to indicate weakly counter-cyclical behaviour in social security spending; which could possibly be explained by the severity of the two economic crises that both resulted in large increases in social security spending. The empirical literature did however point to substantial increases particularly in the generosity of old-age social security in the 1970s-1980s when the economy was performing well.

Not much can be said about whether inflation had any substantial association with social security spending due to endogeneity issues preventing its inclusion in many of the models and weak or insignificant coefficients in the models the change in CPI variable was included.

Another variable that would have been useful to include, but suffered from endogeneity issues, was the change in labour productivity. This is because the labour productivity average growth rate declined substantially over the 1980-2018 time-period, and according to empirics theory should be useful when calculating social security change. Indeed, when included it in the OLS models it had a positive coefficient, which was fairly strong for health-, disability-, and unemployment spending.

If I were to rank the main drivers of social security expenditure in Finland 1980-2018 in order of magnitude they would be (+ indicating increase in spending as a share of GDP, − indicating decrease):

1. Population ageing (old-age dependency ratio) +
2. Labour productivity growth (→ economic growth) −
3. Poverty (share of households in the bottom three income deciles) +
4. Unemployment +
5. Low-skilled and culturally distant immigration (share of foreign born as proxy) +

6. Obesity with associated increased disease risks and functional limitations +

7. CPI growth rate +?

The analysis is not yet complete, as while we now know which the main drivers have been and the order of their magnitude; we also need to understand why these independent variables have developed the way they have in Finland.

The rapid population ageing is related to two phenomena: below-replacement fertility (TFR < 2.1), and increased life expectancy at older ages. The decline in fertility, especially the extremely rapid decline since 2010, has been puzzling Finnish decision makers; particularly because Finland from an international perspective has very generous family benefits, as well as subsidised daycare and education. Several explanations for the continuing decline below replacement-level fertility in Finland have been put forth: women spending more time on education, a growing gap in the share of highly educated women and men, a stronger emphasis on economic independence and career building among women, an insecure labour market, economic recession and poor economic outlooks, decline in marriage rates and increases in divorce rates, and the individualisation of society and reduction in interpersonal (physical) interaction technological improvements in communication technology have brought about(Granholm 2020). The more difficult question, which has no clear answer, is how fertility could be increased at least back to replacement levels, in order to stabilise population ageing and prevent population decline.

Labour productivity growth is in the simplest economic terms decided by technological advances that are the result of the level of human capital in the labour force. The Finnish labour force has become more highly educated over time, but still the labour productivity growth rate has declined. I can think of at least three factors that are dragging down labour productivity growth in Finland. These factors also relate to consistently high unemployment in Finland, which in turn is related to poverty. Firstly, Finland has a very rigid labour market legislation which makes hiring new employees both expensive and risk-fraught especially for smaller businesses. Secondly, Finland has one of the world's highest tax rates, consistently ranking among the top 10 countries in the world 1990-2019 (OECD 2021b). Income taxation is also highly progressive, meaning that the more productive an individual is, the more they are punished with taxation; which is obviously not conducive to labour productivity growth. Thirdly, due to excessive labour market regulation and high taxation, Finland is not a very attractive market for domestic or foreign investors and entrepreneurs; with many domestic companies having lost their international competitiveness or found it more lucrative to establish their production abroad.

A major issue in Finland is the high domestic unemployment, which is partially due to the

three above-mentioned problems; but also a combination of generous unemployment benefits, poor coordination of educational supply and demand, and certain professions being underpaid relative to their workload. These factors produce labour shortages in certain professions, while there is an abundant unutilised domestic labour supply.

These factors in turn partially explain the influx of low-skilled immigrants who are willing to accept poor labour market conditions in order to gain permanent residency, and hence access to Finland's generous social security and welfare systems and the possibility of bringing their family to Finland. The other part is explained by humanitarian immigration, and to a limited extent more skilled labour migration. The latter is however quite limited as Finland is not very attractive for expats due to the above-mentioned issues, as well as the language and location of the country.

Lastly the increase in adult obesity is part of a global phenomenon, just like fertility decline, as individuals are having more sedentary and unhealthy lifestyles; with excessive consumption of processed sugar in particular.

This finally brings us to the policy suggestions of this paper.

9.1 Policy suggestions

- A serious effort needs to be made by the authorities, together with educational institutions and private actors, in getting to the bottom of the root causes behind the low and declining fertility in Finland; and most importantly to address these root causes. The voices of the young must be heard and *understood* by the authorities. The young also must be at the centre of this process; as it is their views and perspectives that determine Finland's fertility, and hence the country's future (Granholm 2020).

- All non-essential government spending needs to be cut in order to slow down, and in the future hopefully reduce, Finland's spiralling public debt (Statistics Finland 2021b). The practice of financing budget deficits with loans that has been going on since the 1970s is unsustainable. Further increasing taxes is not a viable option, as Finland's tax rates are already among the highest in the world (OECD 2021b).

- The current pension reform may not be sufficient as some of the Finnish literature suggests (Valkonen 2020; Lassila 2018), and the forced savings part of the pension may have to be increased. An analysis by Aaltonen et al. (2017) also suggests that the way in which the pension funds are currently managed and invested may be inadequate and require reform (AALTONEN, ILMONEN, and KAHRA 2017)

- The investment climate needs to be further improved to make the Finnish market more attractive to both domestic and foreign entrepreneurs and investors. Finland desperately needs more economic output and high value-added job creation in the private sector. The improvement in the investment climate needs to be combined with a stronger focus on research and development in frontier technology in order to both attract highly-skilled immigrants as well as international students and scholars, and make the Finnish economy more internationally competitive (Bureau of Economic and Business Affairs 2021).

