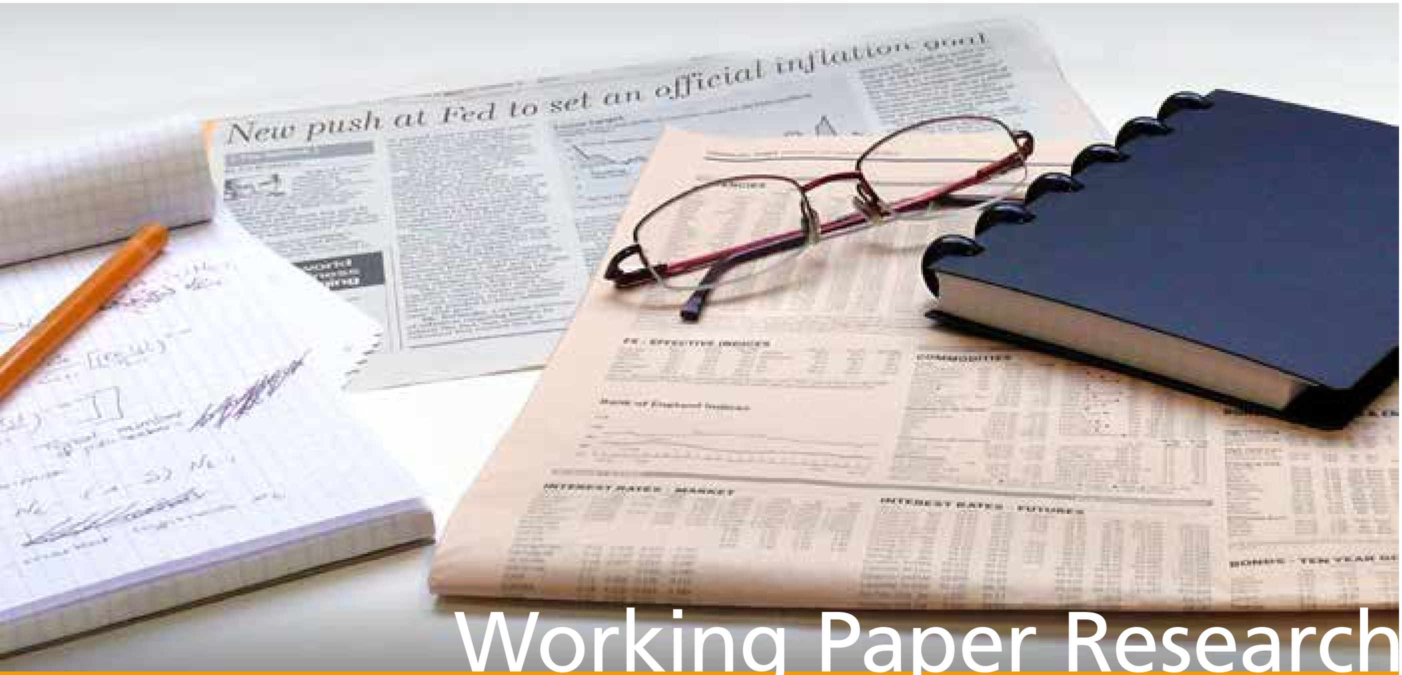
The implications of household size and children for life-cycle saving



Working Paper Research

by Bart Capéau and Bram De Rock

September 2015 No 286

National Bank OF BELGIUM

Eurosystem

Editor
Jan Smets, Governor of the National Bank of Belgium

Statement of purpose:

The purpose of these working papers is to promote the circulation of research results (Research Series) and analytical studies (Documents Series) made within the National Bank of Belgium or presented by external economists in seminars, conferences and conventions organised by the Bank. The aim is therefore to provide a platform for discussion. The opinions expressed are strictly those of the authors and do not necessarily reflect the views of the National Bank of Belgium.

Orders

For orders and information on subscriptions and reductions: National Bank of Belgium,
Documentation - Publications service, boulevard de Berlaimont 14, 1000 Brussels

Tel +32 2 221 20 33 - Fax +32 2 21 30 42

The Working Papers are available on the website of the Bank: http://www.nbb.be

ISSN: 1375-680X (print)
ISSN: 1784-2476 (online)

Abstract

On the basis of a concatenation of fifteen Belgian household budget surveys from 1995/96 to 2010, we investigate the impact of demographic factors, such as ageing and changing household composition, on saving behaviour. Not focusing on high frequency events (e.g. business cycles and unexpected shock), we find that saving behaviour is fundamentally driven by the change in household size and composition. Older people seem to be more impatient, and thus save less, though this evidence is not clear cut. Contrary to the usual practice of considering the allocation of household income over consumption and saving to be the result of one particular household's member decision, we present here a more individually based analysis of the data. By lack of true panel data, the assumptions that have to be made for such an approach (identical intertemporal preferences among household members) are severe, but not necessarily less preferable than those, if any, underlying the common practice of assuming one single individual decision maker.

JEL Classification: D14, D91, E21.

Keywords: Saving, consumption, life-cycle, intertemporal choice, household demographics.

Correspondent author:

Bram De Rock, ECARES-ULB, Avenue Franklin Roosevelt 50, CP 114/04, 1050 Bruxelles.
e-mail: bderock@ulb.ac.be

This paper forms the end report of the National Bank of Belgium project on the "Analysis of saving behaviour on the basis of a concatenation of Belgian Household Surveys". We are grateful to Geert Langenus, Christophe Piette, Raf Wouters, the members of the steering committee of this National Bank of Belgium project, and an anonymous referee for remarks and comments on earlier versions of this paper. Financial support from the National Bank of Belgium is gratefully acknowledged. In the framework of this project permission was obtained to use micro–data of the Belgian Household Budget Surveys 1995/95, 1996/97, 1997/98, and 1999 to 2010, collected by ADSEI–DGSIE (FOD-SFP economie).

TABLE OF CONTENTS

1 Introduction

1.1 The main question

Saving is that part of revenues that is left over after subtracting expenditures on consumption goods and services made over the same period as these revenues are gained. In general, saving serves for expenditures on future consumption. One can however distinguish between different motives for saving.

- *Acquisition of durable goods and financing irregular expenditures.* Saving can serve for financing irregular (large) expenditures: yearly holidays, a new car, furniture, ... This is a stable type of saving, done by many households. Larger availability of consumer credits might have reduced the need for this type of saving.

- *Saving to face uncertainty over the future.* An amount of money can be put aside in order to alleviate future negative income shocks. Assessing a person's attitudes towards risk might play an important role in understanding this aspect of saving. This part of saving is rather volatile and is mainly determined by current income.

- *Life–cycle motive.* This comprises saving to cover changing needs through the life–cycle. This consists mainly of saving related to planned changes in household composition, and to the expected effects of ageing (the change in income after retirement, saving for medical or other expenditures when growing old).

- *Bequest motive.* People bequeath wealth built up during the life–cycle, to their offspring. Even if not intended, this practice is lawfully arranged. It is therefore not always easy to disentangle left over savings due to uncertainty on the moment of death, from wealth deliberately saved with intention bequeathing it to descendants.

In the present contribution we focus on the life–cycle motive. Ageing, the emergence of new, less stable forms of cohabitation next to the classic nuclear family (spouses and children), and the household dilution count among the more salient characteristics of the socio–demographic evolution during the last decades. The evidence on these demographic evolutions for Belgium is briefly summarised in Section 2. It is therefore important to investigate whether planned fertility and other expected changes in future household composition might contribute to explaining the observed life–cycle pattern of saving. Our paper is therefore comparable to the approach in the papers of *e.g.* Cannari (1994), Freyland (2005), Browning and Ejrnæs (2009), and Jørgensen (2014, 2015).

While the consequences of ageing for life–cycle consumption and saving patterns have been the subject of much economic analysis, the impact of the changing composition of households was a less prominent theme. Potentially this is because many studies, especially those focussing on the effects of uncertainty concerning business cycle fluctuations of interests, prices, and especially incomes, use macro–data (*e.g.* Hall 1978, Sargent, 1978, Flavin, 1981, and Campbell and Mankiw, 1989, 1991). As persons observed at a particular moment in time are in different phases of their life–cycle and household composition differs across people, the availability of micro–data seems indispensable for a more detailed and appropriate empirical analysis of these issues. We will use therefore data from 15 waves of the Belgian household budget surveys (1995/96, 1996/97, 1997/98, and 1999 to 2010).[1] These surveys recollect information on expenditures and revenues at the household level, and therefore figures on saving could be extracted from them. They contain also some demographic information on these households.[2, 3]

In Section 3 we give a descriptive analysis of the evolution of the average saving rate over the life–cycle on the basis of these data. Thereto, a cohort analysis as proposed by Deaton and Paxson (1994) is performed. From each of the fifteen budget surveys, persons born in the same year are selected. Consequently, we can follow the evolution of saving and consumption of each such a cohort as their members age. The pure age profile of the household saving rate obtained by this type of analysis, that is after correcting for generation specific and time specific effects, is hump shaped. But when controlling for household size, the saving rate drops, and more outspokenly so in the pre–retirement phase of the life cycle. The hump is therefore tilted down at younger ages. The way this age pattern is affected is closely correlated with the change in household size and composition over the life cycle, as analysed in Section 2.

This empirical evidence suggests that household size and other household demographics may yield a contribution in understanding life–cycle saving behaviour. An increasing number of household members increases consumption needs. But at the same time there is also a trade–off with efficiency, since living together enables persons to share some goods (housing, car, . . .), which increases the saving opportunities. From a dynamic perspective, *anticipated future* fertility would increase *current* saving. Potentially people do not only save for protecting against future income falls, but also because they plan to have children in the next future, or foresee that the studies of their current children would need to be financed when growing older. In Sections 4 and 5 we investigate the impact of demographics

[1] These data are collected by the statistics office (DGSIE/ADSEI) of the ministry of economy (SFP/FOD Economie), according to the Eurostat guidelines. The principal aim of these data is to provide expenditure based weights for the construction of consumer price indices. Next to it, these or similar surveys have been a rich source for consumption analysis. Examples of applications of intertemporal allocation models to these type of data are, amongst others, Browning, Deaton and Irish (1985), and Blundell, Browning and Meghir (1994) for the UK, Attanasio and Weber (1995b), and Browning and Lusardi (1996) for the US, Burbidge and Davies (1994) for Canada, Ando, Guiso and Visco (1994), and Battistin, Brugiavini, Rettore and Weber (2009) for Italy, Deaton and Paxson (1994) for Taiwan.

[2] The samples of the budget surveys are drawn so as to allow for making inference at the population of Belgian private households. Private households are opposed here to so called 'collective' households, which are defined as entities where people live in larger groups such as old people's homes, youth institutions, monasteries and prisons.

[3] In order to correct for non–response, sample weights are constructed by the data agency (DGSIE/ADSEI).

further, by introducing structural models that fit into the, by now in economics standard, life–cycle framework for analysing intertemporal decisions. In the following Section 1.2 we present a brief literature review on the life-cycle framework and in Section 1.3 we provide more details about our specific contribution.

