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The effect of labour market contracts on household savings through the precautionary motive

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Abstract

In this thesis, I investigate the determinants of aggregate household savings and specifically the relation between the type of labour contracts in an economy and the savings decision (driven by precaution) by households in the EU-28 region from 2000 to 2016. By applying both the Fixed Effects '(FE) and Generalized Methods of Moments (GMM) estimator for dynamic panel data models, I aim to robustly estimate the determinants of aggregate savings. It is found that the aggregate shares of non-permanent labour contracts and the specified duration of these contracts do not affect aggregate household savings, whereas a small positive effect was expected. It is identified that this result might be attributable to (combinations of) several causes: Self-selection of individuals in labour contracts with higher income uncertainty, the different nature of temporary contracts related to pay and the income uncertainty resulting from that, the anticipation of these workers to secure future income, the dependency of the holder of the non-permanent contract on other income earners within the household and the fact that overall income uncertainty might be lowered by a more flexible labour market. Besides, I identify the disturbing role of measurement error and heterogeneity to estimate a small precautionary motive. Moreover, it is shown that aggregate macro-economic relations can be considered in a GMM framework. In practice, the use of panels with a very limited number of cross-sectional individuals not only faces a bias as found in previous simulation studies, but also leads to limitations on robust inference of system and difference GMM via the arbitrariness of including moment conditions.

Preface

In the run of writing this thesis, the scope of research shifted quite a lot. This absolutely makes conducting academic research interesting and worthwhile, but not less frustrating. You aim to find something, but end up in doubt whether you're able to do so, and finally find B. My research turned out to be no exception.

My initial idea was to investigate the remarkable shift in labor markets and institutes that Europe has seen in the past two decades. In layman's terms: I wanted to know whether the shift of permanent contracts to temporary contracts and self-employment has effects on the real economy, as we observe it everyday.

This shift has effects on both producer and consumer side. The beneficial effect on the former is pretty clear cut: less permanent contracts increase the flexibility to adjust the use of labour to market conditions. The effect on the latter side is less obvious: what are actually the effects on the households employed under these contracts? Different authors have considered the role of flexible contracts and the development of shift towards more flexible labour contracts but those do not consider the decision how much to consume or save.

As a thesis should be a combined work of the knowledge obtained in the courses, these were also a strong inspiration in my case. For me, the micro-economic foundations of this thesis strongly originate from the course *Microeconomics of household behavior*. The theory of precautionary savings discussed gave an interesting suggestion for the consumption-savings decision. A more uncertain stream of income in theory leads households to want more cash at hand to be able to withstand a loss of income. Already quite fast, it turned out to be hard to find this effect in the limited data available.

At some moment, I deemed it interesting to go into a more elaborate theory, trying to set up a model of uncertainty in intertemporal optimization to be able to consider the dynamic effect of a shift to temporary workers. However, after considering the literature of existing models, I chose not to do this but rather to infer the approximate size of the effect from existing models. The existing models of precautionary saving and buffer stock saving are already not accurately describing savings behaviour.

Next to the effects of this labour market shift, a large emphasis was on how to estimate the effects of various factors on household savings properly. A second direct application of a course in the MSc programme (*Applied Microeconometrics*) was the analysis to perform a so-called difference and system Generalized Method of Moments (GMM) estimation on the somewhat older exercise of estimating household savings determinants.

After studying Economics for four years I have obtained a different view of the world, which is both critical and useful. I am convinced that a proper understanding of markets, interactions and economies is essential for any properly working society. However, I do not know yet whether my future will be in the field of Economics. I will devote the upcoming two years to my studies in Physics to thoroughly understand interactions that are not as fickle as the ones between people that make up Economics. However, as the field of Economics stays appealing to me, I might turn back some day.

I wish the reader good luck conceiving my thesis. I hope my research delivers meaningful insights on how labour contracts might (not) affect aggregate household savings and can be an inspiration for future work.

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Chapter 1

Introduction

In previous years the share of fixed-term labour contracts has risen substantially in some European countries. For example, 5.7 million people were employed through a contract of indefinite duration, 1 million through a contract of fixed-term duration and 1 million were self-employed in 2003 in the Netherlands. In 2016, these figures have dropped and risen to 5.1, 1.8 and 1.4 million respectively (Centraal Bureau voor de Statistiek, 2017). This is part of a longer recent transition in labour markets in Europe. From the end of the 1970s on, in Europe a trend of strong lay-off protection for permanent contracts and new temporary contracts with little protection arose, both having a different effect on job creation (Cahuc et al., 2002). The former enhances the protection of workers against lay-offs, whereas the latter increases the flexibility of the labour market by lowering the protection against lay-offs. This flexibility in theory enhances labour to be allocated whenever and wherever it is most needed. The share of new hiring via fixed-term contracts of total new hirings was as high as 80-90% in the end of the 1990s (Cahuc et al., 2002).

Where flexible, temporary contracts reduce the costs for businesses in downturns (e.g. to prevent costly bankruptcies), it might have adverse effects on other aspects. Blanchard and Landier (2002) find that it has reduced welfare among young workers in France. Boeri and Garibaldi (2007), Battisti and Vallanti (2013) and Ichino and Riphahn (2005) have examined the effects of temporary contracts on employment and productivity, which did not turn out to be unambiguously positive. Aoyagi and Ganelli (2015) identify the role of legislation in the existence of harmful gap between permanent and temporary contracts.

In the macro-economic literature the field of the effect of staggered wage contracts is very established. Basically, staggered wage contracts cause rigidity of wages over time, which affects macro-economic dynamics and has policy implications. However, with a high share of fixed-term contracts wages are expected to be less rigid as the wage is only set for a limited time (Heijdra, 2009). However, the differences of fixed-term contracts and self-employed contracts with respect to permanent contracts are more subtle than only the rigidity of wages.

Contracts with fixed-term duration are generally easier to unilaterally dissolve for the employer and, if not broken, terminate automatically. Therefore the employees employed under these contracts are subject to more uncertain labour income compared to contracts with indefinite duration. On the other side, employers are subject to less flexible labor expenses when contracts are of indefinite duration and when legal protection of the contracts is strong. Furthermore, also contracts of self-employed workers and contractors are generally of a limited duration and thus also face a larger uncertainty in future labour income. The increased uncertainty faced by these employees might affect their behavior with respect to the consumption-savings decision, due to precautionary behavior induced by risk averse preferences. Hence the type of contracts a employer-employee relation is based on could influence aggregate variables.

Household savings have been subject of research for a long time, both from a macro-economic and a micro-economic perspective. In the former, household savings are explained by aggregate variables, such as interest rates and saving by other sectors. In the latter, mostly household-specific characteristics are important determinants of savings, such as age, number of children and income.

However, a topic that has not received any noteworthy interest in either the macro-economic or micro-economic literature are the effects of labour contracts on household savings. The increased uncertainty in future income for non-permanent labour contracts may lead to an increase in household savings and therefore a reduction in current-period consumption in line with the Life-Cycle Hypothesis (LCH). From a micro-economic perspective, the share of savings due to income uncertainty is referred to as 'precautionary' savings. In the literature concerning this, income uncertainty is measured both objectively as the variance in income and subjectively via survey studies and precautionary savings are found to be as high as 25-35% of total savings (Guiso and Jappelli, 1992; Mastrogiacomo and Alessie, 2014) in some studies, although this could be much smaller after accounting for business owners (Hurst et al., 2007). Hence, additional income uncertainty in income could affect savings significantly.

However, in e.g. the household survey of the Dutch central bank (DNB), no question about the type of labour contract is included, making it not possible to estimate the effect of different types of labour contracts on household savings of individual households (CentERdata, 2017). However, from a macro-economic perspective, one can use the variation in types of labour contracts across countries and across time periods to consider the effect of these contracts on the aggregate household savings rate.

The empirical estimation of savings models are part of a wider literature aiming to explain what variables are affecting household savings on the aggregate, nation-wide level. Therefore, if one wants to consider the effect of one particular influence (in our case the labour contract structure), it is essential to also consider the relative importance compared to other influences. Most of the literature concerning household savings on the aggregate (country) level perform Fixed Effects estimations. However, as household savings are of dynamic nature, it might be more appropriate to resort to other estimation procedures, such as the Arellano-Bond (GMM) estimator and its extensions (Arellano and Bover, 1995).

For policy considerations, it is important to know how the labour market structure affects the savings rate of households for policy considerations. The knowledge on this relation could give policy makers a directive how their labour market policy (such as the relative legal protection of non-permanent compared to permanent employees) affects income uncertainty and therefore aggregate quantities such as the rate of savings. Moreover, the extent of saving within an economy determines the amount of investment that is undertaken. However, the savings rate that matters how much is saved for investment, is the national savings, build up of government, corporate and household savings.

This thesis will proceed in the following order. In Chapter 2 non-permanent labour contracts in regulated labour markets and the micro-economic foundations of savings are discussed.

Chapter 3 discusses the model of household savings from the theory and what empirical methods have been considered. Chapter 4 discusses the data used, the choices made for the variables and a brief summary of the data. Chapter 5 reports the results obtained and discuss its implications and limitations. Chapter 6 concludes.

Chapter 2

Theory

This chapter starts with discussing the theory of labour markets and the structure of the labour market in the EU-28 region in section 2.1. Consequently, the various theories of household savings are discussed in section 2.2. We consecutively discuss the Life Cycle Hypothesis [2.2.1], precautionary savings [2.2.2], including a discussion of the size and dynamics of the effect of income uncertainty, and habit formation [2.2.3]. Ultimately, section 2.3 discusses the measurable variables that are ought to affect household savings one-by-one.

2.1 Labour market contracts

In order to understand how various types of labour contracts affect savings, it is essential to have a short insight in how labour markets work in the EU-28 zone. Firstly, section 2.1.1 briefly discusses the theory of different type of labour contracts. Secondly, section 2.1.2 also considers the regulations and practice in the EU-28 zone.

2.1.1 Theory of labour contracts

To consider these contracts, we distinguish the following types of workers related to these labour contracts:

- Permanent contract workers
- Temporary contract workers
- Self employed workers with employees
- Self-employed workers without employees

We coin the term 'non-permanent labour contracts' for the last three categories, to distinguish these from permanent labour contracts.
Examining the type of labour contracts that exist, raises the issue why there are multiple type of labour contracts and which combinations of employer and employee at a point in time end up in a fixed-term contract and which end up in a permanent contract. Cao et al. (2010) construct a model with search costs and matching frictions to explain the coexistence of fixed term (with no cost of dismissal) and permanent contracts. They find, using Canadian matched employer-

employee data, that the effect of higher relative firing costs for permanent contracts raises the wages relative to fixed-term contracts.

Many models using search costs take into account the possibility of workers transferring from fixed-term to permanent contracts (Smith, 2007). In such a framework, fixed-term contracts can reduce the costs associated with asymmetric information between prospective employer and employee, while keeping uncertainty of income for well-matched employees rather low as their contracts are converted to permanent ones.

Self-employed workers can best be described not as workers but as producers, both self-employed workers with and without employees. This makes the income uncertainty risk of self-employed workers to be different from that of employees employed through labour contracts. The 'wage' of these workers is determined by the market and this makes wages fully flexible.

However, evidence from France has shown that the introduction of temporary contracts led to a higher turnover in jobs, no decrease in unemployment, but a drop in welfare for young workers (Blanchard and Landier, 2002).

Advocates in favour of temporary forms of labour argue that those contracts increase the flexibility of labour input for firms, which allows them to adapt to adverse events and hence their eagerness to hire temporary workers. This flexibility has the implications of non-staggered wage contracts, which is a widely discussed model assumption in macro-economics and has effects on e.g. the neutrality of monetary policy (Heijdra, 2009).

The aspect of labour contracts that is most important to the research of this thesis is the effect on income uncertainty of a higher share of temporary or self-employment labour contracts. At first sight, the increase in a share of fixed-term employees with low legal protection is a transfer of business risk (which might be of macro-economic nature, but also of firm specific nature) from businesses to labourers. However, the conclusion that those workers will face more income uncertainty might be mitigated. Employers face a lower risk in downturns and might be less reluctant to hire new workers. The smaller chance of bankruptcy for firms due to the larger flexibility of costs in a downturn situation could decrease the income uncertainty of all employed people. Hence, non-permanent labour contracts might increase the income uncertainty of those who are employed through these contracs, but might alleviate that of everyone else.

2.1.2 Practice of labour contracts

In most EU-28 countries there exists multiple types of labour contracts. Generally there is one type of permanent contract and multiple types of temporary contracts such as a probationary period, a fixed assignment, for a period a replaced employee returns, on-call employees and a training or work experience contract (Expatica, 2017; Rijksoverheid, 2017a).

In some countries (Rijksoverheid, 2017b) temporary contracts become automatically permanent contracts if an employee is employed for a certain number of years or a certain number of subsequent contracts.

These types of limitations to fixed-term contracts are loosely determined in the European Labour Law, in which member states have some freedom to set limitations to the duration and termination of fixed-term contracts to prevent abuse (Council of the European Union, 1999). In these labour laws there is also a strict emphasis in non-discrimination between permanent and fixed-term workers in the same occupation. Fixed-term workers have to be treated equally in compensation and other working conditions for the same job. Whether this is pursued in practice by the member states or even in practice remains questionable (Palubicki and Mietek, 2014).

Aoyagi and Ganelli (2015) discuss why large differences between permanent and temporary contracts (the labour market duality) are detrimental to workers and firms' incentives. They find in a panel regression of OECD countries that high protection of permanent labour contracts and lower protection of temporary labour contracts significantly explain larger shares of temporary contracts. Hence, regulation increasing the gap between temporary and permanent contract protection leads to a raise in the share of temporary workers.

2.2 Models of household saving

Several motives for savings can be identified and can broadly classified. Households can save for retirement and bequests for their offspring, to make a large purchase such as buying a house, to smoothen (expected) consumption, to be able to withstand unexpected losses of income (precautionary savings) or to be able to - in later time periods - keep up with the level of previous consumption (habit formation).

These motives are quite intuitive, as these find their origin in models that are able to explain consumption behavior of individuals within an economy and how aggregate behavior arises from that. Ultimately these motives affect the real economy through the savings of households. In the Keynesian period, the interest in the aggregate savings of an economy arose. Keynes (1936), on page 1 of chapter 9 of his famous work *General theory of Employment, Interest and Money*, already wrote that bequests to following generations, *"Precaution, to build up a reserve against unforeseen contingencies"* and *"Foresight,"* that is, *"to provide for an anticipated future relation between the income and the needs of the individual or his family different from that which exists in the present, as, for example, in relation to old age, family education, or the maintenance of dependents."*

The goal of the following sections is not to show all the applications and extensions of the savings models, but merely its the arising savings motives and their importance of the aggregate economy. To illustrate how comprehensive the LCH is, Deaton (2005) notes: *"Life-cycle analysis is so much a part of our regular everyday toolkit, that we pay Modigliani the great compliment of not citing him"*

Section 2.2.1 discusses the LCH model and its extensions, section 2.2.2 discusses the precautionary savings models in the light of income uncertainty caused by non-permanent labour contracts and 2.2.3 considers habit formation.

2.2.1 Life Cycle Hypothesis

The first versions of the Life Cycle Hypothesis (LCH) were posed by Franco Modigliani and Richard Brumberg in 1954 (Ando and Modigliani, 1963)[1]. We present a simple version of the LCH in appendix A.1.1, in which we aim to convene all important implications of the Hypothesis. The model presented is similar to the model of Modigliani and Brumberg (1954).

The LCH assumes that an agent has a limited lifespan, consisting of a fixed period in work and a fixed period in retirement. Furthermore the LCH makes assumptions about how the agent chooses the level of consumption in every period, subject to an intertemporal budget constraint.

[1] The Life Cycle Theory of Consumption was part of Brumberg's dissertation, but it got never published since he passed away before finishing it. An article written by Modigliani from 1954 on the theory is part of a later published anthology of papers written by Modigliani

This leads to two motives to save: to smoothen consumption over the lifetime (saving in this model is positive over the working life to consume in retirement) and to leave a bequest at the time of death.

As all agents are in different stages of the life cycle, the aggregate behaviour of household savings leads to some interesting conclusions. The savings rate is independent of household income, but does depend positively on long run growth of income and does not need to depend on the savings thrift of its inhabitants, but rather on the inhabitants. Furthermore, the main determinant of household savings is the length of retirement in the LCH model. Ultimately, the LCH predicts that even in absence of a bequest motive, households engage in substantial savings.

2.2.2 Precautionary Saving

2.2.2.1 Models

2.2.2.1.1 Intertemporal model

In this section we examine the effect of unertainty on savings in the aggregate economy. In appendix A.1.1 we already discussed one type of uncertainty affecting savings, namely the uncertainty in the time of death. Now we turn to another type of uncertainty that is relevant in examining the macro-economic effects of labour contracts as discussed in section 2.1. The model presented in this section abstains from life cycle savings and aims to deal with saving from several other motives. One of these motives is the precautionary one related to uncertainty in income, and the other one is related to habit formation. Hence the model in this section is also a blueprint for section 2.2.3. We present the derivation of the model in appendix A.1.2.