- Further efforts need to be made to ease rigid labour market legislation, reduce taxation of both employees and employers, and incentivise re-entry into the labour market of unemployed individuals (Bureau of Economic and Business Affairs 2021). Moreover, there needs to be greater cooperation between the public- and private sectors in matching the supply of educational institutions with the demand of the market for vocational and higher education graduates (Hakola et al. 2016). These measures should help improve the unemployment situation together with the aforementioned suggestion.

- Humanitarian (particularly asylum) immigration in its current form should be ceased completely. Low-skilled immigration from culturally distant countries in particular should also be minimized (referring to immigrants seeking permanent residence, not seasonal or other temporary workers). Efforts to repatriate individuals (asylum seekers) with no legitimate reason to stay in Finland should also be increased. There are several reasons to these suggestions.

  Firstly, both forms of immigration have induced and will continue to induce substantial net costs on public finance due to their high social security consumption and low income of the average immigrant both in the short-run and in the long-run; as the empirical data and literature from Finland have shown (Sarvimäki 2017; Sarvimäki 2011; Salminen 2020a; Jauhiainen and Raivonen 2020; Salminen 2015).

  Secondly, contrary to the dominant political discourse in Finland and other European countries; immigration is not a viable solution in attempting to reverse or stop population ageing. To begin with, there seems to be a naive misconception among politicians about the availability, ”quality” (average human capital and skill level), and adaptability (ability and will to assimilate into the host society) of international migrants. The reality is that the bulk of the immigrants who are willing to move to Finland are from low- or middle-income countries with an average skill-level well below the Finnish native average; which will make them net consumers of tax revenue both in the short- and the long-run. These immigrants can accept poor labour-market conditions

and low pay, as they gain access to Finland's generous social security system once they receive permanent residence permits. It should also not be a surprise to anyone that immigrants age just as natives do, and they also consume social security. Moreover, the sheer amount of immigrants with higher average fertility levels than Finns that would have to be taken into Finland just to stabilize the population is politically, socially, and economically unfeasible (Granholm 2019). Moreover, based on the empirical literature from Finland, we expect also the children of these immigrants (the second generation immigrants) to, on average, perform worse than natives both in education and the labour market (Ansala, Hamalainen, and Sarvimäki 2016; Kirjavainen and Pulkkinen 2015; Tiilikainen, Ismail, and Tuusa 2013; Malin and Kilpi-Jakonen 2019). The migrants are also expected to adapt their fertility levels to host country levels over time, so unless the root causes to fertility decline in Finland are addressed; no amount of immigration would change the low-fertility pattern we have seen over the past decades, and particularly since 2010 (Dubuc 2012; Mayer and Riphahn 2000).

Thirdly, humanitarian immigration does nothing to solve the root causes to international refugee flows; only a select few are helped at a very high per capita cost. Humanitarian (refugee) migration has also become something entirely different from what it was initially designed to be in the 1951 Refugee Convention; persecuted individuals were to be offered *temporary* protection until their situation in the source country could be considered safe. What humanitarian immigration has become in Finland and other European countries is a *permanent* migration closely resembling economic migration. Asylum migration into Europe, particularly in recent years, has on the other hand had economic characteristics (Chain migration: a family sends their most fit member, usually a young male, to seek permanent residence in the host country and form an ”anchor”. Once this person has received permanent residence he or she can make use of the family reunification policy of the host country to bring his or her family into the host country (Massey et al. 1993)) all along; as the data on asylum seeker demographics from Eurostat and information about migrant smuggling from Europol show (Eurostat 2021a; Europol 2016; Europol 2020). Having a lenient asylum policy also acts as a pull factor for economic migrants who use the asylum channel to choose Finland as their final destination. Finland's labour immigration, humanitarian immigration, and asylum policy should therefore be thoroughly reformed; making them strict and highly selective, as well as complementary to the needs of the Finnish labour market (Borjas 1993; Chiswick and Miller 2010).

- Adult obesity has escalated to the point that the government has to take action to stop the increasing trend. Regulation of consumption of processed sugar could be one measure. Exercise

and healthy habits also need to be better promoted at both schools and workplaces. Most importantly, healthy habits need to be promoted from a very young age; public schools need support to better promote exercise, and school canteen lunch should be made a more attractive and nutritious option where needed in order to dissuade students from opting out of school lunch and choosing less healthy alternatives. This being said; a great responsibility also lies on parents, teachers and other mentors in promoting a healthy lifestyle for children by acting as positive role models (Lundqvist et al. 2018; Joki et al. 2020).

- Based on the empirical research on decline in cognitive ability and increase in health risks with age, as well as the high and increasing obesity rate (which in turn has also been found to increase health risks and reduce motor ability) among working-age adults in Finland; it is highly unlikely that extending the retirement age beyond 65 years of age will be an effective measure in reducing social security spending (Rodgers et al. 2019; Salthouse 2009; Tjepkema et al. 2006; Kissebah, Freedman, and Peiris 1989; Wellman and Friedberg 2002; Pi-Sunyer 2009). This is also reflected in employment rates at older ages. While around 80% of workers ages 55-59 were employed in 2018, only 50% of 60-64 year-olds were employed, and less than 15% were employed at ages 65-69 (OECD Publishing 2020).