1.2 The life–cycle framework: a brief literature review

Browning and Crossley (2001a) distinguish the life–cycle *framework* from the more restrictive life–cycle/permanent income model dating back to the seminal contributions of Modigliani and Brumberg (1954) and Friedman (1957). The main idea of this original model is that instantaneous consumption is best interpreted as being the result of an optimal allocation of financial means (conceived as lifetime income, that is the present value of all future earnings and transfers, according to Modigliani and Brumberg, and as permanent income, that is the constant income stream lifetime income can generate over the life–cycle, in Friedman's view) to consumption over the life–cycle. Therefore, instantaneous consumption would be determined by lifetime or permanent income, rather than by current income, as it was conceived in the first Keynesian type of macroeconomic models.
Of course, lifetime income is not known at the moment that a decision on contemporaneous consumption needs to be taken. Therefore, some of the early contributions in the development of life–cycle models tried to pinpoint the role that can be played by expectations about future income in explaining consumption and saving behaviour (Hall, 1978, and Flavin, 1981). The main extension came however from the recognition that intertemporal optimisation can result in changes in consumption that do not stem from permanent income shocks. Under the assumption that agent's preferences exhibit *prudence* (a positive third derivative of the instantaneous utility from consumption), saving should increase with uncertainty about future income, even if expected income remains unaffected. When two income streams yield the same expected revenues, but one of them exhibits higher variance, that one would result in additional, 'precautionary' saving (Nagatani, 1972, and Kimball, 1990; a graphical illustration of the argument is given in Section 4.3).
Besides the introduction of the precautionary motive for saving, caused by future income uncertainty (Zeldes, 1989a, Deaton, 1992) or the probability of very low or zero income events in the future (Carroll, 1997, Alan, Crossley and Low, 2012), other refinements and extensions of the original life–cycle model were made. Liquidity constraints were recognised as a potential explanation for especially the low income earners' consumption being more closely related to current income, than what the life–cycle model would *prima facie* advocate (Hayashi, 1985, 1987, Zeldes, 1989b, Deaton, 1991, Alessie, Devereux and Weber, 1997, and Carroll, 2001a). Furthermore, retirement or unemployment not only cause a fall in income, but also render available more spare time, and make work related expenditures redundant (Heckman, 1974). Moreover, postponing the replacement of small durable goods such as clothes, in case of negative income shocks, may have hardly any effect on the service flow from

the existing stock while implying current income related shocks in consumer expenditures which are nevertheless in line with the life–cycle framework (Browning and Crossley, 2001b, 2009). Finally, the implications for optimal asset depletion of the shortening of the life time horizon when growing older, were already studied in the seminal contribution of Yaari (1965).

In the terminology introduced by Browning and Crossley (2001a), the life–cycle *framework* is then the common denominator of all these models, being the attempt to assess consumption and saving behaviour as the result of optimising a long term objective. As Browning and Crossley (2001a) stress, the life–cycle framework does not always advocate smoothing consumption. Its central device is rather to spread consumption over the life–cycle such that no reallocation can increase lifetime welfare, that is to equate marginal utilities of spending an additional euro at any moment of time. It is thus broader than what popular or over simplistic accounts of the original Modigliani–Brumberg–Friedman contributions would make you believe.[4] The life–cycle framework is however not all encompassing. It is for example at odds with rules of thumb behaviour, such as saving a fixed portion of your current income, since such a rule would only occur under very restrictive assumptions on preferences in a life–cycle model.

1.3 A class of life-cycle models with household composition effects

Without representing a formal test of life–cycle *versus* rule of thumb behaviour, the volatility of the saving rate with respect to generation, age and the business cycle, as obtained in our cohort analysis, yields *prima facie* evidence against the latter. To investigate this further, Section 4 presents a set of intertemporal models that put special emphasis on the potential implications of planned changes in household size and composition on saving and consumption, as another potential factor to drive a wig between (full) consumption smoothing and expected utility maximisation. More in particular, we develop a set of nested intertemporal utility models that allow to diversify between aspects of equitable distribution of available means among household members and efficiency of saving and consumption behaviour.

Equity appeals to the idea of saving in order to be able to serve all future household members' needs equally well. Efficiency uses saving as a means to divert expenditures to moments when they yield most utility, which is dependent on the size (more mouths have to be fed with the same income) and composition of the household (the cost of public goods can be shared among all household members). The focus on household demographics is in line with Browning and Ejrnæs (2009), who claim even that taking into account household demographics could make redundant the other extensions of the

[4] One of the potential sources of this confusion is the practice in theoretical contributions to create an artificial environment in which (full) consumption smoothing indeed coincides with (expected) utility maximisation, *e.g.* by imposing that the interest rate is constant over time and equals the rate of time preference. This allows then to identify more easily whether more complex intertemporal saving and consumption patterns are, or are not in line with expected utility maximisation.

life–cycle model, such as the precautionary saving motive, to explain the from a life–cycle perspective at first sight too close a relationship between income and consumption.

In the literature (Browning and Crossley 2001a, Attanasio and Weber 2010) a distinction is made between low and high frequency implications of the life–cycle framework. The latter concentrates on business cycle effects and the immediate impact of expected and unexpected shocks. Low frequency analysis concentrates on the longer term, such as consumption smoothing and saving to adjust in response to expected and unexpected future income shocks, such as retirement (Skinner, 2007) on the one hand, and the probability of low income events (Carroll, 2002), such as unemployment, sickness or future heath problems, on the other hand. The models we propose in Section 4 definitely belong to the low frequency approach. This does not mean that these types of models neglect the business cycle effect. In low frequency approaches, these effects are captured adding the *real* interest rate as an explanatory variable, and we follow that practice.

In Section 5 we present the empirical results obtained by applying these models to the data of the Belgian budget surveys, and, consequently, we investigate the implications for saving. The results suggest that the life–cycle pattern of saving and the saving rate are indeed dependent on the evolution of household size and composition over the life–cycle. Contrary to Browning and Ejrnæs (2009), we do however find that there remains a non–linear age effect on consumption. This finding pushes the type of analysis we proposed here to its empirical and theoretical boundaries. Indeed, age is an individual characteristic, and if we want to give its impact on saving and consumption a structural interpretation, we need to allow for preference differences among household members, and its implications for the allocation of household income to current and future consumption might require a completely different methodological approach, as we explain in the concluding section. The data requirements for such an analysis seem to transgress the limits of what is possible with cohort data.

2 Demographics and the life–cycle

It should be noted from the very outset that the demographic information drawn from budget surveys is not very well suited to make a demographic analysis: the samples are too small, and the time spell of observations too short. Thereto, census data are indispensable. We will therefore complete the demographic information drawn from the budget surveys with some figures based on census data.

Figures 1 and 2 give an overview of the cross section distribution of the age, household size and number of children in our data.[5] These figures are not sample characteristics, but population estimates on the basis of the extrapolation weights delivered by the data agency (see footnote 3).

As far as the household size is concerned (Figure 1, top), most of the action comes from a shift of three and four–person households to two–person and one–person households. The surveys of 2002

[5] Throughout this paper, we will refer to and treat the surveys of 1995/96, 1996/97, and 1997/98 as observations for the years 1996, 1997, and 1998, respectively.

and 2003 seem to deviate quite strongly from the other ones as far as household size is concerned, with much more two– and, to a lesser extent, four–person households, at cost of substantially less singles.

The authoritative census–based study on the evolution of household composition in Belgium is Deboosere *et al.* (2009). According to this study, the proportion of singles has risen from 1970 to 2001 with almost 13 percentage points, from almost 19% to 32% (a much larger part than we have in the household surveys). To the surprise of some maybe, the share of households without children decreased from 24.3% to 21.3% over the same period. However, the share of couples with children decreased too, with 12 percentage points (from almost 40% to 28%), while the share of lonely *mothers* increased from 4% to slightly over 7%.

As far as the average number of children within a household is concerned (Figure 1, bottom), the picture revealed by the budget survey data does not allow to draw firm conclusions. With some goodwill, we can see a slight increase of the share of households without children and a fall in the relative number of households with four or more children.[6]

Next, we turn to the age distribution (Figure 2). Again the changes are much less outspoken than what can be inferred from census data.[7] Nevertheless, a fall in the relative number of persons aged 25 to 44 can be discerned, in favour of a shift to persons of age 55 to 64.

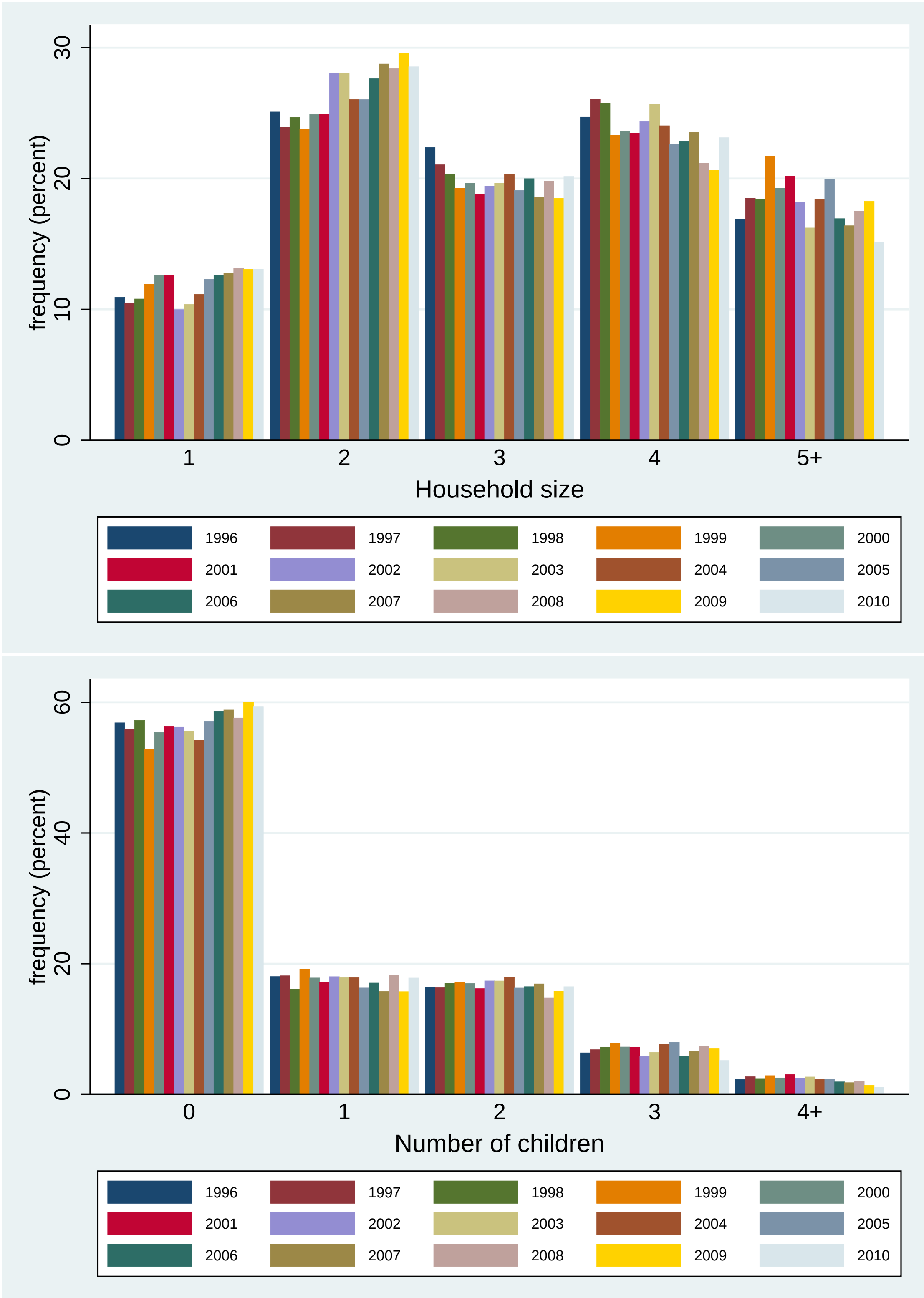
Even though the budget surveys are not very well suited for a demographic analysis, this does not take a way that they are a valid and unique source of information for the type of more disaggregated (as compared to typical macro–studies such as Hall, 1978, Sargent, 1978, Flavin, 1981, and Campbell and Mankiw, 1989, 1991) behavioural analysis we want to do. By concatenating several waves of these surveys, we can follow the consumption, income and saving path of several cohorts over part of their respective life–cycles, and relate it to the information we have on household size and number of children. Such a concatenation of cross–sections is known in the literature as a synthetic, or *pseudo*–panel data set (Deaton 1985).