Assuming a CARA utility function and introducing uncertainty in income. This uncertainty is essential in the emerging phenomenon of precautionary savings. In the model it is assumed that income follows a random walk with normally distributed deviations. This is a highly stylised assumption as income shocks might not follow neatly normally distributed innovations, and might be positively autocorrelated.

Intertemporal optimization of individual expected utility leads to the following savings function:

$$s_t = \gamma s_{t-1} + \frac{\gamma}{1+r}\Delta y_t - \left(1 - \frac{\gamma}{(1+r)}\right)\sum_{\tau=t}^{\infty} E_t \Delta y_\tau + (1-\gamma)\left(1 - \frac{\gamma}{1+r}\right)^2 \frac{\theta\sigma^2}{2r} \tag{2.1}$$

We identify 4 terms in equation 2.1: a persistency (habit) term, a income innovation term, a long run growth term, and a precautionary savings term. We observe that in the equation above the precautionary term also negatively depends on the habit parameter γ. Hence, the stronger the habit, the weaker the precautionary effect as it is suppressed by the desire to keep consumption up with previous consumption. One could argue that this result is mainly obtained due to the convenient choice of the utility function. Literature dealing with (numerical) solutions for other specifications yielded similar results (Alessie and Teppa, 2010).

In the no habit formation case the presented model states that consumption is depressed by a constant term depending on the strength of the CARA risk aversion parameter, θ. However, over multiple periods it will imply that the amount saved ($a_t = a_0 + s_1 + s_2 ... + s_t$) for precautionary reasons depends on the number of periods this person faced this income risk. This is a result that is quite counter-intuitive, as one would expect that the total wealth saved reflects the strength of the precautionary motive . Another model of counteracting forces of risk aversion and willingness to consume, the buffer stock model of precautionary savings, yields more reasonable results.

2.2.2.1.2 Buffer stock model

We furthermore present a simplified buffer stock model along the lines of Carroll and Kimball (2008). We start off by defining assets at end of period t as a_t and m_t as the assets at the beginning of the period, such that:

$$m_{t+1} = (1 + r)a_t + y_{t+1} \tag{2.2}$$

and

$$a_t = m_t - c_t \tag{2.3}$$

In order to make an optimal consumption choice in t, the consumer must know what the value obtained due to a_t in period $t + 1$ is, discounted to the current period:

$$w_t(a_t) = \beta E_t \left[v_{t+1}\left((1 + r)a_t + \widetilde{y}_{t+1}\right)\right] \tag{2.4}$$

Where $\widetilde{y}_{t+1}$ is not certain in time period t.

Now we define the value function, which is the optimal multi-period utility, obtained by tuning c_{t+1} in period t as:

$$v_t(m_t) = \max_{c_t}\{u(c_t) + w_t(m_t - c_t)\} \tag{2.5}$$

The optimal choice in this multi-period setting is where the marginal utility of consumption equals the marginal utility of the assets to be used for consumption in later periods.

$$u^{'}(m_t - a_t) = w_t^{'}(a_t) \tag{2.6}$$

The marginal utility of assets depends on the extent of uncertainty. If there is no uncertainty, we find $w_t^{'} = \beta(1 + r)v_{t+1}^{'}(a_t(1 + r) + E_t\widetilde{y}_{t+1})$, which is a lower bound to the marginal utility derived from assets. If there is uncertainty, the marginal utility differs: $w_t^{'} = \beta(1 + r)E_t v_{t+1}^{'}(a_t(1 + r) + \widetilde{y}_{t+1})$. As the function $v_{t+1}^{'}$ is a decreasing convex function, which happens when the utility function has a positive third derivative, the latter marginal utility is higher than the former marginal utility of assets. The implication of equation 2.6 is that there is some equilibrium level of assets a_t. Kimball (1990) derives suitable parameters of this property he refers to as 'prudence' and derives quantities that are able to quantify the prudence motive. The relative prudence parameter is equal to the constant relative risk aversion plus one, which gives a straightforward relation between the motive to avoid known risks and the motive to hold more assets.

The presented model ignores that m_t is actually endogenous, instead of given. Assuming a specific prudence strength, it can be shown that households hold a specific 'buffer' of wealth. If wealth is below that target, consumption will decrease to make the stock of assets increase to reduce the burden of having little assets. The growth rate of consumption can be written in the following way from the Euler Equation of a CRRA utility function:

$$E_t\left[\Delta \log c^e_{t+1}\right] \approx \rho^{-1}(r-\tau)+\phi \approx g \tag{2.7}$$

Where ρ is the coefficient of relative risk aversion, τ is the time preference rate, r is the interest rate and ϕ is the term that captures precautionary motives. Furthermore we know that the long run growth rate of consumption is approximately equal to the growth rate of income, g. Equating these two, leads to the conclusion that the precautionary motive is endogenous and depends on the difference between growth and other system parameters.

There are, however, many other types of uncertainty that are not considered in the models presented. Often modelled is a risk that is quite related to income uncertainty: namely the risk of unemployment, often proxied by the overall rate of unemployment. Another risk is that of increased expenditures: the risk of an increase in the price of goods purchased might also lead to a precautionary motive. Similarly, one can think of other risks that could fuel precautionary behaviour. However, many of these risks can be insured (or hedged) or even stronger, are required to be insured against by law. These include health insurance, disability insurance, disaster insurance (e.g. a fire or natural disaster) and to a lesser extent unemployment insurance and illness insurance.

2.2.2.2 Empirical findings

A question that is left from the considerations of Modigliani and Brumberg (1954) regarding the stock of wealth and different motives is the size of the precautionary savings motive, which is composed of the size of the precautionary nature of an agent and the uncertainty faced. According to two types of estimation using micro-economic panel data, one with objective data of income variance and the other with survey-obtained data on perceived future income variance, the share of precautionary savings in total wealth as a result of variance in income is estimated to be between 25 and 35% (Guiso and Jappelli, 1992; Mastrogiacomo and Alessie, 2014).

However, the impact of precautionary savings is often criticized, as it turns out that income uncertainty has a limited empirical effect on savings in some other studies. Hurst et al. (2007) find, using the Panel Study of Income Dynamics (PSID) in the United States, by accounting for the different motives for business owners, that precautionary savings are much less important. They find that only 10% of household wealth can be attributed to labour income risk. Moreover, they suggest that the previously found higher shares are due to the inclusion of business owners as normal households, characterised by higher income uncertainty, but also by different motives to save substantially more.

Moreover, Fulford (2015) finds that the precautionary wealth target to permanent income ratio is much lower than predicted from models. Furthermore, he finds from both survey evidence and a regression on the target ratio that other risks, such as saving for unforeseen expenditures are more important drivers then income uncertainty.

Ultimately, one would expect that the buffer stock model would mostly be relevant for young individuals as they have less other motives to save that are not of precautionary nature (such as retirement or bequest savings), but tests of the buffer stock model reject the model (Jappelli et al., 2008).

2.2.2.3 Size estimate of the precautionary effect

As there is a wide set of motives for saving, it might be worthwhile to consider the extent of the effect of those motives on savings, both from theory as empirical findings. This not only suggests what variables to include, but also guides how to interpret the estimates in section 5. We predominantly focus on the labour market variables in this section as those variables have not been included in previous literature.

As discussed, we aim to quantify how income uncertainty arising from labour contracts is related to the savings rate observed. Models such as those of Mody et al. (2012) use inter-temporal optimization algorithms to calculate scenarios with different types of risks. To understand this methodology we will briefly discuss the model presented. These models do not have closed-form solutions and have to be solved numerically.

Mody et al. (2012) solve such a model for two types of risk: the first is the unemployment risk, the other is the interest risk. A change in the former (u_{it}) is the risk most resembling the risk from a fixed-term labour contract, namely the increased likelihood of job loss. Furthermore, the model assumes a size difference in income as a result of unemployment to be approximately 1/2. This assumption seems reasonable when considering the net replacement rates as discussed in section 4.2. In the model of Mody et al. (2012) the savings rate raises upon impact 1.4% in the first year as a result of an increase in unemployment by 5%. Hence, the coefficient for unemployment in our model would be: $\frac{ds}{du} = \frac{0.014}{0.05} = 0.28$.

In this model, the unemployment rate equals the probability of unemployment. This is a very rough assumption and one cold argue that there is not a one-to-one relation between the level of unemployment and the probability of job-loss. However, if unemployment is included, this estimate is reasonable for the coefficient of unemployment.

We would like to infer something about the effect of labour contracts from this estimate, but it seems rather limited to find an effect of labour contracts:

- Firstly, even the risk of unemployment is often found not to significantly effect the level of wealth and savings, as discussed in section 2.2.2.2.
- Secondly, comparing the income uncertainty related to a 1% higher unemployment rate to an increase of temporary workers by 1% of the population might not be sensible at all: the increased uncertainty in the former is for all workers, whereas it is only for the 1% of people that moved to a fixed-term contract. Therefore, it is sensible to suggest that the coefficient for temporary or self-employed workers is approximately 100 times smaller than 0.28.
- Ultimately, people in fixed-term contracts already anticipate the fact that their labour contract is not renewed which might reduce the uncertainty substantially as they could engage in job-seeking long before they run out of their contract.

We can also estimate the effect in a different way. Using the estimates for the precautionary target from subjective data from the Survey of Consumer Finances in the USA as presented in Fulford (2015), we can come up with an upper limit for the increase in savings (so not only precautionary) if a normal employee becomes self-employed. Normal employees aim to have around 1 month of precautionary savings, whereas business owners aim to have 1.7 months.

Under the assumption that a worker moves from employed to self-employment, and assuming the buffer stock is adjusted within the first year the coefficient is not higher then $0.7/12 = 0.058$

Another ratio which might shed light on is the differential precautionary target of employees that are asked whether they know next year's income. The ones who know have 1.07 times monthly income, whereas those who don't 1.13, which is a negligibly small difference. If we naively assume that temporary employees do not know their next year income, whereas permanent workers do know this, this would imply a coefficient of 0.006. However, Fulford (2015) does not convey standard deviations. Interestingly, the ratio between the precautionary target and monthly income is much lower than reported. Literature estimates of precautionary savings range from 1.7 to 7 times monthly earnings.

2.2.2.4 Convergence speed of wealth

In the previous section we have found that an increase of the income uncertainty (in our case: the share of non-permanent workers of different kinds), causes the savings rate to be positive for a period of time, until the preferred level of precautionary wealth is obtained again. Thus, variables proxying a precautionary motive, affect the *level* of wealth directly and these affect savings upon impact *in differences*. In other words, a constant income uncertainty over time leads a person to hold a constant stock of wealth and the level of savings would not be directly affected.

Therefore, the speed of convergence to a new level of wealth influences the size effect we can find. We identify several processes that affect the convergence speed:

Firtslyhe stronger a household wants to smoothen consumption. If this motive is not that strong, the household will increase the wealth in a short period by temporarily saving more. Secondly, the access to borrowing effects the speed of convergence to the new optimal stock of (precautionary) wealth. In some cases when a precautionary motive arises a household might be unable to finance an increase in wealth from capital and labour income. Access to credit thus might increase the effect on impact.

Conclusively, as the periodicity in our data is yearly, we expect that most of the risk due to more households holding non-permanent labour contracts as a share of total labour contracts will be within the first few years as found by Fulford (2015) and Carroll (1992). This is corroborated by the fact that the precautionary target wealth is found to be relatively small compared to yearly income (around 1 month for employees and 1.7 months for self-employed) by Fulford (2015) using US data from 1995 to 2010. This observation implies that the coefficient is barely mitigated due to its effect falling in future periods. However, if such a precautionary variable is found to be a significant this reasoning might be an advocate for including a lag of this variable.

2.2.3 Habit formation

When preferences are not intertemporally seperable, the consumption in a previous time period determines the consumption in the current time period. To illustrate this in terms of the utility function of a household or individual, the utility obtained in period t depends negatively on consumption in $t-1$.

Here we use the results of the model of section 2.2.2, where a version of precautionary saving and habit formation in a simple framework as presented by Alessie and Lusardi (1997) and empirically tested with micro-economic data from the Netherlands in Alessie and Teppa (2010).

The intertemporal separability is explicitly imposed in equation A.10.

The result on savings of the habit formation model are shown in equation A.19. We note that the strength of habit formation γ increases the reliance of savings on lagged saving, increases the reliance on current-period income growth and depresses the negative effect of future income growth on savings and the precautionary effect. The path of consumption with higher γ is more upward sloping over time, starting out at lower consumption, even when the impatience coefficient is not smaller than the rate of interest.

As one finds in equation 2.1, realized income growth causes higher savings in the habit formation model arise due to higher transitory income, but causes only a small difference in consumption. On the other hand, higher expected future income depresses savings as there is no need to save in a current period when permanent income will be higher in future periods.

From micro-economic data, Alessie and Teppa (2010) find a γ of +0.211 in their most credible specification using a GMM approach. The coefficient for realized growth of income in +0.184 as expected and the coefficient for expected 5 year growth +0.0547, which is quite surprisingly considering the model in 2.1. The coefficient of the variance of 1 year change in future income is +0.015, indicating a precautionary motive. These figures are based on survey questions, and the reported expectations might be better reflections on the actual expectations then data from non-subjective variables, since the precautionary motive is driven by expectations. This is an inherent advantage of estimating savings behavior in a micro-economic context.

Demographic variables are deemed very important for the size of the effect of growth on savings in section 2.2.1. The higher the habit formation parameter γ, the more young people save and the less olderly save. In this way, habit formation mitigates any positive effect of population growth on savings.

2.3 Household saving determinants

This section discusses the determinants of savings and how these affect savings. For many of these variables, the Life Cycle Hypothesis and its extensions presented in section 2.2 provides satisfying arguments why several variables need to be included in a model explaining aggregate savings. These variables are summarized in section 2.3.1 However, for others it is less evident from those theories and thorough explanations are laid down in 2.3.2. Section 2.3.3 focuses on how labour market characteristics are able to trigger a precautionary motive.

2.3.1 Life cycle savings

From the theory of life-cycle savings we have seen that growth most likely positively impacts aggregate savings rates, but that in extreme cases this could be mitigated by the demography and strong habit formation. On the individual level, expectations of higher long-run income growth depress savings in theory, but not in practice (Alessie and Teppa, 2010). Temporary increases in income, largely correlated with the level of transitory income, increase savings on the individual level. However, it is not expected that on aggregate level transitory income is rather high, as an increase in aggregate transitory income must be unexpected excess economic growth.

The effect of interest rates is found to be ambiguous, not in the last place due to the difficulty to obtain the relevant interest rate for household decision making, the after-tax real rate. A higher interest rate increases the capital income, but raises the opportunity cost of consumption. Whether the income effect (decreases savings) or the substitution effect (increases savings) is stronger is not obvious, giving rise to an ambiguous effect.

A higher old people-to-dependent people ratio implies that there are relatively many old people in the society. Along the lines of the LCH elderly people dissave during retirement. Hence, we expect saving rates to be lower in economies with a relatively high old-age dependency ratio.

Lagged savings are also included in the model and it has been shown in previous work that it seriously influences the present savings in both micro- and macro-economic estimations (Alessie and Teppa, 2010; Callen and Thimann, 1997). This can be attributed to the theory of habit formation considered in section 2.2.3, where people are better off in terms of utility if their consumption matches previous consumption.

Income inequality is expected to increase household savings, as there are more rich households. This was considered in section 2.2.1: only the very wealthy save for bequests, causing rich households to have a higher savings rate. The larger inequality is, the more such households exist.

Since household savings depend much on expectations of the households' members of future level of income, these might be drastically affected by an economic crisis. (Mody et al., 2012) argue that after a crisis the perception of uncertainty remains which gives rise to higher aggregate household savings. This effect might be captured by a dummy indicating crisis years, or more roughly a full set of year dummies.

2.3.2 Non-life cycle savings

Now we turn to the factors affecting aggregate savings that are not discussed, or to a lesser extent in section 2.2.

If the government saves more, people expect lower taxation in the future, increasing future disposable income, decreasing motives to save themselves. Hence, we expect a negative relation between government savings and household savings.

As the distinction between corporations and households is very difficult to make and can be changing over time and country depending on whether labour or corporate tax is lower, there is likely to be a negative relation between both. Furthermore, households invested in the private sector consider corporate saving as a source of higher future income via capital gains or dividend pay outs. Since markets become more internationally integrated in the Euro countries, it is expected that domestic corporations' influence on household savings has decreased. Hence, cross-border variables might be able to explain household savings as well.

If the financial sector is less regulated, or larger in general, there are more opportunities for households to save their income into some financial product yielding a better expected return. Hence it is expected that it has a positive influence on household saving.

Consumption (indirect) taxes do not change the relative price of present to future consumption, but capital or income (direct) taxes do affect this ratio, distorting the resource allocation decision of individuals. Therefore, if a government charges more in direct taxes compared to indirect taxes, savings are lower (Callen and Thimann, 1997).

As households are net holders of corporate and public debt, inflation reduces the value of this debt and reduces the wealth of households effectively. This causes an ambiguous effect on savings: total wealth is decreased and might induce higher savings, but the real return on the savings is also reduced which might lead households to abstain from saving. Furthermore, inflation can proxy for the risk of higher expenditures and thus induce a precautionary savings motive.

2.3.3 Precautionary savings

The structure of the labor market affects savings in various ways:
A higher than normal unemployment rate signals an oversupply of labour compared to demand. Hence, a higher unemployment rate can increase the expectation about losing income. Unemployment is also closely related to the output and other uncertainty parameters such as an economic crisis.