10 Appendix for theoretical models

10.1 Political theories

The two main ways of modelling a political battle in social security theories are pressure group models and voting models. The latter is more relevant in Finland's case. Mulligan and Sala-i-Martin explore three political theories in the first part of their paper: the majority rational voting model, the time-intensive model of political competition, and the taxpayer protection model.

10.1.1 The majority rational voting model

A straightforward way of modelling old-age social security is to have the elderly be the winners of a pension system as the result of a political battle. The common way is to model public decisions in democracies as outcomes of majority parliamentary rule, where voters are rational and self-interested. The median voter then tends to decide the public decisions. Two modifications to this model have been proposed. One is that the elderly form a coalition together with another group. The other is that there is a deciding election for a stationary policy that remains in effect indefinitely (Mulligan and X. Sala-i-Martin 1999b). Tabellini (2000) takes the former approach where the elderly form an alliance with the poor against the young and the wealthy. According to his model, which he supports with cross-country empirical data; the size of the social security system increases both with the size of the elderly population, and with the level of inequality in pre-tax income (Tabellini, 2000). Mulligan and Sala-i-Martin criticize Tabellini's conclusion that income inequality is positively correlated with social security; referring to studies by Benabou (1996) and Peltzman (1980) who suggest that there is no significant positive correlation between government size and income inequality. (Mulligan and Sala-i-Martin, 1999b; Benabou, 1996; Peltzman, 1980).

Mulligan and Sala-i-Martin also criticize Tabellini's assumption of a majority coalition between the old and the young poor; stating that neither the young poor nor the elderly made up a large enough share of the US population, while the authors mention that those aged 65+ did make up 22% and 33% of voters in Sweden and Germany respectively at the time of writing. Since we are interested in the Finnish context we can note that the share of 65+ year olds in Finland is currently (2020) almost 23% and that this share is expected to increase to 34% by 2070. Finland's unemployment rate is currently (2020) at almost 8%, and the share of households in the lowest three income deciles was around 37% in 2019(Statistics Finland 2021c; European Commission 2021a; Statistics Finland 2021f). This would mean that the assumption of a coalition between the poor and the elderly is indeed likely in the Finnish context, which is also reflected in Finnish election history. Lastly Mulligan and Sala-i-Martin

argue against the assumption that the winning coalition of the old and the poor would push for more progressive social security based on US and third world country data; also mentioning that the poor could possibly be worse off under old-age social security due to their lower propensity to save for retirement (Mulligan and X. Sala-i-Martin 1999b). I would argue that Mulligan and Sala-i-Martin are taking Tabellini's model out of its proper context; namely Europe. The Finnish old-age social security system has been very favourable towards the elderly and the poor, and expanded over time. Reductions to the system's generosity have been recent and quite limited.

The alternative option for the elderly to win the majority vote in the rational voting model is by building a coalition with the middle-aged. While setting up the old-age social security system may end up hurting the middle-aged in the short run; they are relatively close to retirement and thereby the benefits of old-age pension. Browning (1975) considers a model with one election to decide old-age social security for the indefinite future. According to his model old-age social security always wins the vote, even if the election were to be held again at some point in the future. An oversimplified view of his model is that the young, middle-aged, and old form three equally large groups who vote on implementing a PAYG pension scheme. The young and middle-aged both pay T amount of taxes and the old receive subsidies of the size of $2T$ without contributing to the scheme. The old obviously vote in favour as they can only gain from old-age social security, and the middle-aged also vote in favour as they will receive a subsidy of $2T$ in the near-future once they become old. Therefore the middle-aged and the old win the majority vote, and the young end up being the losers.

Conceptually the model is very simple, just like Tabellini's; and neither of these models can explain why pensions in general are earnings-related, why they are financed with payroll taxes, why the retirement age does not increase with life expectancy, or why the share of elderly of the total population is not related to the amount of benefits received by each elderly person. Browning's model also does not consider the possibility of the young and middle-aged voting to temporarily suspend old-age social security for one period t whereby both of them would still gain their $2T$ in benefits, whereas the old would lose their $2T$ (Browning 1975; Mulligan and X. Sala-i-Martin 1999b). It is however questionable how realistic such a scenario would be considering the disruptive effect it would have on trust in a society. This is the "threat" of the unborn doing exactly the same to today's young and middle-aged once they themselves become old that Kotlikoff et al. (1988) suggest works as a deterrent for supporting such a temporary suspension (Kotlikoff, Persson, and Svensson 1988).

Galasso and Conde Ruiz (2000) on the other hand provide insight into why pension schemes are generally funded with payroll taxes and not wealth taxation. In their overlapping-generations model combining both a purely intra-generational distribution scheme and a pension scheme distributing both within and across generations, the authors conclude that both policy tools are used in equilibrium.

However in line with empirical evidence the intra-generational scheme ends up being smaller than the pension system. This is due to the elderly constituting a large and homogenous coalition supporting pensions, but not intra-generational distribution. This observation could help explain why pensions are financed through taxation of wages, but not taxation of wealth; as wealth taxation would break the homogeneity of the elderly electorate and weaken the coalition in favour of larger pensions (Conde-Ruiz and Galasso 2000).

10.1.2 The time-intensive model of political competition

The political model developed by Mulligan and Sala-i-Martin (1999) themselves is also a political competition between the young and the old, where they argue that time allocation of the different electoral groups is a key input. Simply put, the groups that work less are more successful in reaching their political goals as they are able to invest more time and effort into political issues. Moreover, people who do not work have a smaller range of political issues they need to concern themselves with. The elderly can in this model be considered more single-minded than non-retired working-age individuals, as the former focus their efforts mainly on pensions and other income transfers to their group.