Figure 3, which is drawn from constructing such a synthetic panel from the budget surveys, is the central point of departure of our analysis. The left hand panel reflects the average size of the household in which a person of age a and born in year g, lives. The right hand panel gives the average number of children living in a household to which that same person of age a and born in year g, belongs. We present the graph only for a selection of cohorts, but the same conclusions can be drawn from the figures for other cohorts: the household size and number of children living in a household to which a

[6] A household with children is defined as being a household in which someone lives who is younger than 14 years. This makes comparisons with demographical studies less straightforward, since in such such studies, children are usually defined as the offspring of the reference person of the household, or his/her partner. The newer LIPRO (LIfestyle PROjections)–classification uses a broader definition of children, but still clearly distinct from our exclusively age based definition.

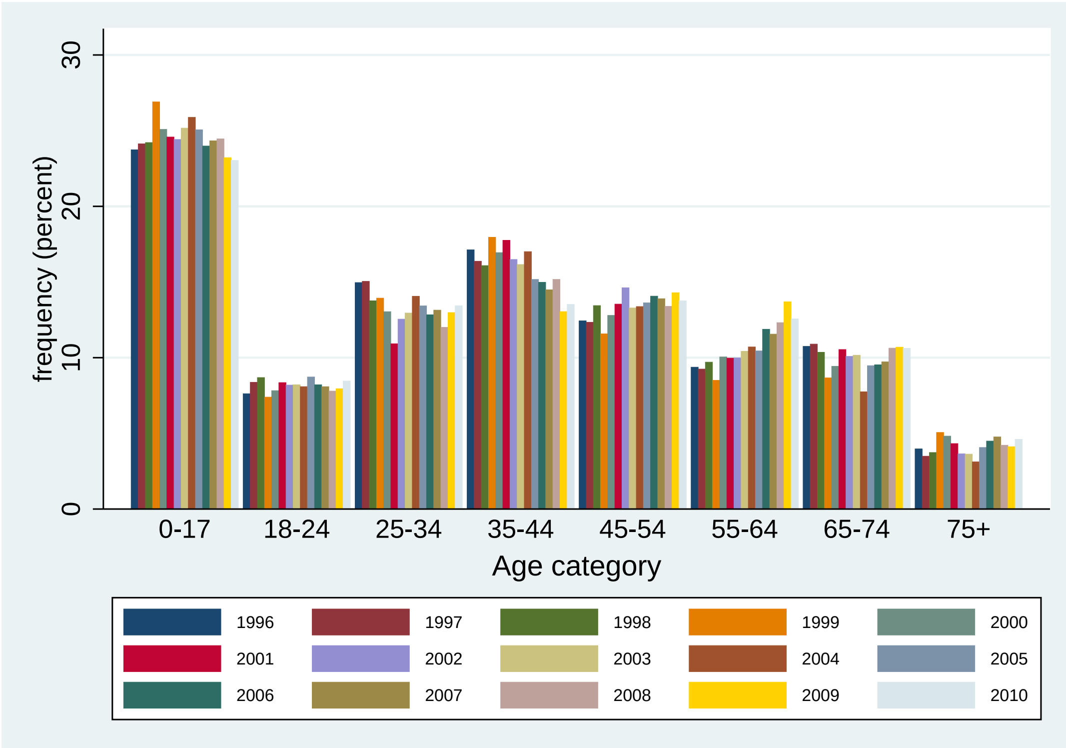
[7] In Appendix I we give some census figures.

Figure 1: Size and composition of households over survey years



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Figure 2: Age distribution over survey years



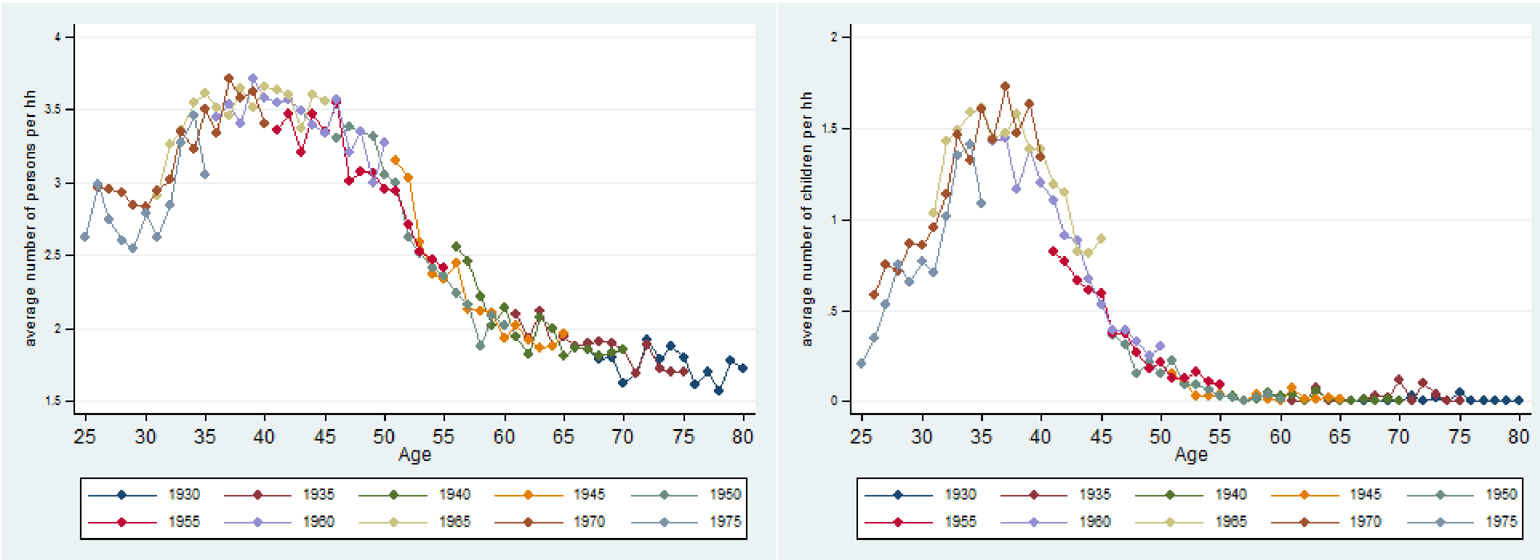
Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

person belongs, is hump shaped over the life–cycle of that person. In itself not so surprising, it is the more amazing that the same shape being obtained when drawing similar pictures for consumption (see Browning and Lusardi, 1996, Deaton, 1997 (Ch.6), Browning and Crossley, 2001a, or Attanasio and Weber, 2010, for overviews) has hardly been related to this household demographical fact in a theoretically consistent behavioural framework. On the contrary, the hump shaped life–cycle pattern of consumption and a similar pattern for income (see Capéau and De Rock (2014b) for similar observations for Belgium) have always given rise to doubts on the life–cycle hypothesis as a valid model for consumption and saving behaviour. It was said that the pattern of consumption over the life–cycle too closely tracks that of income to be rationalisable within a life–cycle framework.[8]

Figure 3 does not exhibit a salient cohort effect in household size and composition. If this were the case, then there would be a clearer vertical shift in the curves for different generations. But again, a time spell of fifteen years might be too short to detect such a demographic shift in the data.

[8] However, Zeldes (1989a), and Campbell and Deaton (1989) argue to the contrary that actually observed life–cycle consumption patterns are too smooth according to some particular life–cycle models of intertemporal utility maximisation that take uncertainty appropriately into account. Similarly, Carroll (1997) relates consumption *growth* to labour income growth in a life–cycle model with uncertainty.

Figure 3: Household size and composition over the life–cycle



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

3 Age, cohort and time patterns of the household saving rate

3.1 Saving and the saving rate

Theoretically, the concept of saving in a life–cycle model is defined as current disposable income *minus* current expenditures. It is a flow variable. Irregular expenditures (yearly holidays for example) might cause measurement problems. Indeed, the measurement of total expenditures might be very different if the measurement spell includes the moment on which these expenditures are done or not. Problem is that the pace at which such expenditures are done differs from good to good (*e.g.* yearly holidays *versus* attending concerts), such that no unique time spell of measurement is optimal. Things get complicated, not only from a measurement point of view, but also conceptually, if some goods render consumer services over a longer period of time (such goods are called *durables*). Indeed, the good then bears some characteristics of an asset, which yields some revenues that can be used for future consumption, in a similar way as savings through other, financial, assets do.

This allows for two options in defining saving. Either the asset character of durable goods is accounted for and the change in monetary value of the stock of these goods during a certain time spell is included in the definition of saving, or one limits saving to be the change in value of the stock of *financial* assets *minus* liabilities.[9] In Appendix I of Capéau and De Rock (2014b), we show that the difference

[9] In both concepts of saving, interest on assets are revenues, while interests on outstanding loans count as a 'negative' income. Capital instalments on loans are part of saving.

between both approaches reduces to including or not including the expenses to the purchase of durable goods into the expenditures that have to be subtracted from income in order to get saving.[10] If the asset character of a durable is accounted for in the definition of saving, then those expenses are considered as an investment that affects the global stock of assets a household owns, and they should not be subtracted from income (and thus are included in the definition of saving). If they are not considered as assets, expenditures on the acquisition of these goods should be subtracted. In this paper, we follow the latter definition, except for one good, owner–occupied housing. In this way, we stay in line with the private and household saving concept of the national accounts.

Due to data limitations, we could not exactly implement this definition. The budget surveys recollect detailed information on household expenditures and try to obtain an accurate picture of all revenues. Saving was constructed by us as the difference between revenues and expenditures. It was impossible to take into account capital instalments in the saving figures thus constructed, since these are not separately registered from interest payments in the more recent versions of the surveys, and for older surveys, information on loan instalments is completely absent.

As far as durables and irregular expenditures are concerned, the older surveys (before 1999) follow a different methodology as the new ones. In general, the sampled households have to register all revenues and expenditures during one month in a carnet. Apart from that, there is a list of goods in the newer versions of the questionnaires (the composition of the list varied over time) for which data on expenditures during the last three months preceding the month during which the carnet had to be filled out, were collected on a recall basis. According to DGSIE/ADSEI, a multiplication by three of the registered expenditures over the last four months (the month of the carnet and three months preceding it) would give a good estimate of yearly expenditures to these goods. This might be questionable. Some goods, such as a car, are not bought three times a years. We suspect that this is not counterbalanced by expenditures on goods which are bought more often than thrice a year, since it concerns goods on which usually smaller amounts are spent than on the purchasing of a car or washing machine.[11] By lack of a better alternative within a reasonable amount of time, we decided nevertheless to follow the annualisation rules used by DGSIE/ADSEI. In the older surveys, the method of asking to note down all expenditures in a carnet during one month was already introduced[12], but on top of that, expenditures exceeding 1900 BEF in 1995/96, and 1000 BEF in 1996/97 and 1997/98,

[10] Compare equations A.8 and A.9 in that paper.