As discussed comprehensively in section 2.2.2.3, we expect that an *increase* in the share of non-permanent labour contracts, increases the overall income uncertainty faced by households which leads these households to engage in precautionary saving to increase their buffer stock of wealth. This conclusion is similar for either temporary contract workers or self-employed workers compared to permanent workers. Self-employed workers with employees workers are considered as a group that causes an upward bias in the estimates of precautionary savings (section 2.2.2.3). Some of these workers are actually (small) business owners. As discussed in section 2.2.2.3, this leads to an overstatement of total precautionary wealth held by households. Therefore we would expect that an increase in the share of self-employed workers with employees would increase savings.

The aforementioned variables are all based on the uncertainty in income and thus the potential loss in case of income loss. The initial net replacement rate determines the extent to which income is recovered due to the social security system. This is expected to dampen the income uncertainty and therefore reduce the precautionary motive.

Chapter 3

Method

This chapter gives an overview of the models and estimation methods employed to find the size of the effect of the labour market structure, among others, on household savings using a panel of countries over time. The first section [3.1] discusses the functional specification for testing the influence of the variables described in section 2.3. The second section [3.2] considers two methods used to estimate the panel data specification.

3.1 Models

To consider the effect of temporary and self-employed labour contracts within an economy on the household savings in these economies, we estimate a panel data model. The variation between countries and over time gives us valuable information on the labour market structure and on household savings. Within countries, the share of fixed-term and self-employed workers only varies slightly in a period of 10 years, as seen in section 4.2, making a panel data model appropriate. Although we explore the institutional differences that make cross-country comparisons of savings difficult in section 4.2.1, we do exploit a panel model. The retrieval and possible manipulation of variables included in sections 3.1.1 and 3.1.2 can be found in Appendix A.3.

3.1.1 Base model

Using the considerations of chapter 2, we estimate the following panel data model where we allow for unobserved heterogeneity:

$$\begin{aligned} sn_{it} = {} & \beta_1 \Delta t_{it} + \beta_2 \Delta se_{it} + \beta_3 \Delta sew_{it} + \beta_4 g_{it} + \beta_5 r_{it} + ... \\ & \beta_6 gs_{it} + \beta_7 cs_{it} + \beta_8 \pi_{it} + \beta_9 oad_{it} + c_i + u_{it} \end{aligned} \tag{3.1}$$

Here, the dependent variable sn_{it} is net household savings rate. c_i is the unobserved heterogeneity, Δt_{it} is the change in the share of temporary contracts, Δse_{it} the change in the share of self-employed workers without employees, Δsew_{it} is the change in the share of self-employed workers with employees. The other regressors are net disposable income growth (g_{it}), the real interest rate (r_{it}), government surplus rate (gs_{it}), net corporate savings rate (cs_{it}), inflation (π_{it}) and the old age dependency ratio (oad_{it}). According to the theories and explanations for the aggregate scale of household savings mentioned in chapter 2, we come up with the following hypotheses for the signs of the coefficients of the above equation:

- $\beta_1 > 0$, a higher share of temporary employees is expected to increase income uncertainty and increase precautionary saving
- $\beta_2 > 0$, a higher share of self-employed with employees is expected to increase income uncertainty. Moreover, along the lines of section 2, this coefficient might be larger than β_1 and β_3 due to business owners actually hold higher savings
- $\beta_3 > 0$, a higher share of self-employed employees without employees is expected to increase income uncertainty and therefore precautionary savings
- $\beta_4 > 0$, higher income growth has probably a positive effect on household life cycle savings
- $\beta_5 \stackrel{?}{=} 0$, a higher real interest rate has an ambiguous effect on household savings
- $\beta_6 < 0$, a higher government savings rate is expected to negatively affect household savings
- $\beta_7 < 0$, a higher corporate savings rate is expected to negatively affect household savings
- $\beta_8 \stackrel{?}{=} 0$, higher inflation is expected to have an ambiguous effect on savings
- $\beta_9 < 0$, a higher old age dependency ratio is expected to decrease household savings, as there is more dissaving then saving of life cycle savings

In this specification, household savings, and corporate and government savings and growth on the other side might be simultaneously determined. Furthermore, several variables might not be stationary in the period examined. This might pose problems which one has to carefully deal with when estimating the model, further explored in section 5.1.2 and 5.2.3. As there is a large dispersion in savings rates and preferences of agents, it is likely the individual effect c_i is correlated with the other explanatory variables.

3.1.2 Extended model

The model of the previous section can be extended by several other explanatory variables for various reasons:

- sn_{it-1}
  We include the lag in household savings since the lagged level of savings might affect current savings through the process of habit formation described in section 2.2.3.
- avt_{it}

  The income uncertainty faced by temporary labourers depends on how long they will be secured of their income. The average months workers are still in temporary labour contracts is a proper inverse proxy of this. The longer someone is still in a temporary contract, the lower the uncertainty in income, as hypothesized in 2.2.2. However, this influences only a small part of the population (millions over entire Europe), since it only applies to workers facing a temporary contract.

- $nrrs_{it}$ and $nrrm_{it}$
  We have added *initial* Net Replacement Rates (NRR) for two common household types, singles and married households with 2 children. The initial NRR specifies what percentage of previous income a household recieves on average in the first months after unemployment.

- Time dummies and a crisis dummy (cd_{it})
  The relationship from explanatory to dependent variable and the offset in savings need not be constant and measurable over the time period. There is strong evidence that this is not the case (Mody et al., 2012). Hence it is intuitive to include a full set of year dummies into our estimation. An alternative or addition to this is the inclusion of a crisis dummy, which increases expectations of future income variance.

The model we estimate can be specified:

$$\begin{aligned} sn_{it} = {} & \beta_1 \Delta t_{it} + \beta_2 \Delta se_{it} + \beta_3 \Delta sew_{it} + \beta_4 g_{it} + \beta_5 r_{it} + \beta_6 gs_{it} + \beta_7 cs_{it} + ... \\ & \beta_8 \pi_{it} + \beta_9 oad_{it} + \beta_{10} sn_{it-1} + \beta_{11} nrrm_{it} + \beta_{12} nrrs_{it} + \beta_{13} avt_{it} + \beta_{14} cd_{it} + c_i + u_{it} \end{aligned} \tag{3.2}$$

We expect the signs of the newly added coefficients to be the following from theory:

- $\beta_{10} > 0$, a higher level of previous household savings might lead to higher current household savings since is was the best estimate the household has for choosing an appropriate level of savings

- $\beta_{11} < 0$, a higher net replacement rate is expected to reduce income uncertainty and thus reduces precautionary savings

- $\beta_{12} < 0$, a higher net replacement rate is expected to reduce income uncertainty and thus reduces precautionary savings

- $\beta_{13} < 0$, higher average number of months still in temporary contract reduces income uncertainty and therefore household savings

- $\beta_{14} > 0$, a crisis increases uncertainty for households leading them to save more

3.2 Panel data estimation

To estimate the model specifications of section 3.1.1 and 3.1.2 we introduce various empirical methods to properly estimate those panel data specifications. Firstly, section 3.2.1 discusses Fixed Effects by within estimations. Considering the bias caused by dynamic regressors, section 3.2.2 considers GMM estimation.

3.2.1 Fixed Effects

To estimate a panel data model, there are various possible estimation methods. The most used and best documented model are the Fixed Effects (FE) and Random Effects (RE) models. The FE specification is valid if the $\mathbf{x_{it}}$ are strictly exogenous and the RE estimator even required that there is no unobserved heterogeneity. The FE model also allows for a varying intercept for the different individuals c_i. The FE model does not face an omitted variable bias when the omitted variables are constant over time: the effect is subsumed in c_i. The Random Effects model assumes a common intercept and c_i as part of the error term. However, this assumptions fails to hold if we have unobserved heterogeneity (Alessie, 2017): $E(c_i|x_i) \neq 0$. Here we present the simple intuition behind the within estimator:

$$y_{it} = x_{it}^{'}\beta + c_i + u_{it} \tag{3.3}$$

We assume that $E_t u_{it} = 0$. We can not use pooled OLS as in this equation $E(u_{it} + c_i|x_{it}) \neq 0$.

We take time averages for every individual i in equation 3.3:

$$\bar{y} = \bar{x}_i\beta + c_i + \bar{u}_i, \text{ for } i = 1, ..., N \tag{3.4}$$

Then we subtract 3.4 from 3.3 and refer to the time demeaned variables by adding a double dot on top:

$$\ddot{y}_{it} = \ddot{x}_{it}^{'}\beta + \ddot{u}_{it} \tag{3.5}$$

Where we see that the individual effect c_i has disappeared and $E(\ddot{u}_{it}|x_{it}) = 0$. By applying OLS to the above equation, we can consistently estimate β if all x_{it} are strictly exogenous.

Furthermore, we note that the within estimator with a lagged dependent variable as an explanatory variable is only consistent when T goes to infinity (Baltagi, 2013). This so-called Nickell bias occurs due to correlation of the lagged dependent variable term and the error term after the within transformation (Nickell, 1981). Hence, we need to be careful with interpreting the FE estimation and we might want to turn to dynamic panel data models to deal with endogeneity (GMM estimation) and the Nickell bias.

3.2.2 Dynamic panel estimation

Callen and Thimann (1997) use a normal fixed effects model for their panel data specification, similar to what we described above. Their model, just as ours, depends on the lagged dependent variable and might face unobserved heterogeneity and not strictly exogenous regressors. Since the publication of their paper, a new literature comprising dynamic models estimated by Generalized Method of Moments (GMM) has arisen, which deals with the issues of endogeneity by internal instrumentation and inclusion of the first lag of savings as a dependent variable in 3.1.2.

To capture the fact preferences need not to be time separable as shown in section 2.2.3, there is a valid theoretical motive to include a lagged savings term in the model. However, as Achen (2001) states, inclusion of a lagged dependent variable increases explanatory power, but might mitigate the coefficient of the other regressors, mostly when there is substantial serial correlation if the lagged term is absent and when the other regressors are trending. When the exogenous regressors are trending, it is even possible that as regressor's sign reverses upon including a lagged dependent variable term.

For FE estimation of panel data, not only the other regressors might be biased, but also the coefficient of the lagged dependent variable. The bias in the coefficient of the persistence in the dependent variable (γ) of OLS (upward) and within estimation (downward) can be also quite severe (Blundell et al., 2000). The bias in the within estimator is of order $\mathcal{O}(\gamma/T)$, often referred to as the Nickell bias (Nickell, 1981). Blundell et al. (2000) also show the strong downward bias of the lagged dependent variable and the moderate bias of other regressors in a simulation at limited T. GMM estimation also does not require regressors to be strictly exogenous as the moment conditions are based on 'internal' instruments and does not face the Nickell bias. However, the estimators for these Dynamic Panel Data (DPD) models are easily found to be yielding erroneous estimates according to Roodman (2009), a seminal paper about implementing dynamic panel data models with Generalized Method of Moments (GMM) estimation in the *xtabond2* command in *STATA*. Henceforth, the estimation method deployed is carefully build up in the next section, with a focus on biases and efficiency in the case of our model, underlying theory and the relatively small N data at hand.

3.2.2.1 From Anderson-Hsiao to system GMM

This section builds up the system GMM estimator by explaining the moment conditions for the simplest estimator, the Anderson-Hsiao estimator for lagged dependent variable, and adding moment conditions when new assumptions are introduced. It also discusses the issues arising with different types of GMM estimations. Appendix A.2 discusses GMM estimation and the assumptions underlying the moment conditions that are considered in the next sections.

3.2.2.1.1 Lagged dependent variable

The Anderson-Hsiao estimator makes use of second lags y_{it-2} to instrument for Δy_{it-1} in the first differences panel model with solely a dependent variable lag regressor:

$$\Delta y_{it} = \gamma \Delta y_{it-1} + \Delta u_{it} \tag{3.6}$$

Leading to the following moment condition, allowing for exactly identified MM estimation:

$$E \sum_{t=2}^{T} y_{it-2} \Delta u_{it} \tag{3.7}$$

However, by not summing over t, but considering every (larger than 2 periods) lagged dependent variable as an instrument, the efficiency of the GMM estimator is enhanced, leading to more instruments (Arellano and Bond, 2006). This also allows to test the over-identifying restrictions and therefore the validity of the instruments. One can even extend these moment conditions by using y_{it-3}, y_{it-4} in a similar moment condition. This Method of Moments Instrumental Variable approach leads to $(T-1)T/2$ moment conditions: this is referred to as the difference GMM estimator. This is widely referred to the Arellano-Bond estimator.

An alternative approach can be pursued to find more moment equations by not differencing the model, but by taking levels:

$$y_{it} = \gamma_{it-1} + c_i + u_{it} \ , \ |\gamma| < 1 \tag{3.8}$$

Here, Δy_{it-1} is a valid instrument for y_{it} if y_{it} is mean stationary ($|\gamma| < 1$), and the following moment conditions can be set up (also for further lags):

$$E \Delta y_{it-k} u_{it}, \ \ k = 1, 2, ..., t-1 \tag{3.9}$$

Using both types of moment conditions, we obtain the 'System' GMM estimator.

Bun and Kiviet (2002) note that the bias with a lagged dependent variable with small N in difference GMM might not be much less than that in a fixed effects specification. Their approach is based on Monte Carlo experiments for different parametrizations of the simulated data and performing the estimation of different estimators. Among these are the fixed effect estimator, the difference GMM estimator, the System GMM estimator and the collapsed versions of the difference GMM methods. It turned out that in the case with $T = 10$, $N = 20$, the bias for difference GMM and fixed effects estimator were of similar size. The bias on γ in equation 3.8 is in both cases downward and substantial. The system GMM estimator performs better than those two, but still has a slight bias on γ. Importantly, they even find that bias can be reduced by using less instruments by for example collapsing the gmm-style instruments. The order of bias of collapsed difference GMM is $\mathcal{O}(N^{-1}T{-}1)$, whereas that of non-collapse difference GMM is $\mathcal{O}(N^{-1}T^{0})$ (Bun and Kiviet, 2002). Collapsing the differenced equation means that for all lags used, the moment conditions take the form of equation 3.7, where we sum observations in time.

3.2.2.1.2 Explanatory variables

However, in a GMM model we want to incorporate explanatory variables next to the lagged dependent regressor, and for GMM estimation we also need to imply moment conditions for these variables. These moment conditions differ regarding whether the explanatory variable is exogenous or not. A more elaborate discussion about exogeneity of regressors can be found in Appendix A.2. The following moment conditions that can be used for strictly exogenous regressors:

$$E\left(\Delta x_{it}\Delta u_{it}\right),\, t = 1, 2, ..., T \tag{3.10}$$

If we also assume that the regressors are not related to the unobserved individual effect, we can consider the following additional moment condition on the equation in differences:

$$E(\Delta x_{it-k}u_{it}) = 0,\, k = 1, ..., T \tag{3.11}$$

The moment conditions of the other explanatory variables add N instruments in total.
To exploit the moment conditions for both the difference and GMM estimator, the error term u_it need to be a white noise error term. If u_{it} is a white noise error term, there is autocorrelation between Δu_{it} and Δu_{it-1}, but not between Δu_{it} and Δu_{it-2}. This autocorrelation can be tested after estimating. Finding a correlation between the latter would imply that the moment conditions underlying the estimator do not hold.

3.2.2.1.3 Further estimation considerations

Instead of using the difference GMM moment conditions, there is a small deviation which could be worthwhile. This uses moment conditions not taking first differences, but taking Forward Orthogonal Differences (FOD) (Arellano and Bover, 1995). The FOD procedure transforms each observation by subtracting the average of all future observations, which is (regardless of gaps in the data for unbalanced panels) for all but the last observation in each panel. This is particularly useful when T is rather large, reducing the bias (Bun and Kiviet, 2002).

GMM estimation can be done by choosing an optimal weighting matrix $\hat{\mathbf{W}}_{\mathbf{N}}$ after the first estimation. If the number of instruments approaches N, the two-step weighting matrix depend on a singular matrix, strongly downward biasing the standard errors.

Furthermore, as there are many moment conditions involved (compared to variables to be instrumented) under rather similar assumptions, one can for robustness test several different combinations of moment conditions. Including too many instruments can increase the estimator its bias, and cause an overfit of the IV first stage regression.

Ultimately, when the number of instruments becomes large, the Hansen test for valid instruments almost never rejects the null of the instruments being exogenous, making it hard to test for weak instruments. Using system GMM, the number of instruments increases as fast as $\mathcal{O}(T^2)$, so at larger T it is unavoidable to select only a part of the instruments.

Chapter 4

Data

This chapter briefly discusses the data used to estimate the models presented in chapter 3. Section 4.1 will describe how the data is obtained and what specific choices are made. Section 4.2 summarizes the data obtained and identifies potential data potential estimation problems.

4.1 Data description

The data is obtained from Eurostat databases for most variables unless specified otherwise in Appendix A.3 and mostly from the labour market data set Labour Force Survey (LFS), based on survey samples within the EU-28 section. The objective was to use all countries from the EU-28 zone, as it is from 2013 onwards when Croatia was included. The labour market indicators in LFS need to be collected according to EU legislation by the member states. LFS has definitions and guidelines for e.g. unemployment, but also lists the slightly different definitions used in several countries and several time periods. Most of the variables are obtained through surveys, which are samples of the size from 0.2% to 2.1% of the population (Eurostat, 2016).