Mulligan and Sala-i-Martin propose that the old make up a lobby that has the incentive to reduce the work effort of its members as they are less productive than the young and as they face the highest implicit tax (i.e. value added tax) rates. As a generous old-age social security program is difficult to make smaller in the future (but easier to make bigger), the young have lower incentives to resist the old and thereby lower incentives of increasing implicit tax rates. As both the result of facing higher implicit taxes as well as other reasons for retiring, the old have more leisure relative to other age groups and end up being the net beneficiaries of the political process. The authors therefore argue that their model explains transfers across cohorts, explicit wage income taxation of the young, implicit wage income taxation of the old, benefit dependency on earnings, and why old-age social security systems that have stronger retirement incentives are larger.

Mulligan and Sala-i-Martin's model can be referred to as a pressure group model; where there is conflict between groups regardless of the political institutions in which these conflicts occur. The same goes for the taxpayer protection model. The weakness of these models is that they do not go into detail on political activity, but a strength is that they can address conflicts in varying political settings and relate government decisions to economic rather than political variables (Mulligan and X. Sala-i-Martin 1999a).

10.1.3 The taxpayer protection model

Becker and Mulligan (2003) in their model argue that inefficient subsidies and taxes may effectively reduce government size and incentives for lobby groups to expand public programmes. In this way the inefficient redistributive schemes of real-life old-age social security programmes are meant to shield taxpayers from excessive pressure by the beneficiaries. Essentially the model boils down to that the old lobby for increasing the size of old-age social security, while the young seek to decrease it. Lobbying from both sides is subject to diminishing returns, but unlike in Mulligan and Sala-i-Martin's model, resources are not time-intensive. While Becker and Mulligan's model can explain intergenerational and inter-group transfers, it cannot explain why the transfers run from the old to the young and not vice versa. Moreover their model simply assumes that there are net tax payers, and the authors do not endogenise political group membership whereby they do not have much to say about retirement ages (Becker and Mulligan 2003; Mulligan and X. Sala-i-Martin 1999b).

10.2 Efficiency theories

Mulligan and Sala-i-Martin analyse eight different efficiency theories in their paper, so the main aspects of these different theoretical models will be summarized very briefly in this section.

10.2.1 Mirrlees' Problem as Optimal Redistribution

This model is based on the idea that old-age social security is implemented in order to alleviate poverty among the elderly due to market failure. If the government places enough emphasis on the well-being of the elderly an old-age social security system emerges. Labour income of both the young and the old is taxed at the margin; which means the tax is applied on every additional unit of earned income, as is the case with progressive wage earnings tax.

The model can explain why even a small share of elderly individuals in the total population receives at least some transfers from the young. Moreover, it is intuitive that the state manages old-age social security, assuming that there is a free-rider problem among those who care about the well-being of the old. But, the model cannot explain how collective decisions about redistribution are made. The model also does not address the fact that pension tends to be earnings-related, but not related to income from assets. Lastly the model does not explain why pension is dependent on retirement rather than poverty, and the potential lack of progressivity in old-age social security.

In essence old-age social security depends too little on asset income and too much on wage income, increases too much with lifetime earnings, and is simply too generous in both Europe and the US to be considered a welfare programme. While pension schemes do indeed alleviate poverty; the poverty

alleviation goal cannot explain variance across countries, growth in size over time, and its size relative to other forms of government welfare spending(Mirrlees 1971; Mulligan and X. Sala-i-Martin 1999c).

10.2.2 Mirrlees' Problem as Risk Sharing

This model assumes that old-age social security is an agreement between identical individuals made to insure each other against unobservable future labour productivity shocks. As the insurance is an optimal risk-sharing agreement, those who contribute more to the system also receive higher benefits. This model shares the same issues as the optimal redistribution model. The model also cannot explain why old-age social security systems transfer from the young to the old (Mulligan and X. Sala-i-Martin 1999c).

10.2.3 Induced Retirement Enhances Efficiency

Sala-i-Martin (1996) has argued that old-age social security was designed to induce the elderly to retire, as aggregate GDP would be larger if they did not work. This is because human capital is expected to depreciate with old age so that the elderly end up having below-average levels of human capital. This would in turn have a negative impact on the productivity of the young, whereby they would have the incentives to encourage the elderly to work less or retire. In a sense this model can be viewed as the young trading some of their income for the jobs of the old.

In contrast to the previous two efficiency models, Sala-i-Martin's model accounts for redistribution being part of the optimal policy; as the elderly may choose to continue working (and thus hurting the economy), and are paid in order to relinquish that freedom. The model also assumes that labour productivity increases in the young-old population with life expectancy and health improvements; it predicts that retirement age rises with life expectancy and health improvement. Some of the major weaknesses in the model, as with other efficiency models, is that it does not explain differences in political behaviour between age groups, or why regulations tend to favour the elderly (Mulligan and X. Sala-i-Martin 1999c; X. X. Sala-i-Martin 1996).

10.2.4 Social Security as "Retirement" Insurance

Without an old-age social security system, the main way of insuring against the inability to earn income at old age is through private savings at younger ages. An alternative option would be to purchase private insurance. The advocates of this model however point to the problem of adverse selection; only those individuals who based on their private information about their own health perceive a high enough risk of disability at older ages would sign up for private insurance programmes. It would then

be intuitive for the government to introduce a mandatory insurance that would potentially end up like the old-age social security programmes we have today.