[11] The annualisation rule used by DGSIE/ADSEI is not based on the concern to get expenditures right for specific households. Due to asking for expenses on these goods on a four month recall basis, there is a probability of two thirds that the household did spend money on these goods that year on a moment not included in the four month recall period. By multiplying *aggregate* expenditures on these goods by three, one could get a good estimate of these aggregate expenditures over the whole population, assuming that there is not too much heterogeneity in the purchasing behaviour of these goods.

[12] It replaced the older, very intensive collection method, used in the surveys of 1973/74, 1978/79 and 1987/88, when data on *all* expenditures over a whole year had to be registered in a carnet.

had to be registered during a whole year.

For owner–occupied houses the budget surveys contain a variable reflecting the rent a household could obtain if they would let their dwelling. In line with the option to include real estate property as part of household's wealth, these fictive rents could serve as a proxy for the income from that asset. They also form an approximation for the user cost of owner–occupied housing, that is the price a household would have to pay for utilising the good during a whole year. So, revenues and expenditures to housing for owner–occupiers are assumed to be equal to each other, and cancel out in our implementation of the saving concept to the data.

Unfortunately, our data did not allow to include employer contributions to pension funds (which form the basis of second pillar pension schemes) in the saving figures, as it should be done according to the viewpoint of Jappelli and Modigliani (2005). In the Belgian context, the benefits of such schemes are usually returned under the form of a one-off payment at the age of 65, for fiscal reasons. As far as these returns are not expensed immediately, but converted into other financial assets, they will contribute to the saving figures of that particular moment. We did not however obtain a peak of saving at the age of 65, but small peaks at the ages of 62, and 68.[13] Private pension saving (third pillar arrangements) are included in the implementation of our saving concept.

The definition of saving we used in the present study is summarised in the next box.

saving = disposable income – expenditures	
income(+)	expenditures(-)
disposable earned income capital income transfers (all exclusive of taxes)	current expenditures expenditures on the purchase of durables (except for purchases of real estate)
fictive revenues of owner–occupied dwelling	user cost of owner–occupied dwelling (in the data equal to fictive revenues)
	interests on loans except interests mortgage for owner–occupied dwelling (not included because not available in the data)

For the definition of the *saving rate*, we stick again to a close equivalent of the classical macroeconomic definition, dating back to the Keynesian model that relates consumption to disposable income, and defines the saving rate as the *ratio* of saving to disposable income (Heylen, 2004, pp.111–112). Similarly, we will define the saving rate as the *ratio* of saving as it was defined previously, to net *disposable* revenues, that is *exclusive* of fictive revenues from owner–occupied real estate.

[13] This might be due to bad quality of the revenue data, but is also partially to be explained by our individual approach, which is explained in the next subsection.

In Appendix II we give some descriptive statistics of the main variables of interest that we constructed from the raw data for this study: real expenditures in 1996 euro (which is a proxy for consumption), real disposable income in 1996 euro, saving, as defined previously, in 1996 euro, and the saving rate, which is the fraction of saving over disposable income.

3.2 Cohort analysis

The availability of a series of cross–sections of micro–data for a cohort analysis allows to track the behaviour of people born in the same year, that is a cohort or generation, during some time (fifteen years in our case).

The purpose of a cohort analysis is to disentangle and quantify the impact of three factors that might affect the evolution of the variable that is the object of its analysis (the saving rate in our case).

The *cohort effect* captures the evolution of the saving rate over generations. It refers to the long run impact of economic circumstances in the past. With regard to saving, a prosperous economic climate in the past may have led to a larger stock of accumulated wealth, yielding higher current capital revenues, and thus a higher saving potential. It is an effect that is common to all members of the same generation.

From an economic theory point of view, the *age effect*, which is the second effect, is a pure life–cycle effect. With respect to saving, it refers to resources put aside for being able to meet expected changes in future needs, or the depletion of stocks built up in the past to alleviate current needs. Saving and consumption expenditures are variables *at the household level*, potentially affecting all of its members. Age and generation are, to the contrary, *personal* characteristics. The usual practice is then to consider the age and cohort of one particular person in the household. As the This practice might lead to a sample selection bias in the resulting analysis. Indeed, the age distribution of the persons selected as reference persons might well deviate from that of the whole sample (even when only adult members are included).[14] We will therefore deviate from this current practice, by including the age and cohort of all household members in the analysis, when considering the life–cycle profile of consumption and saving.

The third effect, next to the cohort and age effect, that is discerned by a cohort analysis, is the *time effect*. It refers to the impact of *current* economic circumstances on the variable that is the object of the analysis. For example, the level of current interest rates or current incomes are obvious potential determinants of saving, and classical ingredients of a saving function.

By and large one can classify the time and, respectively, age effect as the reduced form analogues of the aspects of consumption and saving that have been the subject of a more structural approach of

[14] There is a conceptual difference between excluding particular age classes as a whole from the analysis, and excluding part of the sample of persons belonging to the same age class. The former limits the analysis to part of the life–cycle. The latter is what happens when the traditional approach is followed, and might lead to sample selection bias.

high and, respectively, low frequency analyses within the life–cycle framework. Analogously, we will apply a more structural approach to the data in Section 5.

3.3 A first glance at the empirical evidence

Figures 4 and 5 give some graphical evidence on the three effects just discussed for the saving rate as defined in Section 3.1. Thereto we collect for each survey year the saving rate of all households containing at least one member belonging to a particular generation, say born in 1930. For each year we then calculate the median of these saving rates.[15] It should be stressed that location parameters of the micro saving rate (that is the mean or median of household saving rates) are conceptually different and need not to coincide with the corresponding macro–concept, defined as total or mean gross saving over total or mean disposable income. We treat the difference in somewhat more detail in Appendix II.

Connecting the median saving rate of households with a member born in 1930 in survey year 1995/96 with the corresponding saving rate in survey year 1996/97, 1997/98, and so on, yields a representation of the evolution of that saving rate as the persons of that cohort age (from 66 years in 1996 to 80 years in 2010). This is represented by the dark blue curve in the upper left hand of Figure 4. We did similar calculations for all cohorts born in 1930, 1931, and so on, till 1979. Concatenating the curves of different cohorts, we get *a piecemeal picture of the age profile of the saving rate.*

A generation or cohort effect is a systematic difference in the saving rate among persons of the same age belonging to different cohorts. As far as such a generation effect would be present, this *would be reflected in Figures 4–5 by vertical shifts in the overlapping part of the curves referring to different cohorts.*

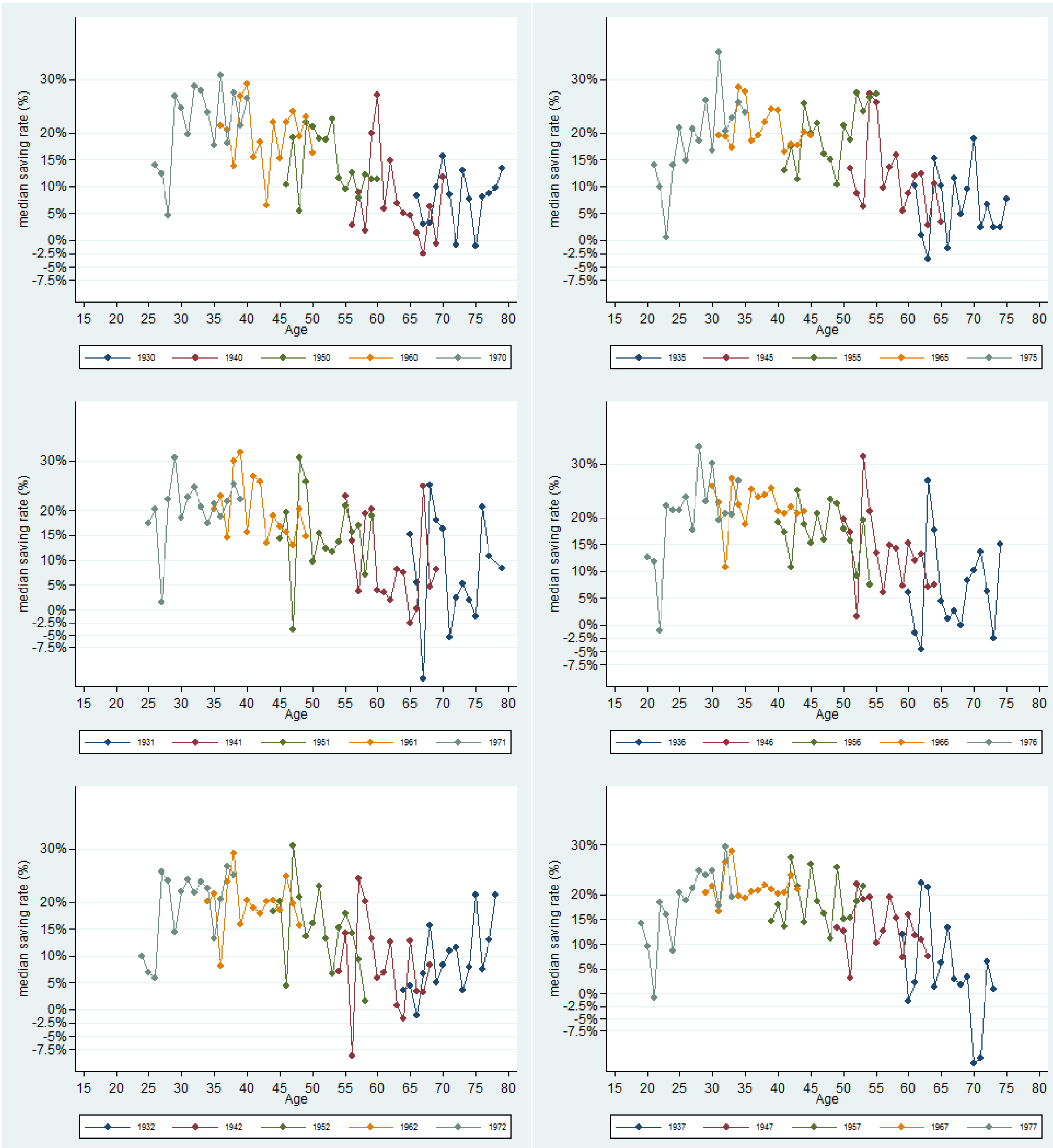
Finally, *time effects can be detected by spotting common patterns exhibited by the line pieces for all generations.* Indeed, the first point of each curve refers to observations made in the survey year 1995/96, the second point to observations in 1996/97, the last point to observation made in 2010. In the figures we can for example see a downward swing in the saving rate for the third observation point of most cohorts, and a spike in the fourth and fifth observation point, *suggesting* a fall in the saving rate in 1997/98 followed by an increase in 1999 and 2000.