The inspiration for the extensive set of variables possibly affecting household savings to include is the discussion of the models in section 3.1. Some of these variables can be obtained in several ways and we note the choices made below.

The dependent variable in all of the models is the household net savings rate. The household savings rate is the most accurate determinant of the consumption-savings decision made by households. The gross savings rate is obtained by dividing the gross household savings divided by disposable income. Net savings are obtained from gross savings if depreciation is subtracted. We hereafter use net savings, as these depreciation costs are largely sunk costs and are not to be used for building up a stock of ‘precautionary’ wealth and other types of wealth that are to be utilized. One could also use the savings divided by GDP, but does not precisely capture the effect on household, in which we are interested.

The share of the three non-permanent types of labour relations are taken to be shares of total employed persons. A challenge faced in this data is that the definition of these contracts and the length of these contracts in the countries considered differ wildly over the EU-28 zone, leading to high standard errors of these variables. However, there are some bounds to these definitions according to section 2.1. Furthermore, the average months still in a temporary labour contract can be derived by computing it by using data from Eurostat which states how many workers are in a specific months-till-expiration bin (see appendix A.3). This might be valuable data to incorporate in a more sophisticated specification.

An often used data source to proxy to what extent or equivalently what the cost of lay-off is is the Employment Protection Legislation (EPL) indicator of the OECD. The EPL measures to what extent employees are protected to lay-offs, for three categories of lay-offs: employees with temporary contracts, employees with permanent contracts, and employees in permanent contracts for collective lay-offs (Boeri and van Ours, 2013). If the differences between countries in labour contracts are too big, it might be necessary to include the three different EPL indicators, to be obtained from the OECD. However, these are not available after 2013 and the total number of observations in our panel is very low.

Furthermore, the majority of temporary contracts are held by 15-20 year old employees. As these are generally dependent on family members, this would have little effect on the savings of entire households since the wages of this age category is extremely low. The benchmark age category we use is 20 to 64 years old, but as a robustness check we also obtain data for 15-64 and 25-64 year old individuals

For the income growth we use the growth in disposable income, which is the most suitable measure for the increase in a combination of both population and productivity.

The choice of interest rate is a very delicate one. The relevant rate for households is difficult to define, since it depends on what these households do with their savings and debts. Assuming more or less constant risk premia, the money market interest rate proxies the relevant rate for households. However, this implies that all Euro countries (which is the majority of our data set), have the same interest rate. So there is little variation in the data set regarding interest rates. The short term interest rate of choice is the 3 month money market, which is the definition of the short run interest rate of the OECD.

The final dataset containing these variables contains eight additional countries: Czech Republic, Estonia, Ireland, Cyprus, Hungary, Romania, Slovakia and Slovenia. Croatia, Lithuania, Luxembourg, Iceland, Malta and Latvia have been disregarded for either their size or the limited availability of data.

4.2 Data summary

This section presents a short summary of the trend in the variables present in the data set. The panel data is slightly unbalanced due to several missing obsrvations in various variables. However, there are no gaps within time series of the cross-sectional units

4.2.1 Savings rate

There are large cross-country differences in saving rates and these have changed over time. There are countries constantly on the low side on figure 4.1 (Greece and Romania) and one on the high side (Switzerland). Most countries have a slightly lower savings rate in 2015 then in 2000.

If we consider the panel of savings, we observe a larger savings in 2009 than in 2008 for almost all countries. Therefore, we expect the crisis to have played a role in higher savings, and further strengthens the motives to add a crisis dummy to the set of explanatory variables.

Furthermore, some countries have persistently much lower savings than others. Rocher and Stierle (2015) elaborate on this issue. They find that this issue is reduced when one accounts for data issues and institutional differences such as social services in kind. This increases the disposable income of countries with lots of public services such as health and education ex-

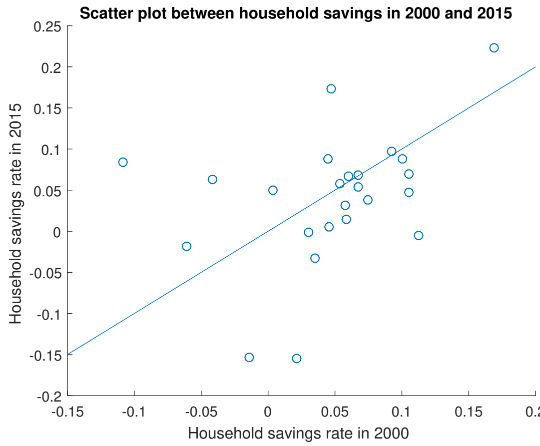

Figure 4.1: *Scatterplot of household savings rate as a share of disposable income between 2000 en 2015. There is not a very strong relation over time. However, Switzerland has a very high savings rate that is persistent over time, just as Greece and Romania on the low side.*

penditures, which overstates the saving rates of such countries with respect to countries with little social services if these social services aren't considered disposable income. In similar ways differing pension systems, the vague border between households and small enterprises, remittances of foreign workers and the shadow economy could lead to largely diverging savings rates. Especially the last two categories have a large impact on increasing the gap in savings between Western Europe and Eastern Europe (mostly Romania, Bulgaria, Poland and Slovakia in our set of data).

Differences in institutions might also lead the slopes, and not the intercept, of the panel data model to vastly different for other categories of countries. For example, Rocher and Stierle (2015) find the effect of public debt is strongly negative for only the eastern European countries and not for the rest of Europe. However, a substantial part of savings differences can be attributed to observable variables (Rocher and Stierle, 2015).

4.2.2 Labour contracts

We observe strong cross-country differences in the share of temporary contracts, whereas these countries are rather similar in other attributes. We illustrate the current dispersion and the development over the last 15 years in figures 4.2, 4.3 and 4.4.

Figure 4.2: *A scatterplot between the share of fixed-term employees of total employees. Between 2000 and 2015 in the most countries, the share of temporary contracts increased slightly for most countries. We note that the majority of countries have a share of 5 to 15 %, but there are some exceptions with much higher shares. These include Spain, Croatia, Portugal, Poland and the Netherlands.*

Considering the time series of the share of temporary workers is that it is continuously upwards, with the exception of the years 2008 and 2009. This indicates that in crisis years mostly temporary workers were fired or their contracts not renewed, confirming the hypothesis that these contracts might cause more uncertainty in income. For self-employed workers with and without employees there is less such a trend visible. Fixed-term labour contracts are mainly labour contracts for young people in all EU-28 countries in 2015 (Eurostat, 2016). As the share of fixed term-contracts has been increasing over time as can be seen from figures 4.2, 4.3 and 4.4, this can be - next to an age effect - also be a cohort effect.

Contrary to the development in the share of temporary contracts, the number of self-employed with employees did not increase. For self-employed with employees we see a small decrease and for self-employed without employees we barely notice any net change.

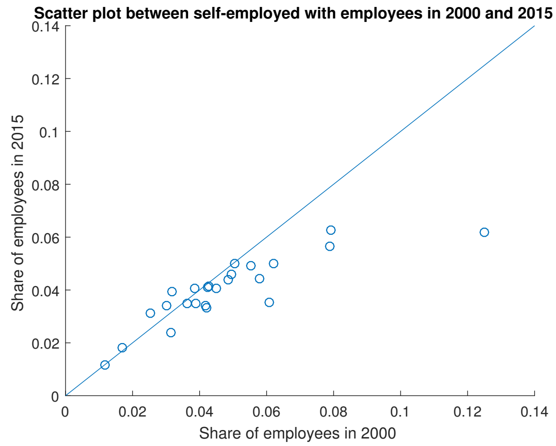

Figure 4.3: *Between 2000 and 2015 in the most countries, the share of self-employed with employees decreased on average. For Italy this is probably a measurement error, as the share dropped with half from 2003 to 2004. These observations are removed.*

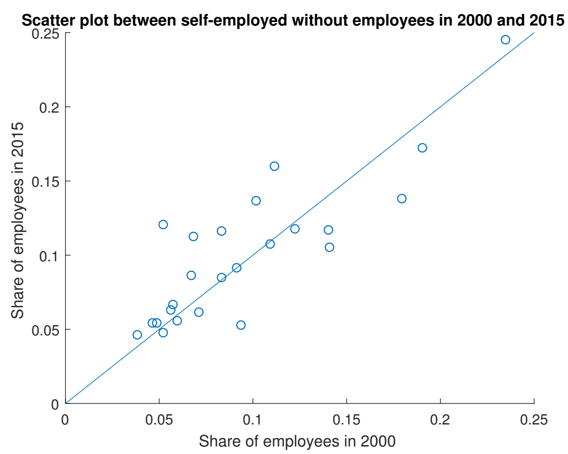

Figure 4.4: *Between 2000 and 2015, the share of self-employed without employees did not change much on average. However, there are some exceptions that showed an increase or decrease. Furthermore, there is a large cross-sectional variation in these type of workers. For example, the share of these type of workers increased in the Netherlands, Italy and the UK, but dropped in many others.*

4.2.3 Other regressors

Disposable household (both net and gross) income gradually raises over time, but is sputtering between 2008 and 2013, over the span of the financial and Euro crisis. Savings initially increased in 2001 (due to a decrease in wealth due to the dotcom-bubble), dropped subsequently and surged in 2009, after the start of the crisis. In the years after, saving decreased in the periphery of Europe (Italy, Spain, Portugal and Greece) and rose in the others, partly caused to differences in GDP growth. Government surpluses are generally negative, with Norway as an exception. In the Euro crisis, most countries started to have larger deficits.

Inflation increased until the financial crisis, immediately dropping after. Despite all kinds of stimulation policies, inflation kept decreasing and even became negative in many countries in 2015. Corporate savings also gradually rose, with a strong increase in 2010, indicating less corporate investment in the crisis. Short run interest rates were on a moderate level before the crisis years, but decreased after, as a result of the ECB's loose monetary policy.The old age dependency ratio increases rapidly over time for all countries, as a result of an aging European population.

The net replacement rate for singles (a family with 2 children, 1 income earner) in most countries in the data set does not change much over time. The cross-sectional differences in NRR run from under 15% (40%) in the UK to over 80% (80%) in pre-crisis Portugal, Switzerland and Netherlands. Unemployment also shows large cross-sectional differences, being high in the periphery, moderate in Eastern Europe and low in Western Europe. After the 2008 financial crisis and the later Euro crisis, unemployment increased substantially, to slowly decrease later on.

The correlation matrix of all variables used above have been plotted in Appendix A.4: there is no correlation larger than 0.5 in absolute value, with exception of the dependent variable and the lagged dependent variable (0.95) and the both types of self-employed and net replacement rates. The first-differenced labour contract variables have very little correlation to the savings rate. Furthermore, due to the low cross-country variation, the interest is almost not correlated at all to the savings rate. Ultimately, as savings are trending down, NRR, unemployment and OAD are roughly trending upward (and are thus negatively correlated to savings) over the period in scope. This could lead to a spurious regression and a downward bias on the coefficients of these three explanatory variables in estimations in levels.

Chapter 5

Results

The models of chapter 3 and its varieties are tested in this section with the data of chapter 4. We are pursuing a panel estimation that allows for individual (unobserved) effects. We perform a Fixed Effects estimation in section 5.1. Hereafter, the Generalized Method of Moments (GMM) estimation is performed on the dynamic model in section 5.2. Ultimately, section 5.3 discusses the results and reconciles these with the theory.

5.1 Fixed Effects

5.1.1 Estimation results

The countries in the data set are heterogeneous as they are in different in unobserved characteristics and also might have different slopes for the different regressors. This increases the standard errors of the coefficients as some countries might have different slopes for some of the explanatory variables. Rocher and Stierle (2015) confirm this by exploiting FE estimations for different groups of countries, and indeed find different slopes.

The results are presented in table 5.1. To the FE estimation of the base model I, variables are added in model IV and V, and in model III the potentially stationary variables are estimated in first differences. However this is to the expense of the number of observations. The coefficients of the full set of time dummies present in model III, IV and V are left out. These are jointly significant with a p-value smaller than 0.01 in all three cases. The later models however face a reduction of the number of observations, due to the lag and difference included and the variables avt_{it} and $nrrm_{it}$ which are missing in some instances.

We find that the pooled OLS (model II) has quite different results from the FE specifications, as it is unable to incorporate the unobserved heterogeneity. Immediately it appears that some variables are (surprisingly) hardly significant in explaining savings such as the income growth, interest rate and old age dependency ratio. The variables proxying the labour market structure turn out not to be significant, giving an incentive to turn to the model of section 3.1.2.
It was also chosen to include the variable avt_{it}, which is the number of months people are still in temporary contracts. Also the net replacement rate has been added, just as the lag in net household savings.

After adopting the extended model, we find a stronger dependency on the growth of income g_{it}, which is in line with the effect according to theory. However, in other work the coefficient is found to be significantly positive and of larger size (Callen and Thimann, 1997).

Table 5.1: Regression results of OLS and four FE estimations. The dependent variable is sn_{it}

	I: FE	II: OLS	III: FE	IV: FE	V: FE
g_{it}	0.0116	0.00709	0.0583	0.0703*	0.0539
	(0.27)	(0.17)	(2.05)	(2.47)	(1.75)
r_{it}	0.110	0.0457	0.0953	0.0811	0.0319
	(0.59)	(0.52)	(1.74)	(0.78)	(0.22)
gs_{it}	-0.251***	-0.0285	-0.134**	-0.133**	-0.165**
	(-4.05)	(-0.90)	(-3.51)	(-3.45)	(-3.87)
cs_{it}	-0.156	-0.278***	-0.112**	-0.0927**	-0.0961**
	(-1.45)	(-4.09)	(-3.59)	(-3.22)	(-3.29)
π_{it}	0.0387	-0.542***	-0.0874	-0.0214	-0.0774
	(0.29)	(-4.35)	(-1.34)	(-0.27)	(-0.57)
oad_{it}	-0.0429	0.0192		-0.133	-0.0210
	(-0.27)	(0.38)		(-1.61)	(-0.24)
Δt_{it}		0.288	-0.203*	-0.0602	0.0307
		(1.47)	(-2.71)	(-0.86)	(0.35)
Δse_{it}		-0.561	-0.185	-0.244	-0.265
		(-0.78)	(-0.63)	(-1.27)	(-1.03)
Δsew_{it}		-0.0773	-0.0730	-0.158	-0.163
		(-0.18)	(-0.50)	(-1.12)	(-0.84)
sn_{it-1}			0.638***	0.685***	0.643***
			(7.04)	(12.41)	(11.41)
$\Delta unemp_{it}$			0.120		
			(1.61)		
$unemp_{it}$				-0.0293	-0.0453
				(-1.04)	(-1.55)
Δnrr_{it}			-0.0123		
			(-0.72)		
nrr_{it}				-0.0426	-0.0963***
				(-1.91)	(-4.05)
Δoad_{it}			0.300		
			(1.20)		
cd_{it}				0.00298	-0.000237
				(1.20)	(-0.07)
Δavt_{it}					0.168
					(1.55)
Observations	306	306	216	235	171
Adjusted R^2	0.158	0.129	0.627	0.695	0.739

I: Stripped FE model, II: Basic OLS model, III: Basic FE model with differences variables
IV: Extended FE, V: Extended FE with interaction term
Models III, IV and V have a full set of time dummies included
t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

It has been confirmed that sn_{it-1} is positive and significant, with a high coefficient of around 0.65. This confirms the importance of the persistence of savings and potentially habit formation in the households savings decision.

From the final model we can conclude that no labour market structure-related variable turns out to be significant. The net replacement rate for married households with two children turns out to be negative, as expected. Although in the first-differences equation it is not significant, the coefficient of -0.09 in the last model could indicate that it has a negative effect on savings.

Inflation, although not in all specifications, turned out to be negative, what is not directly expected.

The coefficient avt_{it} showed up positive in some specifications, contrary to expectation, which is rather odd. We would expect that in a model together with t_{it} the avt_{it}-term would have a negative coefficient as a longer average number of months until contract termination reduces the short time income uncertainty. We further consider the coefficients and interpretation in section 5.3.

5.1.2 Robustness

We performed various robustness checks by estimating different specifications of the models presented in table 5.1. Among others, we estimated the model with the labour market variables in levels, and their coefficients still were insignificant.

Furthermore, we replaced the dependent variable by using the gross savings rate and the net savings divided by GDP per capita instead of dividing by disposable income. Callen and Thimann (1997) abstain from using the latter, since disposable income correlates with taxes and social security benefits as these both depend on the size of disposable income. However, we find almost no difference compared to the estimations presented.

The same models as 5.1 were also estimated with slightly different data: all labour market variables were obtained for the age category 25-64 years old, as we reasoned 20 to 25 year old individuals deal differently with labour contracts than individuals with temporary contracts below 25 years old.

We also tested the effect of the level of income by adding GDP per capita as a regressor, but in no estimation it showed up to be significant. A number of other variables were also included in the specification, but did not show up significantly in either the cross-section or the panel regressions. These variables were the young dependency ratio, the Gini coefficient of disposable income and the net replacement rate for single households.