The optimal retirement insurance model explains important features of old-age social security programmes such as: premiums being paid to those who have avoided the retirement "risk" while still being exposed to it (workers), benefits only being available for collection at retirement, the maintenance of a reserve despite present premiums being the main source in financing benefits, and that the premium-award policies implicitly tax the elderly (though never as high as 100%). What the model also accounts for is the correlation between the number of insured individuals (share of retired individuals in the total population), which would require higher premiums to be paid to remain fully insured; which would in turn encourage higher savings in younger ages and lower consumption in older ages.

What the model cannot explain is why retired cohorts up until the present have received more than they have contributed to old-age social security schemes, and why replacement rates (the percentage of an individual's annual income that is replaced by retirement income once they retire) have been so high in many developed countries (56.5% at retirement and 50.2% at age 80 in Finland 2018)(OECD 2019, p. 147; Mulligan and X. Sala-i-Martin 1999c).

10.2.5 Social Security as Solution to the Prodigal Father Problem: Myopic Prodigality

Another common theory is that old-age social security takes care of those elderly individuals who were prodigal (lived beyond their means) when they were younger, which resulted in these individuals not having enough savings to support themselves once they retired. One version of this theory is that parents did not think far enough ahead when they were younger (hence myopic: short-sighted). In this model insufficient savings at a young age is seen as a mistake.

Diamond (1977) gives reasons such as: insufficient information about the needs in retirement, failure to make long-term decisions due to unwillingness to face the reality of getting old, or that they are simple short-sighted in their economic decisions. Diamond proposes that the solution to the myopic prodigy problem is a fully funded scheme, but Mulligan and Sala-i-Martin believe that the solution involves a PAYG scheme; as there is always the one generation gap due to the first generation of old retirees benefitting from the scheme without being forced to save (P. A. Diamond 1977; Mulligan and X. Sala-i-Martin 1999c). Feldstein (1985) on the other hand suggests that the optimal solution to the problem is a means-tested pension system (eligibility determined on whether the individual can or cannot make ends meet without the benefit) (Feldstein 1985). Merging Diamond's and Feldstein's solutions would make the optimal old-age pension system fully funded, except for the first generation

of elderly for which the benefit is means tested.

10.2.6 Social Security as Solution to the Prodigal Father Problem: Rational Prodigality

The rational prodigality model assumes that parents in their youth were actually forward-looking when they were young to the extent that they anticipated society's response to the needs for retirement (Laitner 1988). They expect that society will aid them if they end up in poverty at older ages, even when it is self-induced. They therefore do not bother saving when they are young as they expect society to bail them out. The main problem with both prodigal father models is that the young are expected to oppose the implementation of a forced savings pension scheme, so neither model can explain why the optimal fully funded forced savings pension system would be the outcome (Mulligan and X. Sala-i-Martin 1999c).

10.2.7 Misguided Keynesian

Thomas Sargent (in Feldstein 1998) proposes that old-age social security was created on purpose to reduce national savings when aggregate demand was low during the Great Depression, and by Keynesian prescription consumption needed to be stimulated (Feldstein 1998, p. 306). This would both account for why old-age social security is run by the government and why the scheme does not require proof of disability. If Keynesianism is considered the wrong approach, then a forced savings pension system would improve welfare long-term. The model could also explain government reductions of the official retirement ages, which is what has happened historically, as a counter-reaction to increased private savings.

Contrary to other efficiency models, redistribution from young to old is expected to enhance efficiency in the Keynesian model as it reduces private savings. However, the model cannot explain why old-age social security systems incentivise retirement, nor does it explain why many countries encourage retirement savings and why some pension schemes started out as funded systems (Germany, Sweden, France, US, Chile). Lastly the Keynesian model cannot explain the correlation between economic growth and the size of the social security system (Mulligan and X. Sala-i-Martin 1999c).

10.2.8 Social Security as Longevity Insurance

This model relates to uncertainties in predicting length of life for individuals. Kotlikoff and Spivak (1981) suggest that a risk-averse older individual may be willing to sacrifice up to half their resources in order to receive an actuarially just annuity (Kotlikoff and Spivak 1981). The fact that uncertainty about life expectancy exists does not necessarily mean that intervention is necessary, private insurance

could be an option. However, with individuals having substantial information about their own health, a private scheme would quickly run into selection problems as mentioned in the Mirrlee's problem models.

Hamermesh (1987) proposes that the selection issue illustrates why government-run social security systems with compulsory annuity are efficiency-enhancing (Hamermesh 1987). The theory is able to explain why old-age social security is government-run, why annuities are earnings-related, and why old-age pensions are disconnected from disability. The theory cannot explain why governments are so heavily invested in their pension schemes, or why some governments give their citizens the freedom to choose when to retire or even whether they want their pension as an annuity or a lump sum. Lastly, as is the case with many of the other efficiency models, the longevity insurance model cannot explain why old-age social security induces retirement (Mulligan and X. Sala-i-Martin 1999c).

10.2.9 Government Economizes on Administration Costs

Diamond (1993) has proposed that old-age social security serves as a private pension plan, but that the government is the best agent to run it; as it has the greatest economies of scale when considering administrative spending. As with private pension plans, old-age social security benefits are earnings-related; not asset-related. They also increase with lifetime contributions, are paid to both emigrants and institutionalised, and retirement ages have not risen with time. According to Diamond, the savings in administrative spending outweigh the reductions in administrative spending of universal rules; such as having the same retirement age for every worker (P. Diamond 1993).