The most salient characteristic of Figures 4–5 is the high volatility of the saving rate. It would be hard to reconcile such a picture with rule of thumb behaviour stipulating to save a fixed amount of disposable income. Cohort effects in the saving rate (vertical shifts of overlapping parts of the curves) seem not to occur.

There is some evidence that the saving rate of households with persons between 30 and 55 years old

[15] When using micro–data, means of rates are heavily affected by outliers, consisting of households with very small reported revenues as compared to the amount saved. We therefore report median rather than mean saving rates, and we will trim the data in the regression analysis below. The figures including the 95%–confidence intervals of these estimated medians are reported in Appendix V.

Figure 4: median saving rate (1)



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Figure 5: median saving rate (2)

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

is higher than that of households with persons older than 55 years. Whether the low saving rates for households with persons between 20 and 30 years is a cyclical rather than an age effect is difficult to judge from the picture. Thereto we revert to a regression analysis in the next section.

3.4 Time series regression analysis: the Deaton–Paxson method

The method of the previous section has the drawback that it only takes into account the age of a specific cohort, to assess the age effect, and *vice versa*, that it only fixes cohort effects at a given age (by for example looking at differences in saving rates between persons aged 55 years, but born in 1941, 1942, 1943, and so on, until 1955). This is solved by a Deaton–Paxson type of multivariate regression analysis (Deaton and Paxson, 1994, and Deaton, 1997, pp.121–128 and Ch.6). As such, the impact on the saving rate that can be accredited to a specific age is fixed by taking into account the saving rates of *all* households in the data with persons of that age. Similarly, the estimated generation effect will take into account all households in the data with members born in the same year, and not only those at a particular age.

Separating out age, cohort, and time effects faces however an identification problem. To explain this more in detail, assume there is a time series (indexed by $t = t_1, t_2, \ldots, t_j, \ldots, t_n$) of cross section data on household saving rates available. Let the saving rate of a household h to which there belongs a person born in year g, and observed at moment t, be denoted by $sr_h(g, t)$. Notice that the age a of an household's member born in year g and observed at time t, is $t-g$ (that is: $a \equiv t-g$). By concatenating several cross sections, persons belonging to the cohort born in year g, are observed during successive years $t_1, t_2, \ldots$, and, hence, at moments that they have different ages $a_1 = t_1 - g, a_2 = t_2 - g, \ldots$. This would, at first sight, allow to estimate the separate contribution of age, time and cohort (denoted respectively by α_a, β_t, and γ_g) on the saving rate by means of a regression equation of the following type:

$$sr_h(g,t) = \alpha_a + \beta_t + \gamma_g + \cdots \quad . \tag{1}$$

However, since age a is determined by year of birth g and time of observation t ($a \equiv t-g$), equation (1) could equally well be replaced by:

$$sr_h(g,t) = \alpha_a + \kappa(a - t_0 + g_0) \quad + \beta_t - \kappa(t - t_0) \quad + \gamma_g + \kappa(g - g_0) \quad + \cdots, \tag{2}$$

where κ, t_0, and g_0 are arbitrary constants.

Indeed, replacing a with the equivalent value $t - g$ gives again equation (1). This holds for any generation g, all age categories a, and all moments of observation t. This implies that the original generation, time and age specific effects, γ_g, β_t and α_a, can without loss of generality be replaced by:

$$\begin{aligned} \widetilde{\gamma}_g &= \gamma_g + \kappa(g - g_0) \\ \widetilde{\beta}_t &= \beta_t - \kappa(t - t_0) \\ \widetilde{\alpha}_a &= \alpha_a + \kappa(a - t_0 + g_0). \end{aligned} \tag{3}$$

To solve this identification problem, a normalisation convention should be adopted. Deaton and Paxson (1994) proposed a method to normalise the time effects so that they add up to zero. This means that *the time specific effect is to be interpreted as a pure business cycle effect.* As far as the household's saving rate would also exhibit a trend, this would be captured by the generation and age specific effects. The normalisation proposed by Deaton and Paxson (1994) is implemented by estimating the parameters of the following regression equation:

$$sr_h(g,t) = c + \sum_{a:a\neq\bar{a}} \alpha_a \, \delta_{a,t-g} + \sum_{\tau=s_2}^{s_n} \beta_\tau \, \delta^*_{\tau,t} + \sum_{h:h\neq\bar{g}} \gamma_h \, \delta_{h,g}, \tag{4}$$

where $\delta_{i,j}$ is a Kronecker–delta, *i.e.* $\delta_{i,j} = 1$ if $i = j$ and $\delta_{i,j} = 0$ otherwise; s_2 is the third oldest period of observation and s_n is the most recent observation period. The values $\bar{a}$ en $\bar{g}$ refer to the reference category for the age and generation specific effects. The constant term c reflects the estimated saving rate of generation $\bar{g}$ at age $\bar{a}$, exclusive of the business cycle effect at the particular moment that we would observe this generation at that specific age.

The explanatory variables that capture the time specific effect, $\delta^*_{\tau,t}$, are *not* ordinary dummy variables. They are defined as $\delta^*_{\tau,t} := \delta_{\tau,t} - ((\tau - s_0)\,\delta_{t,s_1} - (\tau - s_0 - 1)\,\delta_{t,s_0})$, with s_0 being the first observation period. For an observation $sr_h\,(g,t)$ at the moment $t = s_2, \ldots, s_n$, this indeed coincides with an ordinary dummy, since δ_{t,s_1} and δ_{t,s_0} both equal zero when $t \geq s_2$, and also $\delta_{\tau,t} = 0$ for all $\tau \neq t$. So, for an observation $sr_h\,(g, s_3)$ (assuming that $g \neq \bar{g}$ and $\bar{a} \neq s_3 - g$) equation (4) reduces to:

$$sr_h\,(g, s_3) = c + \ \alpha_{s_3 - g} + \beta_{s_3} + \gamma_g, \tag{5}$$

which is equal to our original equation (1).

For an observation of period s_1, $\delta^*_{\tau,s_1} \equiv \delta_{\tau,s_1} - ((\tau - s_0)\,\delta_{s_1,s_1} - (\tau - s_0 - 1)\,\delta_{s_1,s_0}) = -\,(\tau - s_0)$ (the last equality following from the fact that $\tau \geq s_2$). If an observation of period s_1 does not belong to the reference generation and reference age category ($g \neq \bar{g}$ and $\bar{a} \neq s_1 - g$), equation (4) for this observation reduces to:

$$sr_h\,(g, s_1) = c + \alpha_{s_1 - g} - \sum_{\tau = s_2}^{s_n} \beta_\tau\ (\tau - s_0) + \gamma_g. \tag{6}$$

Finally, for an observation in period s_0, $\delta^*_{\tau,s_0} \equiv \delta_{\tau,s_0} - ((\tau - s_0)\,\delta_{s_0,s_1} - (\tau - s_0 - 1)\,\delta_{s_0,s_0}) = (\tau - s_0 - 1)$ (since $\tau \geq s_2$). If an observation of period s_0 does not belong to the reference generation and reference age category, ($g \neq \bar{g}$ and $\bar{a} \neq s_0 - g$), then equation (4) for this observation reduces to:

$$sr_h\,(g, s_0) = c + \alpha_{s_0 - g} + \sum_{\tau = s_2}^{s_n} \beta_\tau\ (\tau - s_0 - 1) + \gamma_g. \tag{7}$$

Summarising, the parameters $\beta_{s_2}, \beta_{s_3}, \ldots, \beta_{s_n}$ will be estimated on the basis of equation (4). These parameters reflect the time specific effects of periods $s_2, s_3, \ldots, s_n$. The time specific effect for period s_0 and s_1 can then be calculated as: $\beta_{s_0} := \sum_{\tau=s_2}^{s_n} (\tau - s_0 - 1)\,\beta_\tau$ and $\beta_{s_1} := -\sum_{\tau=s_2}^{s_n} (\tau - s_0)\,\beta_\tau$ (using the estimated parameters for β_t, $t = s_2, s_3, \ldots, s_n$, on the right hand side). Notice that:

$$\sum_{\tau = s_0}^{s_n} \beta_\tau = \sum_{\tau = s_2}^{s_n} (\tau - s_0 - 1)\,\beta_\tau - \sum_{\tau = s_2}^{s_n} (\tau - s_0)\,\beta_\tau + \sum_{\tau = s_2}^{s_n} \beta_\tau = 0. \tag{8}$$

So, the time effects thus estimated and calculated, do indeed add up to zero.

3.5 The empirical evidence revisited

We ran two regressions in the way described in the previous section. In both, the saving rate acts as the dependent variable. The first one only includes time, age and cohort effects. The second one includes household size as an additional explanatory variable. In this way, we want to investigate whether time, age or cohort effects would be (partially) driven by underlying changes in household size over the life–cycle or over time. The complete regression results are reported in Appendix III.[16] In contrast to the usual practice, we do not assume that the age and cohort effects on the households' saving rate are exclusively determined by the age and generation of one sole household member. This assumption is, by the way, made without a clear principle for selecting this particular person, and the choice is usually made rather arbitrarily. We defend on the contrary that the age and generation of *all* household members should be accounted for somehow, when estimating an age and cohort profile. We thereto included all household members, and not just one, arbitrarily chosen, person per household, in the data used for making these regressions. So, for a multi–person household, we estimate the age and generation profile of the household's saving rate for all household members. The regression results thus reflect in how far the age and generation of each of it members separately, can explain the household saving rate.

In order to have a sufficiently large number of observations per cell, we limited the analysis to persons born after 1929 and before 2010. The age range of observations included in the regression analysis is thus 0 to 80 years. The reference age category in the estimation is 0 years, and the reference generation consists of the persons born in 1930.[17]

Figures 6–8 give a graphical representation of the regression results. For the cohort effects, we represent the estimated saving rate of a household including a 21 years old person, purified from the business cycle effect. The age effects are represented by the estimated saving rate of a household containing a person born in 1930, as that person ages from 20 years to 79 years, again without any business cycle effects. The business cycle effect is the common deviation from the saving rate of a household in that particular year. We concentrate first on the regression without correction for household size. Figure 6 represents the estimated saving rate of a household as far as it can be explained by the presence of a 21 years old person, in the counterfactual cases that she would have been born in the years 1930, 1931, ..., till 1980.[18] The cohort pattern exhibits a strongly to the right