As a higher EPL index implies a larger extent of labour protection, income uncertainty decreases. Hence, via the precautionary pathway, we expect these coefficients to be negative. We added the EPL-indices for temporary workers, permanent workers and for collective lay-offs and an interaction term between $EPLtemp_{it}$ and t_{it}. These regressors did not show up to be significant in any model specification. However, the quality of the EPL data for the EU-28 region is rather poor, reducing the number of observations heavily.

The countries in the data set are heterogeneous as they are in different in unobserved characteristics and also might have different slopes for the different regressors. This increases the standard errors of the coefficients as some countries might have different slopes for some of the explanatory variables. Rocher and Stierle (2015) confirm this by exploiting FE estimations for different groups of countries, and indeed find different slopes. This might be a limiting factor in finding significant regressors.

5.1.3 Identification issues

The results presented above are however dependent on the validity of the model assumptions. We have to consider the comparison of RE and FE, the possibility of endogeneity, the possible non-stationarity, autocorrelation and heteroskedasticity.

A Hausman test showed FE to be preferred over RE in all Fixed Effects models reported. In our favoured model V, the p-value was 0.0020, rejecting that RE is correctly specified.

Exogeneity of the regressors can be tested by the following test if we estimate the following (Wooldridge, 2010):

$$y_{it} = \mathbf{x_{it}^{'}}\beta + \mathbf{w_{it+1}}\delta + \mathbf{c_i} + \mathbf{u_{it}} \tag{5.1}$$

Where $\mathbf{w_{t+1}}$ is the subset of $\mathbf{x_{it+1}}$ we want to test on strict exogeneity. This subset of exogenous variables consists of cs_{it+1}, gs_{it+1}, r_{it+1}, g_{it+1}. x_{it+1} includes all regressors of model V. The null hypothesis of this test is that the set of variables is strictly exogenous, against the alternative that these are predetermined. The F-test of joint significance has a p-value of 0.58. However, the scope of such a test is quite limited, as it only tests against the alternative that the variables in $\mathbf{w_{it}}$ are predetermined. To fully exclude all forms of non-exogeneity, one needs to consider all possible variables and make sure that they do not affect $\mathbf{w_{it}}$ via a correlation of z_{it} on y_{it}.

Non-stationarity of household savings could lead to spurious regressions. We performed the Im-Pesaran-Shin (IPS) stationarity test for all variables of model V, which has the H_0 that all panels contain unit roots. The variables s_{it}, NRR_{it}, $unemp_t$ and OAD_{it} do not reject this test at the 5% level. However, in first differences they are all found to be stationary. The nonstationarity could imply a specification issue leading to spurious regressions, limiting the interpretation of the results of 5.1[1].

Residual autocorrelation and heteroskedasticity could be present in the models presented. To prevent this from affecting our standard errors, all estimations are performed with robust standard errors, to prevent that these are biased.

5.2 Generalized Method of Moments

5.2.1 Estimating a savings model by GMM

This paragraph will discuss what choices have been made in estimating the the model of equation 3.2 with GMM. Collapsed difference GMM bias goes with an order of $1/T$. As we have $N \approx 20$ and $T \approx 15$, this bias is relatively small.

As the estimate in paragraph 5.1 is not close to unity, but also not conclusively far as this coefficient in FE is generally downward biased. However, as pointed out in section 3.2.2, system GMM has often a lower bias at a given T than difference GMM. However, system GMM makes use of the rather strict assumptions of stationarity in the dependent variable and no correlation

[1] In order to conclude that we should include variables in differences, it should be considered whether there is a cointegrated (long run) relation between the non-stationary explanatory variables. As we have panel data, we should resort to total panel data cointegration tests. Westerlund (2007) developed such a cointegration test. These tests however depends on quite a lot of variables, which demands also quite a lot observations per individual. Hence one can not perform a cointegration test with all I(1) variables. However, all tests with 3 out of 4 variables do not reject the Westerlund tests with the null hypothesis that there is no cointegration in *all* of the panels. This suggests that a model with the non-stationary explanatory variables in differences might be more appropriate.

with the unobserved heterogeneity. We continue with both types of GMM estimators and discuss their appropriateness alongside the results. As we have an unbalanced data set and differenced and lagged variables, we lose a lot of observations which reduces N, worsening the lagged dependent variable bias and the amount of instruments we can use.

As explained in section 3.2.2, FOD is preferred over FD. We use the two step estimator as discussed in appendix 5.2, but for robustness we also show some one step estimators. We also make use of the Windmeijer small sample correction for the standard deviation in the two step estimator in all cases. It is well possible that some regressors are actually not exogenous. We derived different moment conditions for strictly exogenous and less exogenous (predetermined or endogenous) explanatory variables. However, we haven't found evidence of endogeneity in our sample in section 5.1.2, so we use the moment condition for strictly exogenous regressors.

As we have a relatively large T in our model, we need to reduce the number of moment conditions related to the lagged dependent variable, which is necessary as we have a case with relatively low N compared to T. The two most obvious choices to make are including not all lags for the gmm-style instruments and 'collapsing' these lags, by only including 1 moment condition per lag by summing over all t. In the following section, both system and difference GMM are performed for different choices for the moment conditions and how to reduce the instrument count.

5.2.2 Estimation results

Table 5.2 presents the results of various GMM estimations of the model that was preferred in the FE estimations in section 5.1[2]. A sharp contrast to the FE estimation is the removal of the full set of time dummies, which led to many new regressors, for which instruments are required. However, due to the low N it was not possible to increase the number of regressors by $T-1$. Hence, we abstain from using these and stick to the crisis dummy only.

Every estimation reports the type of moment conditions, lags and whether these are collapsed or not. We use four types of moment conditions as considered in section 3.2.2.1, which can be used for different lags and by collapsing the moment conditions or not:

1. Non-collapsed Anderson-Hsiao for lag k:
   $E(y_{it-k}\Delta u_{it})$
2. Mean stationarity:
   $E(\Delta y_{it-1}u_{it})$
3. Strictly Exogenous regressor:
   $E(\Delta x_{it}\Delta u_{it})$
4. Strictly exogenous regressor uncorrelated to the unobserved heterogeneity:
   $E(u_{it}\Delta x_{it-1})$

If we impose the first moment condition we call it difference GMM, if we also use the second, we refer to it as system GMM.

[2]We have also extended our data set with OECD data: this led to a larger number of observations, but the results were rather similar, only except for the interest rate being significantly positive. This was not considered our major data set, as there is no neat division of temporary, self employed with- and without contract workers in the OECD data.

Table 5.2 reports the p-values of a test of up to 3rd order autocorrelation in the residuals, in order to observe whether the assumptions are not violated and if there are any measurement problem issues. It also presents the number of instruments used. To indicate potential instrument proliferation we also report the number of instruments. This number of instruments should of course be larger than the number of variables to be instrumented.

As the system GMM estimator assumes mean stationarity, we might question this variable. As we have seen in 5.1.2, we have a dependent variable that is not mean stationary. Table 5.3 presents robustness results for the GMM results, by not adapting the stationarity moment condition that is used in system GMM. Furthermore, it also presents two specifications that deal with non-stationarity to prevent spurious regressions by estimating non-stationary variables in differences.

From table 5.3 we observe that the estimate for sn_{it-1} is lower in difference GMM than it is in system GMM, as often found in simulations (Soto, 2009). We find that in difference GMM the estimate of the coefficient of sn_{it-1} is very dependent on which lags we used in the collapsed gmm-style instruments. These range from 0.55 to 0.90 in all specifications used, for both first differencing and first orthogonal differences. In the non-collapsed estimations for the second lag it does not appear to be significant in both difference and system GMM. This might indicate that only the second lag might not be a proper instrument for Δsn_{it-1}.
The estimate of the coefficient for disposable income growth g_{it} lies around 0.05. However, not in all estimations it is significant at a 5% level.

Unemployment seems to have a significant negative effect, contrary to what one would expect from theory. The effect is however small, being estimated below -0.10. Inflation also show up to have a negative effect that is quite persistent. The size of its coefficient is around -0.2. The interest rate does not show to have a significant effect in all regressions.

The coefficients for gs_{it} and cs_{it} are rather low, especially compared to Callen and Thimann (1997). Those two even show up insignificant for specific choices of moment equation. We also observe that both coefficients are consistently lower in system GMM than they are in difference GMM.

The labour market variables Δt_{it}, Δse_{it}, Δsew_{it} and Δavt_{it} show up insignificant in all specifications, except for Δse_{it} and Δsew_{it} having a very high positive coefficient in system GMM with second lags and Δt_{it} a negative coefficient in system GMM with second to fourth collapsed lags. We do not trust these results, and attribute these to overfitting of the instruments. When insignificant variables were removed from the model, this effect disappeared. The coefficient of nrr_{it} was estimated as negative and significant by difference GMM and to be around -0.10. It did not appear significant in the system GMM estimations. The old age dependency ratio is negative in most specifications, but barely significant. The crisis dummy shows up to be significant an positive just below 0.1 in most specifications, corroborating the suspicion that households are saving more in crisis situations.

5.2.3 Robustness

For robustness, the same procedures as for FE by including more and different regressors, except for EPL due to the missing observations, were performed, but did not yield other results for the currently present variables nor for the newly added variables.

A reason to use difference GMM instead of system GMM (or only leaving out the moment condition for mean stationarity) is that sn_{it} (and thus sn_{it-1}) is non-stationary (see section

Table 5.2: Regression results of difference and system GMM (with difference and orthogonal deviations) for different dependent variable specification. The dependent variable is sn_{it}.

GMM type	VI	VII	VIII	IX	X	XI
Moment cond.$^{\alpha}$	1,3,4 fod	c,1,3,4, fod	1,2,3,4	c,1,2,3,4	1,2,3,4, fod	c,1,2,3,4, fod
Lag structure	2	2-6	2	2-4	2	2-4
sn_{it-1}	0.451*	0.656***	0.721***	0.900***	0.722***	0.866***
	(2.25)	(5.71)	(3.89)	(10.78)	(6.67)	(11.76)
g_{it}	0.0132	0.0475	0.0540	0.0727	0.0498	0.0604
	(0.31)	(1.38)	(1.86)	(1.58)	(1.94)	(1.38)
$unemp_{it}$	-0.0724	-0.0310	-0.103*	-0.0471**	-0.0922*	-0.0600
	(-1.36)	(-0.75)	(-2.26)	(-2.96)	(-2.82)	(-1.87)
r_{it}	-0.0883	0.0256	0.0182	0.110	0.00441	0.00363
	(-0.97)	(0.30)	(0.30)	(1.92)	(0.09)	(0.05)
gs_{it}	-0.179*	-0.145**	-0.0614*	-0.0546	-0.0583*	-0.0511
	(-2.16)	(-3.56)	(-2.28)	(-1.91)	(-2.28)	(-1.63)
cs_{it}	-0.132*	-0.0951*	-0.0897*	-0.0359	-0.0778*	-0.0467
	(-2.41)	(-2.37)	(-2.20)	(-1.01)	(-2.15)	(-1.42)
nrr_{it}	-0.0420	-0.0568	0.0268	0.0135	0.0225*	0.0136
	(-1.86)	(-2.07)	(1.61)	(1.39)	(2.41)	(1.16)
Δse_{it}	-0.444	-0.236	0.0601	-0.146	0.164	-0.170
	(-0.43)	(-1.24)	(0.21)	(-0.72)	(0.55)	(-0.61)
Δsew_{it}	-0.327	-0.148	-0.0114	-0.0265	0.0305	-0.0219
	(-1.20)	(-1.22)	(-0.06)	(-0.17)	(0.14)	(-0.10)
π_{it}	-0.236*	-0.130	-0.251**	-0.113	-0.190***	-0.146*
	(-2.28)	(-1.72)	(-3.57)	(-1.89)	(-3.94)	(-2.81)
oad_{it}	-0.112	-0.0672	-0.0283	-0.00316	-0.0116	-0.0156
	(-1.39)	(-1.22)	(-1.11)	(-0.14)	(-0.37)	(-0.54)
Δt_{it}	-0.0306	-0.0666	-0.0811	-0.185*	-0.0755	-0.158
	(-0.20)	(-0.64)	(-0.86)	(-2.58)	(-0.72)	(-1.97)
Δavt_{it}	0.342	-0.0364	-0.0428	-0.0184	-0.0465	-0.00354
	(0.45)	(-0.38)	(-0.66)	(-0.31)	(-0.09)	(-0.04)
cd_{it}	0.00419	0.00596	0.0109**	0.0101*	0.00880**	0.00861
	(0.69)	(2.05)	(3.29)	(2.51)	(3.56)	(2.05)
$N_{observations}$	208	208	228	228	228	228
$N_{instruments}$	24	18	37	18	37	18
p-value ar(1)	0.0175	0.00614	0.0244	0.00906	0.00935	0.00709
p-value ar(2)	0.216	0.0468	0.0482	0.0366	0.122	0.0341
p-value ar(3)	0.367	0.243	0.126	0.0755	0.177	0.104
Hansen	0.502	0.600	1.000	0.689	1.000	0.277

$^{\alpha}$ c: collapsed moment conditions, 1-4: moment conditions used, fod: orthogonal deviations used
t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.3: Regression results of difference GMM (with orthogonal deviations) for different dependent variable specification. The dependent variable is sn_{it}.

GMM style	XII	XIII	XIV	XV	XVI	XVII	XVIII
Moment cond.$^{\alpha}$	c,1,3	1,3	c,1,3,4	1,3,4	c,1,3,4	c,1,3	c,1,3
lags	2-5	2	2-6	2	2-6	2-8	2-4
sn_{it-1}	0.623**	0.526	0.753***	0.669	0.485**	0.444*	0.639
	(3.54)	(1.46)	(6.66)	(1.95)	(3.42)	(2.38)	(1.50)
g_{it}	0.0528	0.0320	0.0658	0.0614	0.0943	0.0407	0.0619
	(1.24)	(0.77)	(1.68)	(1.75)	(1.89)	(1.28)	(1.21)
$unemp_{it}$	-0.0830*	-0.0726	-0.0993**	-0.111		0.0118	
	(-2.39)	(-1.43)	(-2.38)	(-1.71)		(0.14)	
r_{it}	-0.0313	-0.0538	-0.128	-0.0497	-0.133	0.0662	0.141
	(-0.28)	(-0.28)	(-0.17)	(-0.53)	(-0.90)	(0.44)	(0.66)
gs_{it}	-0.221***	-0.198*	-0.0988**	-0.0934	-0.0276	-0.187**	-0.147*
	(-5.06)	(-2.40)	(-2.69)	(-1.99)	(-0.52)	(-3.34)	(-2.11)
cs_{it}	-0.102**	-0.106	-0.0578*	-0.0867	-0.168***	-0.114*	-0.116*
	(-3.01)	(-1.75)	(-2.03)	(-1.79)	(-17.43)	(-2.21)	(-2.16)
nrr_{it}	-0.0914**	-0.0895	0.0171	0.0173		-0.0636	
	(-3.23)	(-1.70)	(1.34)	(0.52)		(-1.93)	
Δse_{it}	-0.332	-0.159	-0.4017	-0.430	-0.160	-0.0264	-0.157
	(-1.16)	(-0.13)	(-1.24)	(-0.91)	(-0.38)	(-0.11)	(-0.54)
Δsew_{it}	-0.294	-0.213	-0.210	-0.224	0.00587	-0.0418	-0.171
	(-1.52)	(-0.38)	(-0.76)	(-0.71)	(0.02)	(-0.24)	(-0.93)
π_{it}	-0.237*	-0.242	-0.0289**	-0.343***	-0.383	-0.231	-0.175
	(-2.74)	(-0.99)	(-3.65)	(-3.98)	(-1.93)	(-1.51)	(-1.05)
oad_{it}	-0.0905	-0.0890	-0.0289	-0.0662		-0.181	
	(-1.23)	(-0.76)	(-0.74)	(-1.29)		(-1.73)	
Δt_{it}	0.0436	-0.122	-0.0870	-0.460	-0.0615	-0.0284	-0.0115
	(0.34)	(-0.23)	(-1.02)	(-0.67)	(-0.57)	(-0.38)	(-0.07)
Δavt_{it}	0.177	0.132	0.171	0.324	0.222*	0.0308	0.139
	(1.56)	(0.19)	(1.29)	(0.49)	(2.15)	(0.31)	(0.94)
cd_{it}	0.00423	0.00604	0.00844**	0.00765	0.00165	0.00571	0.00505
	(1.32)	(1.55)	(2.39)	(2.11)	(0.55)	(1.66)	(1.39)
$\Delta unemp_{it}$					0.165		0.262**
					(1.97)		(3.08)
Δnrr_{it}					-0.00905		-0.0330
					(-0.43)		(-1.44)
Δoad_{it}					-0.0898		-0.0465
					(-0.17)		(-0.12)
$N_{observations}$	228	228	228	228	209	205	187
$N_{instruments}$	18	25	18	25	19	20	16
p-value ar(1)	0.0497	0.197	0.013	0.0556	0.0149	0.0948	0.125
p-value ar(2)	0.0263	0.126	0.154	0.433	0.651	0.0883	0.400
p-value ar(3)	0.217	0.137	0.096	0.0766	0.0938	0.115	0.120
p-value Hansen	0.542	0.450	0.384	0.967	0.963	0.751	0.535

$^{\alpha}$ c indicates collapsed, the numbers refer to moment conditions

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.1.2). It appears that the specifications only using the second lag moment conditions behave badly: they have high p-values for first order, and high p-values for second order autocorrelation. After removing the mean stationarity moment condition (2), the parameter of savings persistence still took varying values between 0.45 up to even 0.75. It also appears that the estimates for corporate and public savings decreased as we drop these moment conditions. Unemployment and crisis dummy were found not to be significant anymore.