Diamond's argument that government administration of pensions is preferable is somewhat shaky, as it rests on the assumption that even in a privately managed competitive system with rational workers, the private pension managers would not be able to administer pensions more efficiently than the government. The model also fails to explain why old-age social security is compulsory and redistributive across cohorts (Mulligan and X. Sala-i-Martin 1999c).

10.2.10 Return on Human Capital Investment

As we know pension systems are typically funded with payroll taxes, whereby the old in a sense have a stake in the earning ability of the current working-age population. The higher the average worker earnings are, the more funds are available to subsidise the old (which is even more true in countries with strongly progressive payroll taxation) . Becker and Murphy (1988) have suggested that old-age social security is simply a dividend paid to the old for financing the education (human capital development) of today's workers when they were in schooling age. Similarly, governments have also

increased their investments in education over time as with public pensions (Becker and Murphy 1988).

As the model views old-age social security as a return on investment, it does not explain why retirement is necessary to receive these returns. It also cannot explain why the majority of redistribution is from the young to the old, when including not only social security but other forms of government spending as well (Mulligan and X. Sala-i-Martin 1999c).

10.3 Narrative theories

This section briefly goes through the four narrative theories mentioned by Mulligan and Sala-i-Martin.

10.3.1 Social Security as Chain Letter

The chain letter theory assumes that when the first generation takes old-age pension T from the young, they promise that future generations will pay this pension back to the young with interest. Each consecutive generation carries the same belief that paying social security tax will continue the chain letter that will eventually benefit the tax payers themselves, as future generations are expected to pay even more tax. In this way, old-age social security ends becoming a Ponzi scheme; where each consecutive generation draws out more benefits from the system at the cost of the next generation of tax payers.

Proponents of this idea have been prominent economists like Milton Friedman and Paul Romer. The model obviously has several shortcomings such as not being able to explain why the young choose to believe in the Ponzi scheme, why retirement is induced by the old-age social security system, and why the system is financed with payroll taxes. For all its shortcomings, and not being a full-fletched theory, the chain letter model does provide an interesting line of thought on why PAYG systems in Europe have persisted for so long; despite benefits having been made more generous, the retirement age lowered, and the intergenerational transfers from the young to the old having increased over time (Mulligan and X. Sala-i-Martin 1999c).

10.3.2 Lump of Labor

The lump of labour model is similar to the induced retirement efficiency model, as it argues that there is a need to redistribute jobs from the old to the young in a setting of high unemployment such as in Europe. One perspective shared by the induced retirement model is that this is intuitive since the old are less productive than the young. Another perspective is that it is more politically acceptable for the government to induce early retirement rather than to suffer high levels of unemployment. A third perspective is that trade unions favour old-age social security, as a large number of unemployed

job searchers contribute to downward wage pressure. While offering some interesting perspectives on social security, the model cannot be considered a theory in itself; Mulligan and Sala-i-Martin referring to it as a by-product of the induced retirement model (Mulligan and X. Sala-i-Martin 1999c).

10.3.3 Monopoly Capitalism

The monopoly capitalism argument with Marxist roots states that old-age social security is a measure taken by capitalists to maintain peace in society. Older workers are laid off because they are deemed less efficient than the young, but they are paid a pension in order for them not to stir up dissent and become a political threat to the state. The model is somewhat similar to the time-intensive political competition and human capital models; although carrying a stronger ideological undertone due to its Marxists roots. As with the other narrative models, the monopoly capitalism model is not an official theory due to its lack of mathematical presentation, but also the fact that it provides little support to its many refutable claims (Mulligan and X. Sala-i-Martin 1999c).

10.3.4 Sub-but-Nearly-Optimal Policy Response to Private Pensions

As with old-age social security; private pension providers also encourage, or even mandate, retirement(Kotlikoff and Wise 1987; Lazear 1979). In case private pensions on their own cause enough workers to retire, then an additional incentive of a public pension system would not change much. Moreover, little would change if public pensions also copied other aspects of private pensions such as use of payroll tax and the choice of retirement age.

Several caveats that can be made to this argument; such as the model not explaining why private pension induces retirement, why the old benefit from old-age social security, why so many governments opt for the same sub-optimal policies, and how private pension schemes induce enough retirement to make public pension target mainly those who have already retired. It is also not very suitable for the European context with low shares of the populations under private pension schemes (Mulligan and X. Sala-i-Martin 1999c).

11 Appendix for equations

11.1 Pension system life expectancy equation

$$A(t, 62) = \sum_{s=63}^{100} S\,(t-1, 62, s)/(1.02)^{s-62} \tag{1}$$

where S is the probability of survival from age 62 to age s, measured as five year moving averages.

From the first argument we see that the probability of survival is based on the information from time-period t with the last observed mortalities being from time-period $t-1$. The second term represents the 2% annual discount rate. Individuals are expected to die by age 100.

The pension of a person who is born in year $t-62$ is multiplied by a longevity adjustment coefficient $E(t, 62)$ after turning 62. This coefficient is a ratio of two terms A in the equation:

$$E(t, 62) = A(2009, 62)/A(t, 62) \tag{2}$$

For cohorts born in 1965 and later the earliest retirement age V will be:

$$(V-18)/(\text{life expectancy at age V}) = C \tag{3}$$

where C is determined through the equation:

$$C = (65-18)/(\text{life expectancy at age 65 in year 2025}) \tag{4}$$

where life expectancy is calculated based on mortality rates for the latest 5 years where data is available.