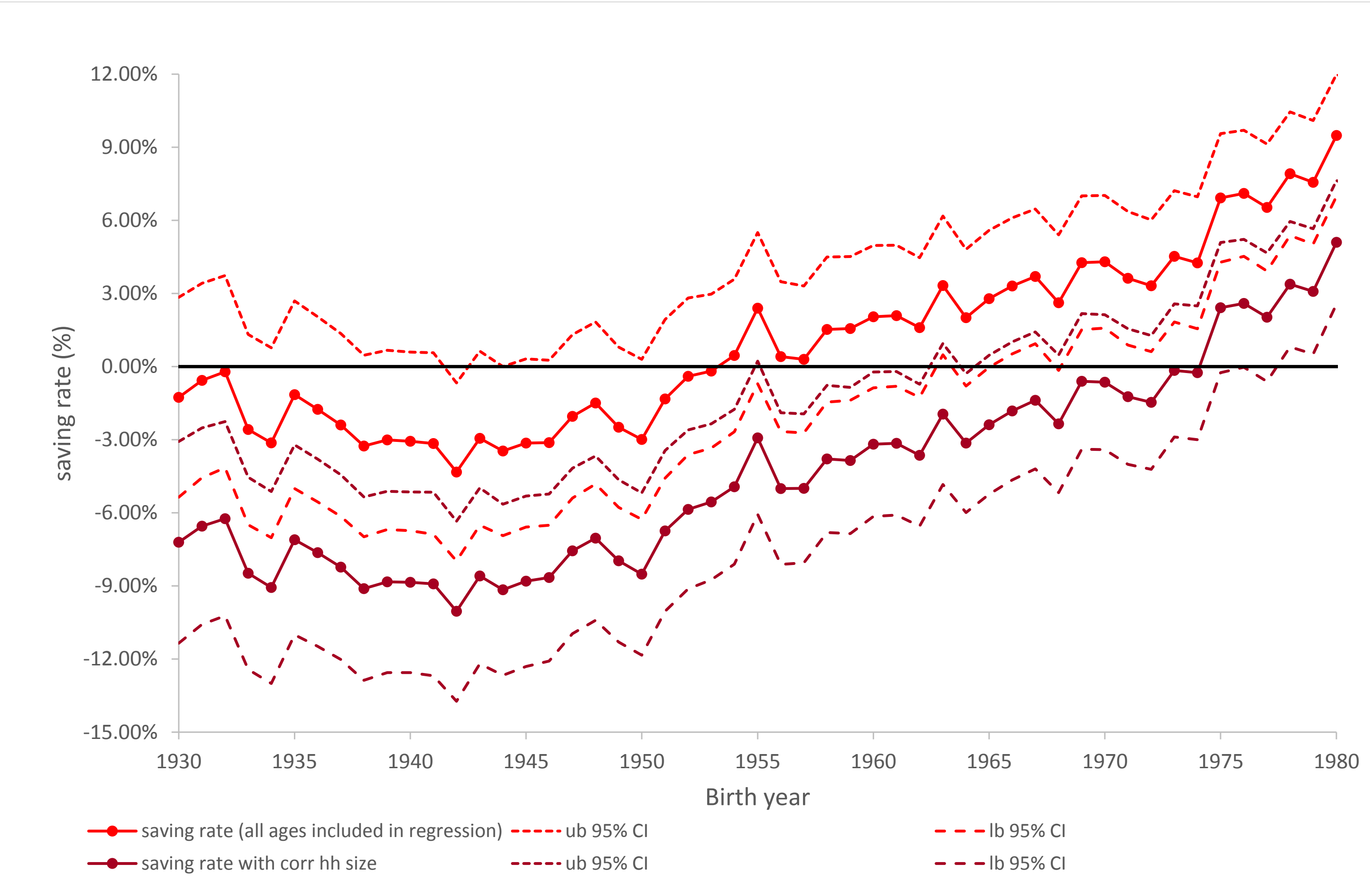
[16] As mentioned before (see note 15), we trimmed the data, excluding observations for which the saving rate lies outside the interval $[-120\%, 120\%]$. Figure A.II in Appendix II gives an idea of the number of observation that are thus excluded.

[17] While selecting only one (adult) household member per household as the traditional approach does, only a sub–sample of each age class is selected, and this makes the estimates vulnerable to sample selection bias. Dropping an entire age class on the other hand (which is done *also* in the traditional approach) has limited influence on the estimated effects of other ages and cohorts. Indeed, adding an age class would imply to include additional dummies for this age and the newly included cohort. Truncating the dataset at a particular age at the lower end might slightly bias the estimated cohort effects since younger person belonging to a recently born generation would then not be taken into account for estimating the cohort effect of that generation. Therefore we did not truncate the age at the lower end. At the upper end, age truncation is unavoidable, due to lack of sufficient data. The estimated age effects are therefore less reliable for older ages.

[18] We do not report in the figure the effect of younger born cohorts than 1980. The cohort effects continue to increase

leaning J–shape. Notice that this cohort pattern would simply shift vertically if the reference age of that person were changed to another age than 21 years. Therefore, we concentrate in our comments on the pattern of the effect, not on the level, and our remarks are thus general and independent of the age at which this curve was calculated.

Figure 6: Cohort pattern of household's saving rate for a 21 years old person



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Households with persons born between 1938 and 1946, that is during or around world war II (WW II), exhibit the lowest saving rate (around –3% at age 21). If the household contains a member born before WW II, the household saving rate tends to increase slightly the earlier this household member was born (the years 1933 en 1934 being an exception). If there are household members born after 1950, the household's saving rate will be higher the more recent these persons are born.

up to 2009, as can be seen from the regression results in Appendix III.

There are multiple possible explanations for this pattern. It can be due to effects from the past, such as inheritances these household members received in the past, or it can reflect differences in current saving behaviour of these generations, or it can be explained as the effect on other members of the household in response to the presence of household members of that particular generation. The Deaton–Paxson times series analysis does not allow however to pinpoint the exact reason. The only reason which is excluded is the age of that person (the effect is calculated for the counterfactual case that the age of that person would remain constant).

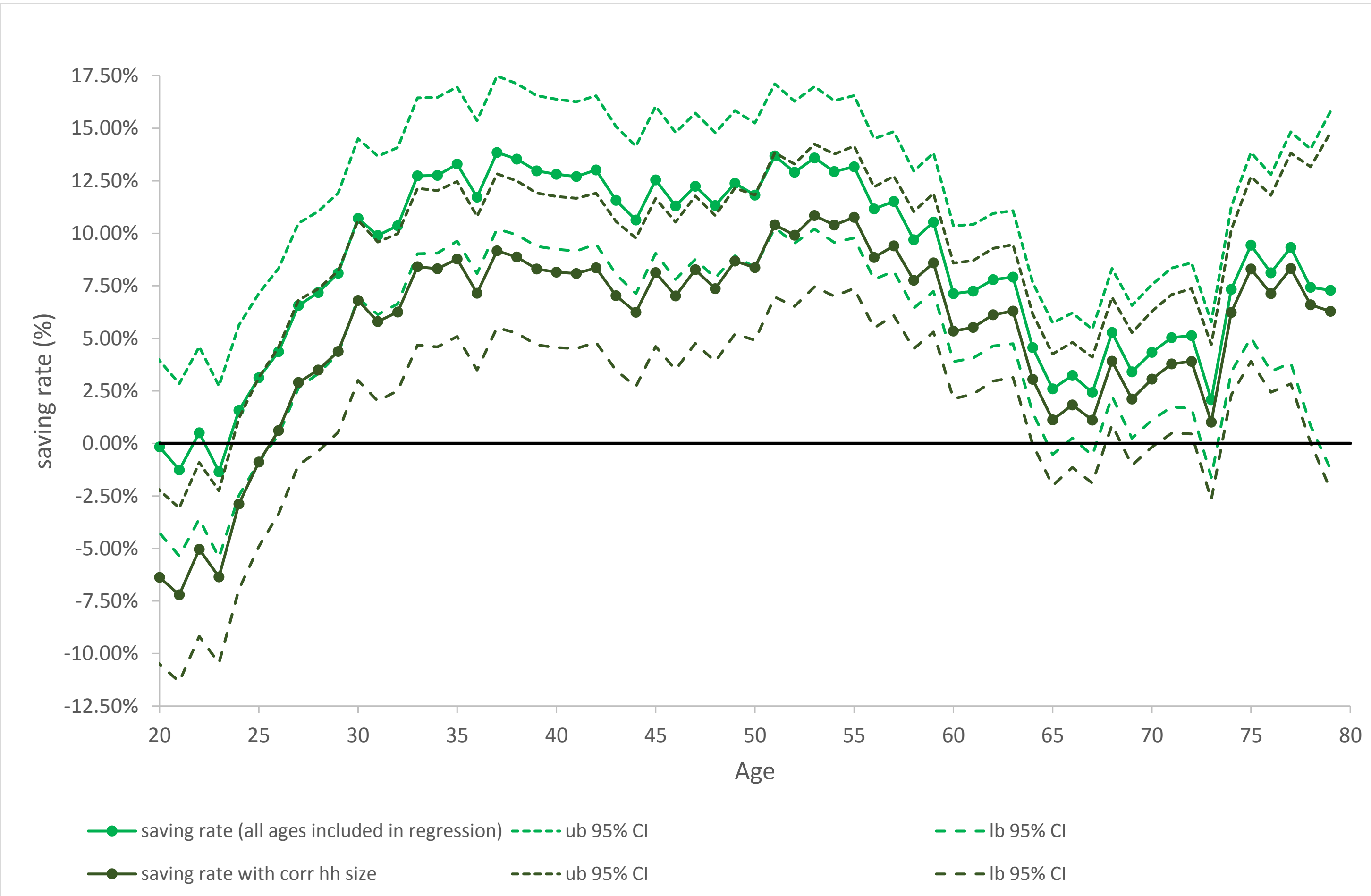
If we would invoke the increase in real income over time as a potential explanation, it seems that households with members born in an era with higher incomes save a larger part of their current income. This is an empirical hypothesis however, since there is no straightforward theoretical reason why the fraction of household income to be saved should depend on income in one or another particular way. If saving were *e.g.* a luxury good, a larger fraction of the income will indeed be saved if income rises. There is some some empirical evidence that this is indeed the case (see *e.g.* Dynan, Skinner and Zeldes, 2004). A similar cohort analysis (available upon request from the authors) as the one presented here, but for saving and income *levels* per household seems to indicate that household saving is tracking household income closely over the life–cycle, which is a necessary condition for an increasing saving rate with income. Surprisingly, this analysis revealed also that *contemporaneous* household income tends to increase by 118 euro (in real terms) with the presence of a one year more recently born persons in the household. That is, of two similar households, except that in one household one of the members is born one year later than the corresponding person in the other household, the former (with the younger born person) will on average earn 118 euro more than the latter.

The introduction in 1986 of pension savings accounts bearing fiscal advantages, might well have contributed to the increased saving rate of *post* second world war generations. Furthermore, increasing life expectancy is another potential explanation for the higher saving rate of more recently born generations.

Figure 7 represents the evolution of the saving rate of a household as its members age from 20 to 79 years (conditional on the assumption that household members were born in 1930).[19] Again, changing the reference birth year would shift this curve vertically but does not affect its pattern, so that the next discussion is general. The saving rate of a household exhibits an inverted U-shaped pattern. There seems to be an exception at the very end of the life–cycle, but this part is statistically very unreliable. For the same reason we omitted the estimate for the 80 years old person which is less than –11%. The similarity with the life–cycle pattern of household size and number of children (Figure 3) is striking . A more structural analysis of this relation between household size and composition on the one hand and the life cycle pattern of saving and consumption will be the main focus of investigation

[19] We do not represent the estimated effects for the ages 0–19 years. The estimated saving rate is declining with age from 0 to 21 years. More details can be found in Appendix III.