Including the explanatory variables that might face non-stationarity in differences we observed that the persistency coefficient dropped significantly, indicating that the non-stationary variables affected the estimates. In these robust models, it was also observed that π_{it} was not significant more in most of these. The crisis dummy did not appear positive in those specifications, whereas unemployment had positive coefficient which was rather high (around 0.20).

For robustness, for all explanatory variables we removed the moment condition 4 that assumes no correlation of the explanatory variable with the individual effect in table 5.3. Models XVI and XVIII estimate the regression with the potentially non-stationary variables in differences. This affects mostly two regressors: inflation becomes insignificant and unemployment becomes significant. This can be explained by the negative correlation between those two variables and the savings rate. Estimating in differences caused both of these variables' coefficient to increase.

Models VI, VII, X, XIII and XV have too much instruments, which also makes Hansen and Dif-Sargan (see section 5.2.4) tests impossible. Also regressions XVII and XVIII face the issue that the number of instruments is relatively high with respect to the number of cross-sectional units. What we observe for system GMM is that the lagged dependent variable is overstated and the others regressors are understated/upward biased. To conclude from this, our preferred models are XII and XVI. However, both models face their own issues: model XII faces the non-stationarity issue and significant second order autocorrelation (see section 5.2.4), whereas XVI surprisingly has a non-significant coefficient for government savings.

5.2.4 Identification issues

In this section we consider the further estimation issues of the GMM approach employed. In the GMM approach several issues need to be addressed. The validity of the instruments, the stationarity assumption, measurement error, heteroskedasticity and autocorrelation will be discussed.

In every estimation we consider the Hansen test for over-identifying restrictions. If we can't reject the null of over-identifying restrictions, the instruments are valid. We use the Hansen instead of the Sargan test as the latter is not robust to heteroskedasticity leading the test statistic not to be χ^2-distributed. We present the p-value together with the results in tables 5.2 and 5.3.

The Difference-in-Sargan or C test is a test that tests a subset of instruments on their validity (Baum et al., 2003). The test statistic of this test is the difference in the well-known Hansen J statistic between the unrestricted and restricted (the set of instruments is removed). In this way we can consider whether some instruments are included falsely. This statistic is χ^2 distributed with as many degrees of freedoms as restrictions. Under the null hypothesis, the removed instruments are proper instruments. However, the restricted equation must be over-identifying to compute such a statistic. In our case, the number of instruments is just above the number of variables to be instrumented, thus in many cases we can not report it. As the Dif-Sargan can be performed for many choices of instruments, we do not report them in the main tables. We are however interested in particular in the validity of the mean stationarity moment condition. For model XI we find that applying the Dif-Sargan test on the level moment condition (2) yielded a p-value 0.143, which is similar in other specifications. Therefore, we are very cautious in interpret the results of the system GMM results where the levels equation has been used for the dependent variable. The model specification used for the derivations of the moment conditions derived from the would imply that the error term is serially uncorrelated (see appendix A.2). Therefore, the p-value of second order autocorrelation being lower than 0.10 in many specifications indicates a problem with this assumption.

If there is third order autocorrelation in the model, there might be autocorrelation in the measurement error that disturbs the estimation. Non-persistent measurement error can be mitigated by an IV approach as performed by (Dynan, 2000). As discussed in section 4.2.1, Rocher and Stierle (2015) conclude that there is very probably a measurement error that is persistent over time and differs per individual. We find in many of the estimations p-values for 3rd order autocorrelation between 0.05 and 0.10, indeed indicating a measurement error in sn_{it}

Using robust standard errors, we ensure that any heteroskedasticity and autocorrelation does not lead to biased standard errors.

5.3 Discussion

In this section we will discuss the results of the estimations. Firstly, we will reconcile the results of the FE and GMM results in the previous section. Secondly, we will reconcile the results with the theory underlying, mostly regarding the precautionary motive. Ultimately, an outlook for further research will be given.

5.3.1 FE versus GMM estimation

We have seen that the results of FE and GMM can vary as the assumptions underlying these estimators differ and those might be violated. The previous sections discussed in detail which assumptions of the GMM estimator might have been violated and which assumptions are dropped.

The lagged dependent variable coefficient is however not far off the credible estimates in GMM. The FE estimate is around 0.65, whereas the GMM estimates of credible specification range from 0.45 to 0.75. However, in system GMM, this estimate was much higher. For the other explanatory variables we see some deviations. Government and corporate savings have less pronounced coefficient values in system GMM than in difference GMM and FE.

The labour market variables are insignificant in both FE and the GMM models with exception of the t_{it}-coefficient in one FE model and two coefficents in an overfitted GMM model. The crisis dummy is significant in GMM, but not in FE, as we also included time dummies in FE. The estimates for the interest rate (both insignificant), growth (around 0.05), net replacement rate (around -0.05, but often insignificant) and the old age dependency ratio (insignificant but suspicion to be negative around -0.05) are similar in FE and GMM.

We prefer the difference specifications over the full system GMM specification, as the latter falsely accepts the stationary condition and the no unobserved heterogeneity assumption for the regressors. Furthermore, we also find that dropping the no unobserved hetereogeneity condition changes the estimations slightly, such as for the coefficient of government savings. However, the major limitation of GMM estimation compared to FE is that our N is rather small, especially compared to the number of variables we have, so also the number of instruments we need. This restricts the GMM estimation.

5.3.2 Result interpretation

5.3.2.1 Precautionary motives

We find that the three types of shares of temporary workers do not significantly influence household savings in all credible estimations. This is anticipated in section 2.2.2.3, although we would have expected a positive sign for non-precautionary motives for self-employed workers. However, we do not find this coefficient to be significantly positive. Another variable influencing income uncertainty is the net replacement rate for married households, which shows the expected sign, just as the crisis dummy variable which proxies for cautious behaviour.

The former is related to the precautionary motive, as it reduces the income uncertainty given all other determinants of income uncertainty. A higher Net Replacement Rate ensures that the income loss as a result of job loss is mitigated more.

Whether the latter is an implication of precautionary behavior is questionable. In the life cycle framework, one can argue that the start of a crisis might imply reduced future income expectations leading to lower consumption as households smoothen consumption. Those expectations might be rational or not, but in both situations the increase in savings is not of precautionary nature. However, if these households address future income in a larger range of values, they lower consumption to counter this uncertainty. However, there might be a counteracting force at work, namely through reduced household income in crisis years. This, considering consumption is not affected, reduces the savings rate via a lower disposable income. This, in its turn, does also depend on the labour market. If wages are slowly adjusting to the new situation of lower demand, the disposable income will not decrease that quickly until major lay-offs or bankruptcies take place.

The legal protection for workers might be a factor that reduces income uncertainty. However, three types of EPL indexes showed up not to be significant in explaining household savings. However, the data availability for many EU-28 countries was very limited.

Unemployment shows up to have a negative effect on savings, contrary to the theory where unemployment is a proxy for income uncertainty. If we estimate the model with unemployment in differences, this disappears and in some specifications it is even positive. This might be an effect of non-cointegrated non-stationarity.

A surprising result is that the average number of months into temporary contracts affects the household savings rate in a positive way in some specifications at a 10% level. There is not a clear indication which causes this anomaly.

As we discussed in the previous section, the effect of non-permanent contcan be really small and due to the large variety not to show up significantly. In the theory we argued that this coefficient is rather small, but we however did expect to encounter a positive effect. There are several possible explanations for this, which we summarize in a list:

- Self-selection of individuals into groups facing higher income uncertainty might lead those who better bear risk shift to higher risk jobs, both over time and over countries. In such a framework, a higher share of non-permanent contracts should coincide with a shift to less risk-averse preferences over time.

- Moreover, temporary contract workers could be on the low end of the pay scale, which would lead them to easily be able find another low end job, so there is little down side and no income uncertainty when people on the low end of the job market move from a permanent to a temporary contract, which might be credible by the evidence that a large share of new hirings involves non-permanent labour contracts. Furthermore, if these workers are part-time workers in general, the effect might be further mitigated, as their absolute uncertainty in income is rather small.

- An alternative explanation might be found in the limited income uncertainty that those non-permanent workers actually face. It might be that those workers anticipate the termination of their labour contract and might reach agreement on a new contract long before termination of the previous contract. Furthermore, as these are probably low paying jobs, the income uncertainty is lower than that of higher paying job, as the *actual* (instead of the average over the economy, which we included as a regressor) replacement rate is higher for low-paying individual. Another explanation is that a large share of these workers are workers in the start of their career that are only expecting higher levels of income, as a higher share of temporary workers might indicate expectations of favourable foresight of future employability and thus wages.

- As temporary workers are on the low end of the pay scale as they have a low marginal productivity (Battisti and Vallanti, 2013), do not work full time and often are dependent on other earners within the family (which often coincides with workers being young), it might be that the effect on savings might be different than expected.

- Furthermore, the broader effects of time-dependent flexibilisation characterised by more non-permanent contracts might have a different effect on income uncertainty as a whole. We argued that income uncertainty increases for the people employed in such a contract. However, for the total of workers these reforms might reduce income uncertainty as firms are less reluctant to hire people, keeping all other things constant. Aoyagi and Ganelli (2015) state that these temporary contract can solve unemployment spells and allow workers to fill employment history gaps.

- As we reasoned in section 2.2.2.3, the effect is expected to be rather small. As we observe a measurement error in savings (Rocher and Stierle, 2015), and maybe also in the share of workers due to different cross-country definitions, the coefficient slopes might be different per individual. This increases the standard errors of these coefficients and causes variables with a small coefficient to be insignificant.

5.3.2.2 Miscellaneous motives

- g_{it}
  The effect of growth on the savings rate was around 0.05, which is significantly lower than found by Callen and Thimann (1997), who find a coefficent of around 0.15. A mitigation of the effect of growth might be found in the highly changing demographics. The relative share of older to working and young people increased, which reduces the positive effect of productivity growth on aggregate savings, as the part of the society that saves is rather small compared to those who dissave. We also tested the implication of the LCH that income in levels did not affect the savings rate at all.

- sn_{it}

The coefficient of lagged savings from the FE estimation (around 0.65) shows up to be around the coefficient of the GMM estimations. We suspected that not accounting for the dynamics (as in FE), this estimate would be downward biased. Previous FE results showed a lower coefficient (around 0.45) (Callen and Thimann, 1997). This indicates that the coefficient estimate has increased, which can be attributed to the smaller effect of other variables such as the government and corporate savings and thus savings are relatively more dependent on past savings.
We can also compare this coefficient with the one found in micro-economic data. Although it concerns the same variable, the interpretation is vastly different. Estimations on household panel data suggest that the coefficient is around 0.2 (Alessie and Teppa, 2010). There are many variables in micro-economic estimates that also can be used in an aggregate model in the form of a share (as we do), or an average. However, many of these variables might strongly affect individual behavior but might be on average very persistent over time in average and hence end up in the sn_{it-1} coefficient in a macro equation, whereas in a micro equation it might be -observed or not- very variable for an individual. Good examples of these are demographic variables, e.g. the number of children in a household or the unemployment benefits of a specific households. In our model, this is subsumed in sn_{it}.

- r_{it}
  The interest rate does not show up to be significant, as the short run interest rate in many of the individuals in the data set are EU countries are the same. Hence, it shows up insignificant as there is very little variation.

- gs_{it}
  However, for example from theory we can expect the amplitude of some coefficients, such as that for gs_{it}, since it would be -1 if Ricardian Equivalence would hold, but much lower in the LCH model. The estimate in our estimations is lower (between -0.08 to -0.25) than with older OECD data (-0.29)(Callen and Thimann, 1997). The close economic integration of European countries might lead to a reduced dependency of own country variables on household saving.

- cs_{it}
  The corporate savings rate shows a coefficient of around -0.10, which is lower than the coefficient from previous literature, which was around -0.25 (Callen and Thimann, 1997). As with government savings, the close economic integration of European countries might lead to a reduced dependency of own country variables on household saving.

- π_{it}
  The inflation shows up to be strongly negative, opposite to previous literature. This disappears if the possible stationary variables are estimated in differences. In Rocher and Stierle (2015) a between estimation is performed of the difference between the current period inflation and average inflation of that individual country, which has also a very negative coefficient (-1.28), which is subsumed in c_i in our model. This suggests that economies with higher inflation save less, but that the relative increase of inflation compared to a county's average barely affects saving

- $Gini_{it}$
  The life cycle theory describes that some motives for savings only arise in very wealthy households, such as the motive for 'warm glow' bequests. However, a larger gini coefficient (corresponding to a more convex Lorentz curve) does not affect the savings ratio.

5.3.3 Further Research

This thesis showed that it is possible to pursue a GMM approach for a savings regression, but due to the low N panel and the absence of several observations, selecting the proper moment consitions is hard and somewhat arbitrary. In the future, using a larger dataset might mitigate this issue. Another limiting factor was the measurement error in savings, for which we found indications in the GMM procedure. Applying corrections to the savings rate as suggested in recent literature could reduce this issue (Rocher and Stierle, 2015).

The share of total worker variables for non-permanent labour contracts can be really rough measures and do not reflect properly what situation an average individual is in. Not in the last place this is due to a large variety in definition of non-permanent labour contracts. The "Main reason for the temporary employment"-table of Eurostat may be able to shed more light on the situation of temporary workers. The several categories in this table range from *education* or *training* to *could not find a permanent job*. In the former case it is much more likely that the employee will be having a job afterwards and faces little income uncertainty, but in the latter it is more likely. However, many observations are missing in such data sets.

The explanation that the share of non-permanent contracts does not affect households due to the total effects of labour market reforms related to these contracts on income uncertainty, can be tested in micro-economic panels when the labour contract of the individual is known. Then one can separate out the effect on income uncertainty on the holders of non-permanent contracts and the effect on all households.

Chapter 6

Conclusion

In brief, this thesis adressed mainly two issues: the estimation of the aggregate savings rate in a GMM framework and in particular the effect of the contract structure of the labour market on the precautionary part of household savings in the EU-28 region between 2000 and 2016. After considering the determinants of aggregate household savings in the theoretical framework of the Life Cycle Hypothesis, precautionary savings and habit formation were emphasised.
To estimate a functional form in which savings are explained by aggregate macro-economic and labour market variables based on theory, a data set was constructed with available data from a subset of countries within the EU-28 zone with data from Eurostat and OECD.

Firstly, the estimation was performed in a Fixed Effects framework as previous literature also estimated aggregate savings models used FE for panel data (Callen and Thimann, 1997; Rocher and Stierle, 2015). Secondly, it was performed by the system and difference GMM estimators, which use internal moment conditions. The validity of system GMM estimation was limited by the moment conditions that assumed mean stationarity of aggregate household savings and no correlated unobserved heterogeneity. This reduction to difference GMM led to more credible estimation surpassing the biases in FE and system GMM. We have shown that GMM estimation for dynamic panel data models can also be used for macro-economic estimations. However, the restriction of low N increases the bias of the estimates and even more importantly, the limited freedom in selecting the most relevant moment conditions.

The results showed that higher share of workers in non-permanent labour contracts did not affect aggregate savings through the precautionary motive. However, it was shown that two other coefficients proxying income uncertainty (the net replacement rate and the crisis dummy) did affect household savings. We furthermore found a decrease in importance of government and corporate saving on household saving, attributable to European integration. Also income growth impacted savings less than found in previous estimates.

I suggested various factors that could be responsible for reducing the ability to measure the effect and the size of the proposed effect. The measurement error in household savings and heterogeneity might have been responsible for small effects being insignificant in estimation. Although we expected to find the contract structure to affect savings, our estimates from empirical targets of households already suggest a very moderate effect on savings.

Self-selection of individuals in labour contracts with higher income uncertainty, the different nature of temporary contracts related to pay and the income uncertainty resulting from that, the anticipation of these workers to secure future income, the dependency of the holder of the non-permanent contract on other income earners within the household and the fact that overall income uncertainty might be lowered by a more flexible labour market could all have been responsible for mitigating or even reversing effects on household savings.

Finally, I suggest that accounting for the measurement error, further exploiting more details of the contract structure of the labour market, and applying a micro-economic analysis which allows for separating the effect on workers in specific contracts from that on other workers could shed more light on the relation between the share of non-permanent labour contracts on household saving behaviour.