11.2 Augmented Dickey-Fuller test

In order to perform the augmented Dickey-Fuller test we first estimate the regression model:

$$Y'_t = \phi Y'_{t-1} + \beta_1 Y'_{t-1} + \beta_2 Y'_{t-2} + \cdots \beta_p Y'_{t-p}$$

where Y' is the differenced series $Y_t = Y_{t-1}$. p is the number of lagged terms; usually around 3. In this case if the original time series Y_t requires differencing, the estimated value of ϕ will be almost 0. In case the Y_t series is already stationary, ϕ will take on a negative value. ϕ is estimated using the OLS regression above. In case differencing is required the assumption of the t-test for ϕ is invalidated. If

this is the case the ϕ value has to be compared to critical values of a Fuller (1976) table. If the estimated ϕ parameter is significant then the tested time series is likely stationary.

11.3 The Hausman-Wu test

The Hausman-Wu test formula is:

$$H = (\beta_1 - \beta_0)\prime(Var(\beta_0) - Var(\beta_1))^{\dagger}(\beta_1 - \beta_0)$$

where β_0 and β_1 are two estimators for b, and † is the Moore-Penrose pseudouniverse. Under the null hypothesis both estimators are consistent, but β_1 has the smaller asymptotic variance at least for the estimators containing β_0. For the alternative hypothesis β_0 is consistent whereas β_1 is not. A consistent estimator refers to an estimator with the property of concentrating near the true value of the parameter being estimated when the number of data points increases towards infinity. Efficiency, having the smallest possible asymptotic variance, means that the estimator needs fewer observations than less efficient estimators.

11.4 Autoregression (AR)

An autoregression function can be written as follows:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots \beta_p Y_{t-p} + e_t$$

where each Y_{t-p} on the right-hand side of the equal sign is a previous value of the forecast variable Y_t. This means that the predictors in this regression are the time-lagged values of the forecast variable, hence the name *autoregression*. Autoregression has to be treated differently from OLS models as the assumption of independence in the residual terms is easily violated due to the time-lagged regressors usually having a dependence relationship. Determining the suitable number of time-lagged regressors is also not always clear-cut.

11.5 The 'integrated' part (I)

The integrated part (I) in ARIMA stems from the fact that some time series need to be differenced in order to reach stationarity; as this is a requirement for both autoregression and moving average models.

11.6 Moving average (MA)

As it is possible to regress on the past values of the forecast variable, it is also possible to regress on the past errors. This leads to a moving average model which can be expressed as:

$$Y_t = \beta_0 + \beta_1 e_{t-1} + \beta_2 e_{t-2} + \cdots \beta_q e_{t-q} + e_t$$

where the dependence relationship is in the successive error terms e_{t-q}. The model name *moving average* comes from the fact that the model is a moving average of the error series e_t.

11.7 ARIMA

ARIMA models were popularised by Box and Jenkins (1970), and are commonly used when doing time series forecasts. There are a plethora of different ARIMA models, as changing any of the three components (AR, I, MA) results in a different ARIMA model. The general non-seasonal ARIMA model is usually written as ARIMA(p, d, q) where:

AR: p = number of autoregressive parameters

I: d = degree of first-differencing

MA: q = number of moving average parameters

If any of p, d, q are 0, the models can be written with the '0' parts omitted so that ARIMA(1,0,1) becomes ARMA(1,1), and ARIMA(0,1,1) becomes IMA(1,1). The formula for the simplest ARIMA model ARIMA(1,1,1) is:

$$\underbrace{(1 - \phi_1 B)}_{\text{AR(1)}} \underbrace{(1 - B) Y_t}_{\text{first difference}} = c + \underbrace{(1 - \theta_1 B) e_t}_{\text{MA(1)}}$$

where ϕ_1 is the 1st autoregressive parameter, θ_1 the first moving average parameter, c the constant, and e_t is the error term at time t (Makridakis, Wheelwright, and Hyndman 2008, pp. 335–345).

11.8 Durbin-Watson statistic and Durbin h-test

The Durbin-Watson statistic tests the hypothesis that no autocorrelation at lag one in the residuals of an estimated model. When there is no autocorrelation the Durbin-Watson distribution is symmetric around its mean value of 2. A value less than DW_L or higher than $4 - DW_L$ indicates the existence of autocorrelation, if the value is between DW_U and $4 - DW_U$ there is no autocorrelation present, and

if the value is between DW_L and DW_U or between $4 - DW_U$ $4 - DW_L$ the test is inconclusive. The standard Durbin-Watson test is however biased when analysing models where some of the regressors are lagged dependent variables, which leads to autocorrelation being underestimated. This applies for instance to ARIMA models, which is why the standard Durbin-Watson could not be used on in this study. Instead the Durbin (1970) h-test has to be used, for which the critical values are the same as for the Durbin-Watson test.

To ease the interpretation of these values, the upper and lower bounds for 5 or 1 percent significance levels are given in Durbin-Watson tables; where a value between the upper and lower bound indicates that the data is autocorrelated at lag 1. As the test was run with an intercept in Stata, $k = 2$(intercept+first lag of dependent variable) and $n = 38$(number of observations).

11.9 AIC and BIC

The theory for AIC was developed by Hirotugu Akaike (1974) based on entropy concepts. The AIC formula is as follows:

$$AIC = -2 \log L + 2m$$

where L denotes the maximum likelihood function, and m is the number of parameters in the model.

BIC is a modification of AIC developed by Gideon E. Schwarz (1978), which sometimes leads to less complex models than AIC. Its formula is expressed as:

$$BIC = m \log(n) - 2 \log(\hat{L})$$

where n is the number of observations.