Figure 7: Life–cycle pattern of household's saving rate for someone born in 1930

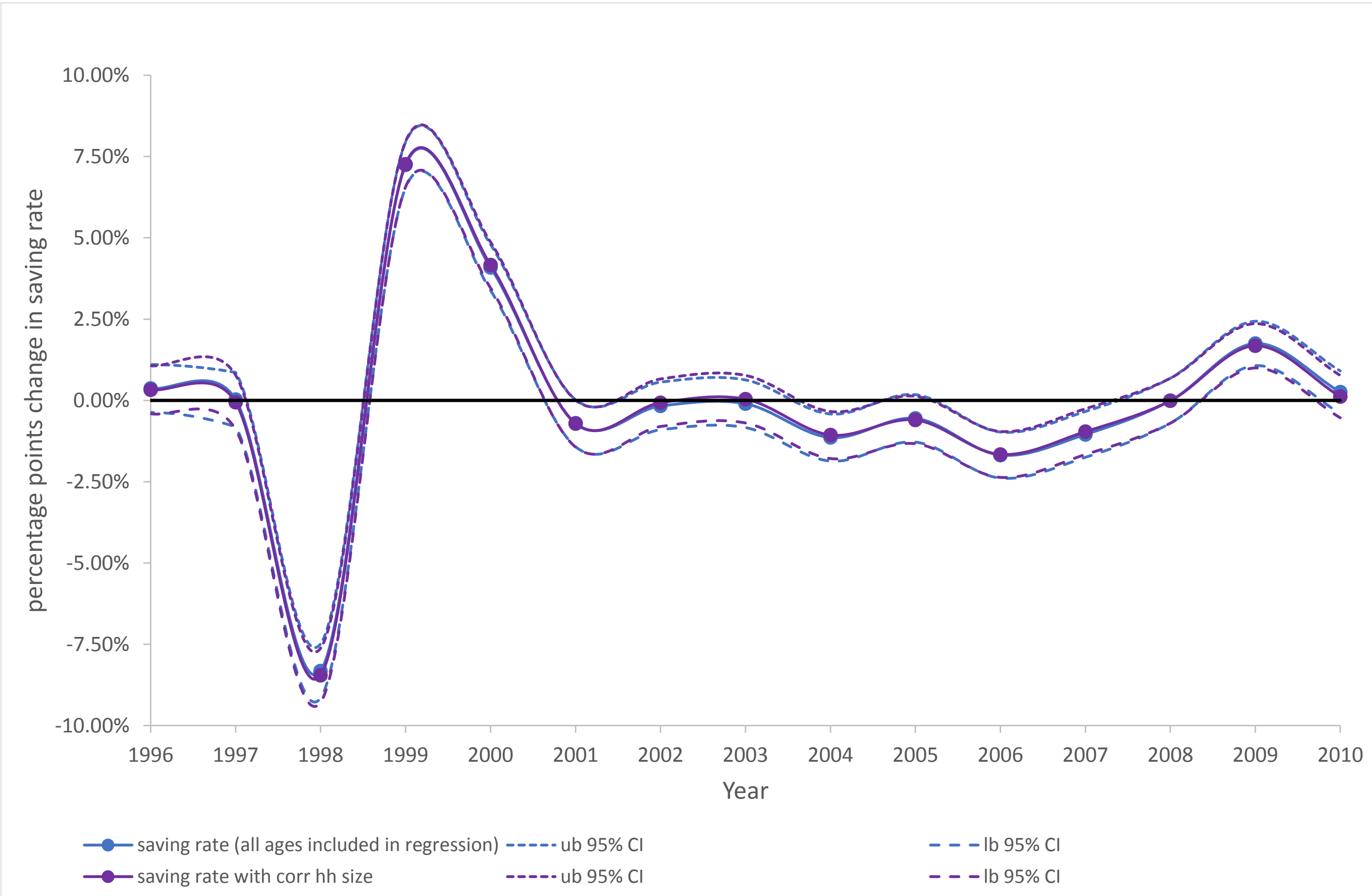


Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

in Sections 4 and 5.

Figure 8 reflects the detrended percentage point change of the household saving rate over time. These cyclical effects confirm the 1998–dip in the saving rate, which was already suggested by the purely descriptive figures reported in the previous section. It might be that the magnitude of this effect is due to the use of micro–data. While the median household saving rate in 1998 was slightly less than 5%, the corresponding macro–concept as calculated from the 1997/98 survey (see Appendix II for more details) is 12.40%, which is low but somewhat higher than the corresponding figure for 2001, which is equal to 12.09%. Nevertheless, the 1998–figure, however calculated, is puzzling, as it is not connected with any underlying business cycle event we are aware of. The 1999–2000 boom in the household saving rate coincides with the growing phase of the dot–com bubble, followed by its bursting out in the course of 2001, provoking a recession in Belgium in that year. This might explain the fall in the household saving rate of 2001. To face the negative income shock, usual saving might have been reduced, and some households might have reverted to asset depletion.

Figure 8: Business cycle pattern of household's saving rate



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Surprisingly, we do not detect a fall in the saving rate during the great recession (starting at the end of 2008). On the contrary, the saving rate exhibits a small peak in 2009, the year that the crisis struck hardest. Stagnating consumption as a consequence of the crisis cannot serve as an explanation since it turns out that consumption figures are also rather high that year (see Appendix II; this last finding is however *not* in line with the national account figures, which show stagnating private consumption from 2008 to 2009). The high inflation figures of 2008 provoking a wage indexation in the first quarter of 2009 might be an important factor to understand what was going on. It implied a real wage increase since inflation was very low in 2009 (over the whole year there was even deflation), a fact which is also reflected in an increase of real disposable income in 2009 according to the national accounts. While discussing potential explanations for the cohort pattern, we already suggested an increase in household income might raise the saving rate (if *e.g.* saving would be a luxury good). Another interesting explanation on the base of macro–figures (which exhibit a similar, and even more outspoken spike in the saving rate for 2009) is provided by Basselier and Langenus (2014), who argue that augmented uncertainty due to the crisis might have given raise to increased saving for precautionary motives.

We turn now to the comparison of the regression results with and without correction for household size. Neither the level nor the pattern of the business cycle effect on the household saving rate is affected by including household size as a control variable. The figures for the household size corrected age and cohort pattern reflect the saving rate of a single. As household size increases, the lines would shift upwards, at a rate of 1.6 percentage points per additional member in the household to which that person belongs. The estimated cohort *pattern* is not affected by including household size, while its level shifts down. The age pattern on the contrary is affected: though the inverted U shape is maintained, the younger half of the life–cycle and the peak are lower than without household size, while the curves come close to each other at old ages. The latter stands to reason, since the average household size of households containing members of 65 and more is smaller than two, meaning that there are a good deal of singles among them. That the age pattern of the estimated household saving rate is affected by including household size, indicates that the age effects of the uncorrected regressions are partly affected by changes in household size which are correlated with age and have an impact on the household saving rate. We saw indeed in Figure 3 that household size exhibits a life–cycle pattern. The age effects of the regressions with correction for household size are therefore purified from this household size effect. A similar reasoning can be made to include the number of children or youngsters as an extra explanatory variable. Doing so for the number of persons younger than 18 years within the household, the estimated impact of age on the household saving rate is further decreased, especially for ages between 18 and 24, and between 45 and 60 years old.[20] The gross impact of an additional household member is increased to 2.5 percentage points. An additional household member younger than 18 *decreases* the saving rate however by 1.7 percentage points. We conclude that the uncorrected Deaton–Paxson regression results for the age effects seem to include household size and composition effects that are correlated with age.

Apart from the business cycle effect, structural interpretations of these regressions need however to be made with caution. We regressed a variable at the household level, the saving rate, on individual characteristics, such as the age and cohort of its members. In the absence of a convincing theory about exactly whose household member's age or cohort would determine the household saving rate, we decided, contrary to the usual practice, not to fix arbitrarily one person, but including observations for

[20] Results are available upon request.

all household members in the regression analysis. We did not however derive the household saving rate (or any other household decision variable) from a model that tells how *all* the household members' age and cohort would affect that variable. We simply augmented the traditional regression of a household level variable on age and cohort of a particular individual, with observations on the same equation for other household members. These regressions would thus better be read as revealing potential correlations between the household level variables and the individual characteristics. Moreover, we saw that such correlations might be affected by other potential explanatory factors such as household size and composition, which are correlated with age. The analysis therefore leads to the hypothesis that the life–cycle pattern of the household saving rate might be driven by changes in household size and composition. To test this hypothesis, we propose in the next section a class of life–cycle decision models that take into account various ways in which household size and composition might affect household decisions. In the empirical application of the models (Section 5), it is then evaluated whether age and cohort effects still exhibit any additional explanatory power.

4 A class of life–cycle models with household composition effects

We will formulate and test the subsequent models in terms of their implication for household consumption over the life cycle, rather than saving. This is because life–cycle models allow for more precise and testable conclusions in terms of consumption behaviour. Excluding the effect of prudence, saving is usually a residual in life–cycle models, which absorbs shocks in income, interest rates or prices.[21] Therefore, testing life–cycle models through saving behaviour requires an accurate measurement of these shocks, which is hard. There is also an empirical reason for this approach. Current income is an important determinant of saving in life–cycle models. However, we have no independent information on saving and income. Indeed, as was mentioned in Section 3.1, saving was constructed by us from the budget survey data, by subtracting expenditures from revenues. Consequently, estimating a correlation between these variables risks to yield spurious results.

We will thus follow the usual practice (see *e.g.* Attanasio and Browning, 1995a,b, or Attanasio, Banks, Meghir and Weber, 1999) of analysing (this section) and estimating (Section 5.1) consumption Euler equations derived from the models. We then investigate in Section 5.3, by means of a simulation exercise, the implications of our estimates for the propensity to save out of current income, for the interest sensitivity of saving, and for the effect of changes in household composition on saving.

4.1 The standard intertemporal utility model

Our basic framework is a standard intertemporal utility model, which we will first solve under the assumption of perfect foresight (including a fixed life time horizon of $T+1$ periods). We use a unitary

[21] See *e.g.* equation 8 in Capéau and De Rock, 2014a.

decision model, by which it is meant that *all household members have the same preferences and take somehow the well–being of household members into account.*[22] A unitary decision model is somewhat hard to reconcile with the viewpoint that personal characteristics, such as age, might influence preferences. As such, we thus concentrate on the question in how far *household* characteristics, such as the size and composition of the household in which persons live, can explain saving and consumption behaviour, without having to revert to individually specific characteristics of a particular household member, such as age. We nevertheless assume that every individual considers her own full life–cycle, but taking into account the household characteristics of the household to which she belongs at each particular moment of time. In this way, we try to give an individual decision theoretic foundation to the unitary model. We come back to this issue at the end of Section 5.2, when testing for additional explanatory power of age and cohort effects in this framework, and in the concluding section.

The standard assumptions of an intertemporal utility model are additive separability of preferences over time and constant discounting by a factor β ($\beta > 0$). This discount factor provides a measure of the degree to which a person prefers consumption today over consumption tomorrow: when $\beta < 1$, a unit of consumption today is valued higher than the same unit of consumption tomorrow, and the consumer is said to be impatient. Reversely, when $\beta > 1$, a person is said to be patient, as a unit of consumption tomorrow is valued more than the same unit today.