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Appendix A

Appendices

A.1 Models of household savings

A.1.1 Life-Cycle Hypothesis

We have agents of a life span $N + M$ (earnings span plus retirement span) equal to L (life span of economic significance). This person has assets a_t in the beginning of year t, savings rate r, non-interest income y_t, consumption c_t and saving s_t in the year t. The individual obtains utility from present and prospective future consumption and final assets:

$$U_t = U(c_t, c_{t+1}, ..., c_L, a_{L+1}) \tag{A.1}$$

Which is subject to the lifetime budget constraint at all t, where future consumption, income and assets are discounted with a constant interest rate r:

$$a_t + \sum_{\tau=t}^{N} \frac{y_t}{(1+r)^{\tau+1-t}} = \frac{a_{L+1}}{(1+r)^{L+1-t}} + \sum_{\tau=t}^{L} \frac{c_t}{(1+r)^{\tau+1-t}} \tag{A.2}$$

Where we have lifetime income discounted to t on the left hand side and discounted expenditures and leftover assets to t. To solve this model for the optimal λ^*, c_t^* and a_{L+1}^*, we use the Lagrangian constrained optimization method, leading to the following first order conditions:

$$\frac{\partial U}{\partial c_\tau} = \frac{\lambda}{(1+r)^{\tau+1-t}}, \text{for } \tau = t, t+1, ...L \tag{A.3}$$

and

$$\frac{\partial U}{\partial a_{L+1}} = \frac{\lambda}{(1+r)^{L+1-t}}$$

where λ is the Lagrange multiplier.

This system has a unique solution for an identified multiperiod utility function. In such a life-cycle model, current income, $y_t + ra_t$, can be unequal to that period's consumption, c_t, driven by two motives, which we further on refer to as *Life cycle motives*:

Motive I: The bequest motive arises when there is a desire that is reflected in the utility function leading to $a_{L+1}^* > a_t$.

Motive II: The motive to smoothen consumption arises when preferred consumption c_t^* does not coincide with the pattern of current and prospective income. This leads to the strong conclusion that there might not be a strong relation between consumption and income in the short run. This consideration shows that the retirement motive also rests on this motive.

Modigliani and Brumberg (1954) identify that their model might be leading to other motives, if the agent faces uncertainty:
Motive III: The agent under uncertainty may have a desire to let income exceed consumption to increase wealth to meet possible emergencies whose occurrence, nature and timing can't be foreseen.
Motive IV: The agent under uncertainty wants to purchase assets that are durable and consumed over a longer period of time. Under no uncertainty, this person could always borrow this asset against the risk free rate. However, introducing uncertainty leads the individual to contribute at least a share of his own wealth in this asset.

An absolute novelty of the LCH theory is that it abolishes the idea of the representative agent, but rather a population of agents that express different behavior over the life cycle. The aggregation over these agents in different stages of the life cycle produces interesting expectations on the macro-economic level (Deaton, 2005).
To obtain a closed form solution for the consumption-savings decision in the model presented, we require some additional assumptions:

1. An individual starts of without any assets, ignoring the motive to bequeath for now, implying:

   $a_1 = 0$, $a_{L+1} = 0$

2. The utility function is a function such that the individual his tastes, and not his resources, affect the proportion of resources devoted to consumption in τ considered in t, implying: $c^*_\tau = \gamma^t_\tau \nu_t$
   Where ν_τ are the lifetime future resources: $\nu_t = a_t + \sum_{\tau=t}^{N} \frac{y_t}{(1+r)^{\tau+1}}$,
   where γ^t_τ depends on the utility function and interest rate and indicates what fraction of total resources ν_t is spent.

3. An individual plans to spend resources evenly of his time span, implying:
   All γ^t_τ are equal. This is in further literature internalised in utility functions that are characterised by a diminishing marginal effect of consumption.

4. The interest rate is 0 ($r = 0$)

Leading to the following consumption and savings functions for individuals:

$$c = \frac{1}{L_t} y + \frac{N-t}{L_t} y^e + \frac{a}{L_t} \tag{A.5}$$

and

$$s = y - c \tag{A.6}$$

Where all undated variables are for the period τ and t is the current period where the consumption decision is made. y^e is the expected future income in periods t up to N. As can be seen from the above equation, the marginal propensity to consume thus depends on the partial derivative of y to y^e among others.

Hence, as we can't empirically test this theory on an individual level (since savings has only a single value for an individual at a specific age - remember that we got rid of the representative agent assumption!), we think of how it revolves in a cross-section of individuals. The difference between a cross-section and an individual is illustrated in the following relevant example:
For an individual, its assets at the beginning of period t do not change due to a change in income in period t. In other words, $\frac{\partial a}{\partial y} = 0$. However, for a cross-section this might not hold true as households with higher income, hold more assets, so $\frac{\partial a}{\partial y} > 0$. The other way around is also the case, as the behavior of the group does not fully allow us to explain what happens on the individual level.

The assumptions allow us to derive cross-sectional relations between assets, savings and income. This leads to the following predictions, which also hold for slightly modified cases of Modigliani and Brumberg (1954):

- The marginal propensity to consume increases over age
- Consumption is flat over lifetime when income is stationary
- Assets increase (linearly) over the working life
- Assets decrease (linearly) over the retirement life
- Transitory innovations in income for an individual do not lead to sharp reactions in consumption

The addition of uncertainty to the model will absolutely alter the results but not drastically. Modigliani and Brumberg (1954) state that the assets saved (for life cycle motives) might be also suitable for other motives. The uncertainty in the length of life also demands to hold more assets, as given by **Motive III** and **IV**. However, the various types of uncertainty are likely to be independent of each other. Ando and Modigliani (1963) note that although assets can satisfy several purposes, their efficiency will not be the same in all respects. For instance, those assets which are best suited to satisfy **Motive IV** are generally not very well suited to satisfy **Motive III**.
The importance of the motives vary over individuals over the life cycle and also the type of assets related to the motives. Uncertainty might not be that essential in explaining the overall rate of saving, as already a large pile of net wealth is saved for retirement in life cycle savings. The effect of uncertainty on savings is further discussed in section 2.2.2.

A closely related theory, suggested by Friedman (1957) is the Permanent Income Hypothesis (PIH). This theory assumes that life is infinitely long and that consumption relies on *permanent income*, rather than on current income, which could largely rely on *transitory income*. From this proposition in combination with the basic propositions of LCH it follows that individuals consume at a stable rate since most of income fluctuations are transitory. Hence, transitory income is an important determinant of savings and permanent income is not. However, as Deaton (2005) notes, consumers in practice do not smoothen consumption over their entire lifetime, but shorter periods of time, since they are hindered by liquidity constraints and a large uncertainty in future income.

Modigliani and Brumberg (1979) discusses the aggregate effects of the life cycle theory and formalizes this with a set of propositions. The propositions on aggregate savings can be summarized:

- The savings rate of an aggregate economy is independent of its per capita income.
- The savings rate is not a result of the differential thrift of the citizens: different national savings rates can be underlying the same behavior of the citizens, but other demographics.
- The higher the rate of long run income growth, the higher the savings rate will be.
- An economy can accumulate a substantial life cycle stock of wealth without a bequest motive present.
- The main parameter in determining life-cycle wealth-to-income ratio and savings rate is the (expected) length of retirement.

To understand these macro-economic implications of the life cycle model on the rate of saving we write the following:

$$s = \frac{S}{Y} = \frac{\Delta W}{W}\frac{W}{Y} = \gamma w \tag{A.7}$$

$$\frac{ds}{d\gamma} = w + \gamma \frac{dw}{d\gamma} \tag{A.8}$$

Here, w is the wealth-to-income ratio, γ is the growth rate of income (and also wealth, which is a simplifying assumption) and s is the savings-to-income ratio (often referred to as the savings rate). Here, we have assumed the economy grows steadily, with no deviations in income.

The sign and size of the partial derivative of w to γ depends on what kind of growth one assumes. If this growth is due to population growth, the young savers present a larger share of the population then the dissaving old. However, young people also hold lower wealth-to-income ratios, which reduces the latter effect through the first term on the right hand side of equation A.8.

If the growth is due to productivity growth, younger individuals have higher lifetime resources than older individuals, causing savings of the young to be higher than dissaving of the old. Interestingly, this effect does not exist in Friedman's PIH model as it is assumed that life is infinite and thus lifetime resources are independent of age.

The critique of James Tobin to this reasoning is that at young age many young people also dissave and that high growth in an extreme case growth could even lead to a *lower* savings rate. The validity of this critique is however largely depending on the existence of a constraint to borrow, as many of these young individuals do not have wealth at hand to deplete.

If we assume that the age profile of wealth is independent of growth, we find $\frac{ds}{d\gamma} = w = M/2$, with M the retirement length[1]. Hence, a longer retirement length increases the slope of growth to savings.

From the previous notions we can construct a very simple aggregate consumption function. Compared to the individual consumption function of equation A.5, the dependency on age drops out and the length of retirement and total live are subsumed in coefficients α and δ. YL is the aggregate labour income and W is aggregate wealth, which is a generalization of assets:

$$C = \alpha YL + \delta W \tag{A.9}$$

This result differs from the Keynesian consumption function, which is based on the idea that saving is a kind of superior consumption good, most resembling a 'luxury' good (Keynes, 1936). However, savings are expected to be negative if income is below a certain threshold. To formalize this, the Keynesian consumption function would be also linear in labour income with a positive intercept, but not depending on wealth.

We can test the aforementioned aggregate effects against extensions of the theory by relaxing assumptions of zero interest rate, exogenous retirement age and certain lifetime.
Dropping the assumption that $r = 0$ leads to two offsetting effects. The extra income rW increases C via the income effect, but the relative cost of consumption will increase as well. In the case the elasticity of substitution is 0, a higher rate of interest implies a lower savings rate, since consumption is closer to income. If substitution is positive, initial consumption is lower and increases exponentially, leading savings to decrease again. Hence, the effect of interest on the rate of savings is ambiguous.

Dropping the assumption that the span of retirement is fixed has its implications. Higher productivity could also lead to a different choice of the length of retired life, what was regarded as exogenous up to this point. The choice for a longer retirement life might be feasible at higher income, but is coinciding with the choice for higher savings. However, there is also counteracting substitution effect due to the increase in the opportunity cost related to retiring as income has increased. Via this income and substitution channels the level of income Y could affect the savings rate.

Dropping the assumption that an individual has a known span of life, initiates the motives of bequests. A relevant puzzle in the savings literature is the size of the role of bequests, which can be decomposed in two motives: bequests to insure against living longer than the expected lifetime and bequests due to a 'warm glow' of leaving wealth to beloved ones. In the case of the first one would expect individuals to save in retirement annuities to mitigate this risk. Adverse selection problems (healthy individuals take annuities, others don't), actual 'warm glow' feelings and the co-use of assets for other motives than life cycle motives might be reasons why people do not take annuities in practice. It is found that only the top 20% income households actually engage in saving for the real bequest motive, as bequests rise faster than their total resources (Hurd, 1986). Hurd (1986) estimate the total share of bequest motive related wealth in total wealth is estimated to be 1/5. Therefore, even without a bequest motive households engage in significant saving.

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[1]This relation can be understood by the following explanation. In a stationary economy, $\gamma = 0$, implying a simple relation between income and consumption: $C = \frac{N}{L}Y$. The total wealth one need for retirement then is $W^* = \frac{MN}{L}Y$. As the distribution if individuals in such a stationary economy is flat, the total wealth held equals $W = \frac{1}{2}LW^* = \frac{1}{2}MNY$ (as the wealth profile of age is a triangle, with the top at N). As total income is Ny it simply follows that the aggregate wealth-to-income ratio is $\frac{M}{2}$.

Some interesting conclusions related to macro-economic policies can be drawn from the extended life cycle model. The Ricardian Equivalence proposition by Barro (1974) states that government deficits will be counteracted by higher private savings to anticipate to higher taxation for further generations, such that is has a similar effect if a government expenditure is financed by a tax increase. However, in the Life Cycle model, private saving does not depend on current taxation and thus government deficits are not anticipated by higher private saving and the LCH thus predicts Ricardian equivalence not to hold[2].

A.1.2 Precautionary Savings

Most of the more elaborate models concerning utility analysis of a household's consumption-saving decisions over its life-cycle is performed with the Friedman's PIH as it allows for closed-form solutions for consumption and savings (Alessie and Lusardi, 1997). We present a simplified version of the model of Alessie and Lusardi (1997). Firstly, we assume the following Constant Absolute Risk Aversion (CARA) utility function:

$$u(c_\tau) = -\frac{1}{\theta} e^{-\theta(c_\tau - \gamma c_{\tau-1})} \tag{A.10}$$

Where γ is the strength of the habit: the larger it is, the less utility is derived from a certain level of consumption with respect to previous consumption. θ is the coefficient of absolute risk aversion. Agents maximizes *expected* lifetime utility, discounted by the rate of time preference ρ. Furthermore, we assume a random walk of income with normally distributed innovations. Note that this introduces uncertainty to the labour income.

$$y_{\tau+1} = y_\tau + w_{\tau+1} \tag{A.11}$$

where

$$w_{\tau+1} \sim N(0, \sigma^2) \tag{A.12}$$

And we can conveniently write the budget equation as follows:

$$\sum_{\tau=t}^{\infty} \frac{c^*_\tau}{(1+r)^{\tau-t}} = -\gamma c_{t-1} + \left(1 - \frac{\gamma}{1+r}\right)\left[(1+r)A_{t-1} + \sum_{\tau=t}^{\infty} \frac{y^*_\tau}{(1+r)^{\tau-t}}\right] \tag{A.13}$$

Where the term in square brackets is permanent income, which is the total lifetime income if we take its expectation value. Here we have substituted $c^*_\tau = c_\tau - \gamma c_{\tau-1}$ and assumed $r = \rho$. Alessie and Lusardi (1997) show that it yields the following Euler Equation:

$$e^{-\theta c^*_\tau} = E_t\left(e^{-\theta c^*_{\tau+1}}\right) \tag{A.14}$$

And we guess that the solution is a martingale with drift, that needs to obey equation A.14:

$$c^*_{\tau+1} = c^*_\tau + \Gamma_\tau + w_{t+1}\left(1 - \frac{\gamma}{1+r}\right) \tag{A.15}$$

[2]A consumption function that depends on wealth has also police implications. Via the market value of assets, monetary policy is able to affect aggregate demand, contrary to the Keynesian result. Furthermore, restraining or boosting demand by transitory income taxes has a very small effect on consumption in the LCH model, as the permanent income is barely affected by a transitory tax. Hence, taxes on consumption are fairer than taxes on income, as they only tax the permanent component of income, and not the transitory components.

Plugging A.15 into A.14 and reducing leads to:

$$e^{-\theta\Gamma_\tau} = E_t\left[e^{-\theta w_{\tau+1}}\right] \tag{A.16}$$

And after rewriting we find:

$$\Gamma_\tau = \Gamma = \theta\frac{\sigma^2}{2}\left(1 - \frac{\gamma}{1+r}\right)^2 \tag{A.17}$$

And we see that Γ_τ is independent of τ due to the chosen form of the income path. σ^2 is the variance of the innovations $w_{\tau+1}$.

Using the budget constraint, and the solution for $e^{-\theta c^*_\tau}$, we find optimal consumption:

$$c_t = \frac{\gamma}{1+r}c_{t-1} + \left(1 - \frac{\gamma}{1+r}\right)[Y_{pt}] - \left(1 - \frac{\gamma}{1+r}\right)^2 \frac{\theta\sigma^2}{2r} \tag{A.18}$$

Where $Y_{PT} = \frac{r}{1+r}\left[(1+r)A_{t-1} + \sum_{\tau=t}^{\infty}\frac{y^*_\tau}{(1+r)^{\tau-t}}\right]$ is the permanent income. We observe that when $\gamma = 0$ we obtain the standard result without habit formation, where the last right hand side term is the precautionary motive. The residual consumption is determined by permanent income. We note that the transitory income innovations do not enter the consumption equation, similar to the standard LCH. The last step to perform is to rewrite the consumption in a savings function:

$$s_t = s_{t-1} + \frac{\gamma}{1+r}\Delta y_t - \left(1 - \frac{\gamma}{(1+r)}\right)\sum_{\tau=t}^{\infty} E_t\Delta y_\tau + (1-\gamma)\left(1 - \frac{\gamma}{1+r}\right)^2 \frac{\theta\sigma^2}{2r} \tag{A.19}$$

We also observe that in the equation above the precautionary term also negatively depends on the habit parameter γ. Hence, the stronger the habit, the weaker the precautionary effect as it is suppressed by the desire to keep consumption up with previous consumption. One could argue that this result is mainly obtained due to the convenient choice of the utility function. Literature dealing with (numerical) solutions for other specifications yielded similar results (Alessie and Teppa, 2010).

In the no habit formation case the presented model states that consumption is depressed by a constant term depending on the strength of the CARA risk aversion parameter, θ. However, over multiple periods it will imply that the amount saved ($a_t = a_0 + s_1 + s_2 ... + s_t$) for precautionary reasons depends on the number of periods this person faced this income risk. This is a result that is quite counter-intuitive, as one would expect that the total wealth saved reflects the strength of the precautionary motive . Another model of counteracting forces of risk aversion and willingness to consume, the buffer stock model of precautionary savings, yields more reasonable results.

A.2 GMM estimator

A.2.1 Moment conditions

Different GMM estimators are based on more moment conditions that rely on different assumptions.