For both information criteria a lower absolute value indicates a better model fit, so that a value of -2 for instance indicates a better fit than a value of -1; while a value of 1 indicates a better fit than a value of 2. On the question of which one of the criteria to prefer, an answer the user found on an online discussion forum suggested using both criteria as they most of the time agree on the preferred model; but measure slightly different things. AIC attempts to select a model that describes a high-dimensional unknown reality; hence reality is not a candidate model that is considered. On the other hand BIC attempts to find a true model from a set of candidates, which is related to why it sometimes leads to less complex models than AIC (Makridakis, Wheelwright, and Hyndman 2008, pp. 362, 589, 592; Wit, Heuvel, and Romeijn 2012).

11.10 The Ljung-Box test

The Ljung-Box test calclulates the statistic Q for k number of time units as follows:

$$Q(\hat{r}) = n(n+2)\sum_{k=1}^{m}(n-k)^{-1}\hat{r}_k^2$$

$$\hat{r}_k = \text{sample autocorrelation at lag } k$$

$$m = \text{number of time lags}$$

The null hypothesis of the test is that the data are independently distributed (exhibit white noise), whereas the alternative hypothesis is that the data are not independently distributed and exhibit serial correlation.

We reject the null hypothesis that the time series :

$$Q > \chi^2_{1-\alpha,m}$$

where α is the significance level and m is the degrees of freedom. As the test is applied to the residuals, we must account for the estimated parameters so that in a:

$$\text{ARMA}_{(p,q)}$$

the degrees of freedom are:

$$m - p - q$$

where p is the number of autoregressive terms and q is the number of moving average terms of the model.

11.11 Random walk model

A random walk model is widely used for non-stationary data. Random walks usually have long trends that may unpredictably and suddenly change direction. A common example is for instance analysis of stock prices or other economic series. One way to determine whether a random walk model is appropriate is if the undifferenced time series wanders irregularly, but the first-differenced time series looks like white noise. The model is written as follows:

$$Y_t = c + Y_{t-1} + e_t$$

where c is the constant (drift term) e_t is white noise. If the constant is included the model is referred to as a random walk with drift. Thereby the random walk models for other spending (with drift) and administrative spending (without drift) can be expressed as:

11.12 Dynamic forecast equation model

The formula for the dynamic forecasts for time-period f is:

$$\hat{y}_f = \widehat{\beta_0} + \widehat{\beta_1} x_f + \hat{\rho} y_{f-1} \tag{1}$$

using the observed y_{f-1} value.

For time-period $f + 1$ the dynamic forecast will compute:

$$\hat{y}_{f+1} = \widehat{\beta_0} + \widehat{\beta_1} x_{f+1} + \hat{\rho} \hat{y}_f \tag{2}$$

using the predicted value of y_f instead of the observed value y_{f-1}.

And the dynamic forecast for time-period $f + 2$ is:

$$\hat{y}_{f+2} = \widehat{\beta_0} + \widehat{\beta_1} x_{f+2} + \hat{\rho} \hat{y}_{f+1} \tag{3}$$

and so on (StataCorp 2013).

12 Appendix for differenced OLS regressions

Table 9: Differenced final OLS models

	Old-age spending	Health spending	Family spending	Disability spending
Old-age dependency ratio	0.07	–	–	–
	(0.08)			
Share of households in	0.03	0.05	0.16**	0.09
the bottom three income deciles	(0.07)	(0.08)	(0.06)	(0.05)
Real GDP per capita growth	-0.13***	-0.11***	-0.03***	-0.06***
	(0.01)	(0.02)	(0.01)	(0.01)
Share of obese 20-64 year-olds	–	0.01	–	–
		(0.06)		
Unemployment rate	–	-0.08**	0.03	–
		(0.03)	(0.02)	
Political leaning fixed effects	Yes	Yes	Yes	Yes
R^2	0.86	0.61	0.49	0.64
Number of observations	38	38	38	38

Notes: Standard and robust standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels. The observation for year 1980 was dropped as the variables were first-differenced; which is why the number of observations is not 39 as in the original OLS models, but 38 instead. All variables except for the real GDP per capita growth and the political leaning fixed effects were first-differenced.

Table 10: Differenced final OLS models

	Unemployment spending	Widowhood & Orphanhood spending	Housing spending	Other spending
Unemployment rate	0.26***	0.02***	0.01	-0.01
	(0.03)	(0.01)	(0.01)	(0.01)
Share of households in	0.12*	0.01	0.00	-0.03
the bottom three income deciles	(0.07)	(0.01)	(0.02)	(0.02)
Real GDP per capita growth	-0.03**	-0.01***	-0.01	-0.01*
	(0.01)	(0.00)	(0.00)	(0.01)
Life expectancy (at birth)	–	0.00	–	–
difference between the sexes		(0.03)		
Percentage of population	–	–	0.10	0.08
born abroad			(0.11)	(0.25)
CPI growth rate	–	–	0.00	0.01
			(0.00)	(0.00)
Political leaning fixed effects	Yes	Yes	Yes	Yes
R^2	0.88	0.71	0.42	0.35
Number of observations	38	38	38	38

Notes: Standard and robust standard errors are reported in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels. The observation for year 1980 was dropped as the variables were first-differenced; which is why the number of observations is not 39 as in the original OLS models, but 38 instead. All variables except for the real GDP per capita growth, the percentage change in CPI, and the political leaning fixed effects were first-differenced.

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