We start off with equation 3.8, where $u_{it} = \epsilon_{it} + c_i$. The basic assumptions for the difference GMM estimator are that the errors have mean 0 and that the error term is uncorrelated to the unobserved fixed effect (Blundell et al., 2000):

$$E(c_i),\ E(u_{it}),\ E(u_{it}c_i), \text{ for } i = 1, ..., N, \text{ and } t = 2, ..., T$$

And we assume that the errors are not correlated, that is:

$$E(\epsilon_{it}\epsilon_{is}), \text{ for } i = 1, ..., N \text{ and } t \neq s$$

And furthermore assume the initial condition for the dependent variable:

$$E(y_{i1i1}), \text{ for } i = 1, ...N \text{ and } t = 2, ...T$$

These three moment conditions validate the use of moment condition set 1 as stated in 5.2:

$$E(y_{t,t-2}\Delta u_{it}) = 0, \text{ for } t = 3, ...T \text{ and } 2st - 1$$

which are $\frac{1}{2}(T-1)(T-2)$ moment conditions

If we now also assume mean stationarity in y_{it} we write:

$$E(c_i\Delta y_{i2}) = 0, \text{ for } i = 1, ..., N$$

Which is a further restriction on the initial condition of y_{i1} and we can write moment condition set 2:

$$E(u_{it}\Delta y_{i2}) = 0, \text{ for } t = 3, ..., T$$

This gives $T - 2$ moment conditions

When adding other regressors, we can set up different types of moment conditions. If the regressors are strictly exogenous, we can write:

$$E(x_{is}\Delta u_{it}) = 0, \text{ for } t = 3, ..., T \text{ and } ssT \tag{A.20}$$

Whereas not all these moment conditions are zero for $s > t$ if x_{it} is predetermined and for $s \geq t$ if x_{it} is endogenous. In these cases the first-difference moment conditions remain valid. This gives T(T-2) moment conditions

Under the assumption Δy_{it} and Δx_{it} are uncorrelated with the individual specific effect c_i, we use:

$$E(u_{it}\Delta x_{it}) = 0, \text{ for } t = 2, ...T \tag{A.21}$$

Giving T-2 moment conditions.

A.2.2 GMM estimation

To give an idea how these moment conditions can be implemented to an estimator we give the following simple example. A convenient way to write the dependent variable moment conditions of e.g. difference GMM without a GMM-style regressor is the following:

$$E(\mathbf{Z}_{\mathbf{di}}^{'}\mathbf{\Delta u_i}) = \mathbf{0}$$

Where the $(T-2)\times(T-2)$ matrix $\mathbf{Z_{di}}$ (the number of columns are the number of moment conditions) is :

$$\mathbf{Z_{di}} = \begin{bmatrix} y_{i1} & 0 & ... & 0 & 0 \\ 0 & y_{i2} & ... & 0 & 0 \\ . & . & . & . & . \\ 0 & 0 & ... & y_{it-3} & 0 \\ 0 & 0 & ... & 0 & y_{it-2} \end{bmatrix}$$

and the vector $\mathbf{\Delta u_i}$

$$\mathbf{\Delta u_i} = \begin{bmatrix} \Delta u_{i3} \\ \Delta u_{i4} \\ . \\ . \\ u_{iT} \end{bmatrix}$$

Where one can see we used all lags and collapsing in difference GMM, implying as much moment conditions as columns. This leads to the following GMM estimator for the lagged dependent variable:

$$\hat{\gamma}_d = (\mathbf{\Delta y}_{-1}^{'}\mathbf{Z_d W_N Z_d^{'} \Delta y_{-1}})^{-1}\mathbf{\Delta y}_{-1}^{'}\mathbf{Z_d W_N Z_d^{'} \Delta y}$$

Where Δy, Δy_{-1} and Δu are stacked across individuals and $\mathbf{W_N}$ is the optimal weights matrix, making use of the residuals of an initial consistent estimator $\widehat{\Delta u_i}^{'}$:

$$\mathbf{W_N} = \left(\frac{\mathbf{1}}{\mathbf{N}}\sum_{\mathbf{i=1}}^{\mathbf{N}} \mathbf{Z}_{\mathbf{di}}^{'}\widehat{\mathbf{\Delta u_i}}\widehat{\mathbf{\Delta u_i}}^{'}\mathbf{Z_{di}}\right)^{-\mathbf{1}}$$

Which gives the so-called two-step estimator.

A.3 Disclaimer of variables

In this appendix, the source, method of collection and use of every variable used in the analysis of the main text will be clarified. Data modifications and the way of dealing with missing data will be mentioned as well.

A.3.1 Raw variables

1. **Net savings**
   The net savings are obtained from Eurostat from the (*nasa_10_ki*)-table for households.

2. **Net disposable income**
   The net disposable income is obtained from Eurostat from the (*nasa_10_nf_tr*)-table for households.

3. **Gross savings**
The gross savings are obtained from Eurostat from the ($nasa\_10\_ki$)-table for households.

4. **Gross disposable income**
The Net disposable income is obtained from Eurostat from the ($nasa\_10_{tr}$)-table for households.

5. **Net household lending rate ($hhlend_{it}$)**
The Net household lending is obtained from the (National Accounts)-database of OECD as a percentage of GDP

6. **Share of fixed-term labour contracts (t_{it})**
The share of fixed-term labour contracts is obtained from Eurostat from the ($lfsa\_esgan$)-table.

7. **Share of fixed-term labour contracts for employees between 20 and 64 (t_{it})**
The share of fixed-term labour contracts is obtained from Eurostat from the ($lfsa\_esgan$)-table.

8. **Number of self-employed workers without employees between 15 and 64**
The number of self-employed employees without employees is obtained from Eurostat table $lfsa\_esgan$.

9. **Number of self-employed workers with employees between 15 and 64**
The number of self-employed employees with employees is obtained from Eurostat table $lfsa\_esgan$.

10. **Number of employed persons between 15 and 64**
The number of employed persons is obtained from Eurostat table $lfsa\_esgais$. Employed persons are persons aged 15 and over who performed work, even for just one hour per week, for pay, profit or family gain during the reference week or were not at work but had a job or business from which they were temporarily absent because of, for instance, illness, holidays, industrial dispute, and education or training.

11. **Number of self-employed workers without employees between 20 and 64**
The number of self-employed employees without employees is obtained from Eurostat table $lfsa\_esgan$.

12. **Number of self-employed workers with employees between 20 and 64**
The number of self-employed employees with employees is obtained from Eurostat table $lfsa\_esgan$.

13. **Number of employed persons between 20 and 64**
The number of employed persons is obtained from Eurostat table $lfsa\_esgais$. Employed persons are persons aged 20 and over who performed work, even for just one hour per week, for pay, profit or family gain during the reference week or were not at work but had a job or business from which they were temporarily absent because of, for instance, illness, holidays, industrial dispute, and education or training.

14. **Old-Age dependency ratio** (oad_{it})
The Old-Age dependency ratio is obtained from Eurostat from the (*demo_pop*)-table where dependent people are aged 15-64.

15. **Inflation rate** (π_{it})
The HICP inflation rate is obtained from Eurostat from the (*prc_hicp_aind*)-table.

16. **Nominal interest rate** ($rnom_{it}$)
The 3-month nominal interest rate is obtained from Eurostat from the (*irt_st*)-table. This data was extended by adding data for Norway from the OECD.

17. **Government surplus rate** (gs_{it})
The government surplus rate is obtained from Eurostat from the (*gov_10dd_edpt*)-table for the general government as a percentage of GDP.

18. **Net Corporate savings**
The Net corporate savings are obtained from Eurostat from the (*nasa_10_nf_tr*)-table for the corporate, non-financial, sector.

19. **Gross Corporate savings**
The Gross corporate savings are obtained from Eurostat from the (*nasa_10_nf_tr*)-table for the corporate, non-financial, sector.

20. **Net Corporate lending rate** (cs_{it})
The Net corporate lending is obtained from the National Accounts database of OECD.

21. **GDP** (gdp_{it})
The GDP is obtained from Eurostat from the (*nama_10_gdp*)-table.

22. **Unemployment cash benefits rate** (ub_{it})
The total cash expenditures of governments for unemployment benefits obtained from Eurostat from the (*spr_exp_fun*)-table as a percentage of GDP.

23. **Unemployment rate between 15 and 64 years old** ($unemp_{it}$)
This quantity is obtained from eurostat table lfs.

24. **Unemployment rate between 20 and 64 years old** ($unemp_{it}$)
This quantity is obtained from eurostat table lfs.

25. **Employment Protection Legislation for collective dismissals** ($eplc_{it}$)
We obtained the EPL index from the OECD's (Labour)-database for collective dismissals

26. **Employment Protection Legislation for permanent workers dismissals** ($epli_{it}$)
We obtained the EPL index from the OECD's (Labour)-database for dismissals of permanent workers

27. **Employment Protection Legislation for temporary workers dismissals** ($eplt_{it}$)
We obtained the EPL index from the OECD's (Labour)-database for dismissals of temporary workers

28. **Initial Net Replacement Rate for a single household ($nrrs_{it}$)**
This quantity is obtained from OECD's (Social protection and well-being)-database for a single person for the initial net replacement rate of income after unemployment.

29. **Initial Net Replacement Rate for a married family with two children ($nrrm_{it}$)**
This quantity is obtained from OECD's (Social protection and well-being)-database for a single person for the initial net replacement rate of income after unemployment.

30. **Gini coefficient ($gini_{it}$)** The Gini coefficient is obtained from Eurostat table ilc

A.3.2 Derived variables

- **Net household savings(sn_{it})**
This quantity is derived by dividing the net savings by the net disposable income: $((A.3.1.1)/(A.3.1.2))$

- **Gross household savings rate(sg_{it})**
This quantity is derived by dividing the gross savings by the gross disposable income: $((A.3.1.3)/(A.3.1.4))$

- **Net household savings per GDP($sngdp_{it}$)**
This quantity is derived by dividing the net savings by GDP: $((A.3.1.3)/(A.3.1.21))$

- **Gross household savings per GDP($sggdp_{it}$)**
This quantity is derived by dividing the gross savings by GDP: $((A.3.1.3)/(A.3.1.21))$

- **Share of self-employed workers without employees between 15 and 64 (se_{it})**
This quantity is derived by dividing the number of self employed workers without employees by the total number of employed persons: $((A.3.1.8)/(A.3.1.10))$

- **Share of self-employed workers with employees between 15 and 64 (sew_{it})**
This quantity is derived by dividing the number of self employed workers with employees by the total number of employed persons: $((A.3.1.9)/(A.3.1.10))$

- **Share of self-employed workers without employees between 20 and 64 (se_{it})** This quantity is derived by dividing the number of self employed workers without employees by the total number of employed persons: $((A.3.1.11)/(A.3.1.13))$

- **Share of self-employed workers with employees between 20 and 64 (sew_{it})**
This quantity is derived by dividing the number of self employed workers with employees by the total number of employed persons: $((A.3.1.12)/(A.3.1.13))$

- **Real rate of interest (r_{it})**
This quantity is derived by subtracting the inflation rate from the nominal interest rate: $((A.3.1.15) - (A.3.1.16))$

- **Net corporate savings rate (csn_{it})**
This quantity is derived by dividing the net corporate savings by GDP: $((A.3.1.20)/(A.3.1.21))$

- **Gross corporate savings rate (gs_{it})**
This quantity is derived by dividing the gross corporate savings by GDP: $((A.3.1.19)/(A.3.1.21))$

- **Income growth of net disposable income (g_{it})**
  This quantity is derived by computing the change in ($A.3.1.2$) and then subtract ($A.3.1.15$).

- **Average number of months in temporary contract (avt_{it})**
  The average number in months is calculated by the author from the (lfs_etgadc)-table from Eurostat. However, these are mentioned in categories with a range of months and there is a $>$ 36 months category. The midpoint of these categories is chosen as a best estimate for the average number of months still in contract for workers in a specific category.

- **Crisis Dummy (cd_{it})**
  The crisis dummy is calculated by the author from the GDP(($A.3.1.21$)). If a country i at date t has a negative gdp_{it} growth, will have a crisis dummy equal to 1 if real net disposable income is negative, and 0 otherwise.

A.4 Correlation structure

Table A.1: Correlation table between the variables used in the regression analysis. We observe moderate correlations, except between the explanatory variable and its one period lagged variable, and between the two types of net replacement rates.

	sn_{it}	sn_{it-1}	Δt_{it}	Δsew_{it}	Δse_{it}	Δavt_{it}	g_{it}	r_{it}	gs_{it}	cs_{it}	π_{it}	oad_{it}	$nrrs_{it}$	$nrrm_{it}$	u_{it}	cd_{it}
sn_{it}	1	0.95	0.06	0.00	-0.02	0.08	0.25	0.01	0.19	-0.41	-0.20	-0.06	0.39	0.50	-0.42	-0.10
sn_{it-1}	0.95	1	0.12	0.02	-0.03	0.04	0.19	-0.04	0.17	-0.40	-0.14	-0.05	0.38	0.50	-0.39	-0.17
Δt_{it}	0.06	0.12	1	0.05	-0.13	0.02	0.04	0.15	-0.06	0.01	-0.10	-0.12	-0.04	-0.10	0.08	-0.19
Δsew_{it}	0.00	0.02	0.05	1	-0.71	-0.02	-0.14	-0.18	-0.11	0.10	-0.03	0.06	-0.01	0.02	-0.00	0.10
Δse_{it}	-0.02	-0.03	-0.13	-0.71	1	-0.11	0.06	0.06	0.07	0.02	-0.03	-0.14	0.03	0.00	-0.06	-0.00
Δavt_{it}	0.08	0.04	0.02	-0.02	-0.11	1	0.07	-0.04	0.11	-0.11	0.00	-0.05	0.15	0.11	-0.02	0.03
g_{it}	0.25	0.19	0.04	-0.14	0.06	0.07	1	0.23	0.33	-0.29	-0.12	-0.25	0.10	0.08	-0.30	-0.56
r_{it}	0.01	-0.04	0.15	-0.18	0.06	-0.04	0.23	1	0.33	-0.08	-0.26	-0.34	-0.02	-0.10	-0.12	-0.14
gs_{it}	0.19	0.17	-0.06	-0.11	0.07	0.11	0.33	0.33	1	-0.29	-0.08	-0.19	0.31	0.29	-0.55	-0.20
cs_{it}	-0.41	-0.40	0.01	0.10	0.02	-0.11	-0.29	-0.08	-0.29	1	-0.20	0.04	-0.29	-0.30	0.32	0.13
π_{it}	-0.20	-0.14	-0.10	-0.03	-0.03	0.00	-0.12	-0.26	-0.08	-0.20	1	-0.15	-0.19	-0.21	-0.10	-0.12
oad_{it}	-0.06	-0.05	-0.12	0.06	-0.14	-0.05	-0.25	-0.34	-0.19	0.04	-0.15	1	0.03	0.08	0.18	0.19
$nrrs_{it}$	0.39	0.38	-0.04	-0.01	0.03	0.15	0.10	-0.02	0.31	-0.29	-0.19	0.03	1	0.89	-0.24	-0.10
$nrrm_{it}$	0.50	0.50	-0.10	0.02	0.00	0.11	0.08	-0.10	0.29	-0.30	-0.21	0.08	0.89	1	-0.27	-0.11
$unemp_{it}$	-0.42	-0.39	0.08	-0.00	-0.06	-0.02	-0.30	-0.12	-0.55	0.32	-0.10	0.18	-0.24	-0.27	1	0.29
cd_{it}	-0.10	-0.17	-0.19	0.10	-0.00	0.03	-0.56	-0.14	-0.20	0.13	-0.12	0.19	-0.10	-0.11	0.29	1

A.5 Nederlandstalige samenvatting (Abstract in Dutch)

In deze scriptie onderzoek ik welke factoren een invloed hebben op huishoudbesparingen en in het bijzonder het effect van het type arbeidscontract dat huishoudensdeelnemers bezitten op het spaargedrag (gedreven door zogeheten ‘precaution’, dat voortkomt uit onzekerheid over toekomstige inkomsten) in de EU-28 zone tussen 2000 en 2016. Door gebruik te maken van de zogeheten Fixed Effects (FE) en Generalized Method of Moment (GMM) schatters voor dy-

namische modellen van panel data, streef ik er naar om op een robuste manier de omvang van deze effecten te bepalen. Het blijkt dat het aandeel van tijdelijke arbeidskrachten en zelfstandige arbeidskrachten geen effect heeft op het gedeelte van het besteedbaar nationaal inkomen dat gespaard wordt. Dit kan verklaard worden door verschillende onderliggende oorzaken: Individuen die minder risicomijdend zijn accepteren eerder een tijdelijk arbeidscontract, de afwijkende aard van tijdelijk en zelfstandig werk en de inkomensonzekerheid die daar bij hoort, het anticiperen van arbeiders op naderend verlies van inkomen door te zoeken naar nieuw werk, de afhankelijkheid van niet-vaste arbeidskrachten op anderen binnen hetzelfde huishouden en het feit dat een meer flexibele arbeidsmarkt een omgekeerd effect op inkomensonzekerheid zou kunnen hebben voor alle werknemers. Bovendien is het effect lastig te bepalen door verschillende definities van gebruikte variabelen binnen de EU-28 zone en de meetfout in deze variabelen. Er is aangetoond dat het mogelijk is om de GMM schatter te benutten voor het afschatten van macro-economische relaties. Desalniettemin bemoeilijk een beperkt aantal individuen in de data set het afschatten op twee manieren: de schatter is niet volledig correct en het beperkt de vrijheid in het kiezen van gedegen verzameling Moment Conditions door het lage aantal te gebruiken Moment Conditions.

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