We use a discrete time setting. Under these assumptions, lifetime utility, $U\left(c_\tau, c_{\tau+1}, \ldots, c_{\tau+j}, \ldots, c_{\tau+T}\right)$, can be written as:

$$U\left(c_\tau, c_{\tau+1}, \ldots, c_t, \ldots, c_{\tau+T}\right) = \sum_{t=\tau}^{\tau+T} \beta^{t-\tau} u\left(c_t; \mathbf{x}_t\right), \tag{9}$$

where c_t is household consumption during period t ($t \in \{\tau, \tau+1, \ldots, T+\tau\}$) and $\mathbf{x}_t$ is a set of potentially time varying preference shifters. In the present paper these preference shifters will be household size, n_t, and an equivalence scale, e_t. This equivalence scale comprises information on the number of people in the household belonging to a certain age class, expressed in a single index number. The choice for such a restrictive functional form for the effect of age and number of children facilitates the interpretation of the structural models we propose, as we will see further.[23]

The function u is the instantaneous utility function and is assumed to be increasing and concave in the consumption variable. In this framework, the degree of concavity of that function determines simultaneously the degree of substitutability of consumption at different moments in time and the

[22] The unitary decision model comes nowadays under growing threat of the concurring *collective* model (see *e.g.* Browning, Chiappori and Meghir, 2014), in which all household members have their own preferences. Intertemporal applications of collective models are still in its infancy (see *e.g.* Mazzocco, 2007, 2008, Lise and Yamada, 2014 and Adams, Cherchye, De Rock and Verriest, 2014), and applications that go beyond testing the model against the unitary one, are usually more demanding in terms of data.

[23] Investigating the potential gains in terms of fit, and drawbacks in terms of loss of interpretability, of more flexible functional forms, is left for future research.

degree of risk aversion. Intertemporal substitutability refers to the ease with which a fall in consumption at one moment in time can be compensated by an increase in consumption at another moment of time, without a loss of overall lifetime well–being. The degree of risk aversion reflects how much current consumption one wants to give up in order to fully insure against the occurrence of income shocks in the future. A higher degree of concavity of u means less substitutability and a higher degree of risk aversion. Both concepts are indistinguishable in the present type of models, and we will stick to the substitutability interpretation, since uncertainty is not the main focus of our paper.[24]

We will use a *constant elasticity of substitution* (CES) specification for the instantaneous utility function, and assume that household size and composition enter through an index function $\gamma(n_t, e_t)$ into the instantaneous utility function as follows:

$$u(c_t; n_t, e_t) = \frac{\sigma}{\sigma - 1}\gamma(n_t, e_t)(c_t)^{\frac{\sigma-1}{\sigma}}, \tag{10}$$

where σ is a measure for the degree of intertemporal substitutability of consumption, ranging from zero to infinity. For this specification, lifetime utility then becomes:

$$U(c_\tau, c_{\tau+1}, \ldots, c_t, \ldots, c_{\tau+T}) = \frac{\sigma}{\sigma - 1}\sum_{t=\tau}^{\tau+T}\beta^{t-1}\gamma(n_t, e_t)(c_t)^{\frac{\sigma-1}{\sigma}}. \tag{11}$$

The intertemporal budget equation is:

$$W_\tau := (1 + r_{\tau-1})\bar{A}_{\tau-1} + \sum_{t=\tau}^{\tau+T}\frac{y_t}{\rho_t} - \frac{\bar{A}_{\tau+T}}{\rho_T} \geq \sum_{t=\tau}^{\tau+T}\frac{p_t c_t}{\rho_t}, \tag{12}$$

where y_t is the sum of earned income and transfers received in year t and p_t are consumption prices in year t; $\bar{A}_{\tau-1}$ is wealth inherited at the beginning of the life cycle, and $\bar{A}_{\tau+T}$ is the amount that is bequeathed to heirs at the end of the life cycle, an amount that is determined exogenously to this model. The variable W_τ is known as the lifetime income.[25] We assume that there is only one financial asset available. Throughout, we will adopt the convention that financial wealth is measured at the end of the year, and bears the interest of that year. Let r_t denote the interest on financial assets held during period t. So, if wealth available at the end of year $t-1$ is equal to A_{t-1}, it bears an interest equal to $r_{t-1}A_{t-1}$ at the end of that same year $t-1$. Thus, total available means for consumption at year t equal $(1 + r_{t-1})A_{t-1} + y_t$. Values measured at time t can be converted into present values at time τ by dividing through with a factor ρ_t, which equals the value at the beginning of period t, of one unit of the unique financial asset, held since the beginning of period τ, till the beginning of period t. Thus, $\rho_t = \prod_{s=\tau}^{t-1}(1 + r_s)$ for $t = \tau + 1, \ldots, \tau + T$, and $\rho_\tau := 1$.

[24] For a specification of an intertemporal objective function that can distinguish intertemporal substitutability from risk aversion, see *e.g.* Epstein and Zin (1989).

[25] Usually the present value of the bequest is included in the definition of lifetime income, but we do not follow that convention here.

The first order conditions for maximising lifetime utility (equation 9), or more specifically, for the class of utility functions defined in equation (11), w.r.t. $c_\tau, \ldots, c_{\tau+T}$, subject to the lifetime budget equation (12) and the end state condition $A_{\tau+T} \geq \bar{A}_{\tau+T}$, can be combined to yield the following equation for any $t = \tau, \ldots, \tau+T-1$, known as an *Euler equation*:

$$\begin{array}{lcl} u'\left(c_t;\mathbf{x}_t\right) & = & u'\left(c_{t+1};\mathbf{x}_{t+1}\right)\beta\frac{1+r_t}{1+\pi_t}, \qquad \text{or more specifically,} \\ \gamma\left(n_t,e_t\right)\left(c_t\right)^{-\frac{1}{\sigma}} & = & \left(c_{t+1}\right)^{-\frac{1}{\sigma}}\beta\gamma\left(n_{t+1},e_{t+1}\right)\frac{1+r_t}{1+\pi_t}, \end{array} \tag{13}$$

in which $\pi_t := \left(p_{t+1}-p_t\right)/p_t$, is consumer price inflation. Notice that $\left(1+r_t\right)/\left(1+\pi_t\right)-1 = \left(r_t-\pi_t\right)/\left(1+\pi_t\right)$, a value reflecting the real interest rate. The second line of equation (13) can be rewritten as:

$$\frac{c_{t+1}}{c_t} = \left(\beta\frac{\gamma\left(n_{t+1},e_{t+1}\right)}{\gamma\left(n_t,e_t\right)}\frac{p_t}{p_{t+1}}\left(1+r_t\right)\right)^{\sigma} = \frac{\varphi_{t+1}}{\varphi_t}, \tag{14}$$

with $\varphi_t := \left(\beta^{t-1}\gamma\left(n_t,e_t\right)\frac{\rho_t}{p_t}\right)^{\sigma}$. From this equation it follows that for a constant household composition throughout the entire life–cycle, the optimal consumption path is increasing (resp. decreasing) as the real interest rate is greater (resp. smaller) than $\left(1-\beta\right)/\beta$, which is known as the *rate* of time preference. On the other hand, assuming that the rate of time preference equals the real rate of interest, the optimal consumption path is increasing as $\gamma\left(n_{t+1},e_{t+1}\right) > \gamma\left(n_t,e_t\right)$. We come back to this property when specifying some examples of the γ–function.

It is important to note that the Euler equations are equal for all household members, if they all have the same preferences, except for a person which switched household between period t and $t+1$ (*e.g.* a child leaving the parental home, going to live alone). In our use of the data these structural breaks will not play an important *role* since we are aggregating them over cohorts. Thus, apart from these structural breaks, these equations can serve as a microeconomic foundation at the *individual* level of our estimates below.

Equation (14) can be solved recursively to obtain the following explicit expression for optimal consumption:

$$c_t = \frac{\varphi_t W_\tau}{\sum_{t=\tau}^{\tau+T}\left(p_t\varphi_t/\rho_t\right)}. \tag{15}$$

From this, it follows that the corresponding saving function, which relates optimal saving during period t to the structural parameters of the model, is equal to:

$$\begin{array}{lcl} s_t & = & r_{t-1}A_{t-1} + y_t - p_t c_t \\ & = & Y_t^d - \frac{p_t\varphi_t W_\tau}{\sum_{t=\tau}^{\tau+T}\left(p_t\varphi_t/\rho_t\right)}, \end{array} \tag{16}$$

where Y_t^d is disposable income in period t, that is $y_t + r_{t-1}A_{t-1}$. Equation (16) makes clear that saving in life–cycle models is a residual category: it absorbs all transitory fluctuations of current income, that is, all deviations of current income from the necessary expenditures to follow the optimal consumption path.[26] It serves as the formal argument to estimate the life–cycle model in terms of the consumption Euler equation, rather than in terms of a saving function, because the latter has a much more complicated dynamics.

4.2 Three specifications of the contribution of household demographics

We now introduce three functional forms of the γ–function, each of which leads to a distinct life–cycle model. These three specifications are inspired on a debate in normative welfare economics between Ebert (1997) and Shorrocks (2004) concerning the relevant weights in a welfare function with heterogeneous agents (*e.g.* persons living in households with a different composition).

In the first specification, a person in a household is assumed to value adult equivalent consumption. She tries to find the optimal path of the consumption that a single person would need, in order to obtain the same welfare as she does, taking into account the composition of the household in which she lives. We call this the *pater familias* model, as it amounts to instantaneous household welfare being determined by the adult equivalent consumption of one single individual, the representative *pater familias* say. In this model, the classical approach is followed to convert household consumption into adult equivalent consumption by dividing household consumption by an equivalence scale e. So, it is assumed that the instantaneous welfare of the representative agent living in a household with a composition that is characterised by an equivalence scale e, and total consumption c, is equal to the welfare of a single consuming c/e (see Deaton and Muellbauer, 1980 Ch.8, and Lewbel 1989, 1997). Alternatively, the equivalence scale can be interpreted as a measure of household needs. A higher equivalence scale thus means that more consumption is needed to reach the same welfare.

This is embodied by specifying the γ–function as:

$$\gamma(n_t, e_t) = (e_t)^{\frac{1-\sigma}{\sigma}} . \tag{17}$$

Note that in this specification, γ is independent of household size, and is solely determined by the equivalence scale. It implies that starting from a situation in which adult equivalent consumption is equal in two periods, increasing household consumption by one unit in the period with higher needs due to household composition, yields less additional welfare than when the same additional unit would be consumed in a period with lower needs. Consequently, there is a tendency in this model to give up equality of adult equivalent household consumption over the life–cycle for higher overall lifetime welfare by diverting more means than what full equality of adult equivalent consumption would advocate, to periods when household needs are lower. This trade–off can also be assessed by inspecting the optimal consumption path embodied in the recursive reformulation of the Euler

[26] Compare also with equation (8) in Capéau and De Rock, 2014a.

equation (equation 14) for this model, which reduces to:

$$\frac{c_{t+1}}{c_t} = \left(\beta \frac{p_t}{p_{t+1}} (1 + r_t)\right)^{\sigma} \left(\frac{e_{t+1}}{e_t}\right)^{1-\sigma}. \tag{18}$$

Optimal consumption is increasing with household needs if and only if the intertemporal substitutability, σ, is smaller than one. So, if intertemporal substitutability is larger than one, this model would result in shifting consumption towards periods were household needs are relatively small. Indeed, if adult equivalent consumption in two periods were equal but equivalence scales differ, marginal utility of an additional unit of consumption when the household equivalence scale is small, is larger than that of an additional unit when the household equivalence scale is large. If the substitution elasticity is lower than one, there is a trade–off between caring for equal adult equivalent consumption over the life–cycle, and diverting money to periods when household needs are low. The latter effect will dominate the concern for equal distribution of adult equivalent consumption over the life–cycle, if intertemporal substitution is larger than one.

Our second specification of γ, which weights instantaneous utility from adult equivalent consumption in the previous specification with the equivalence scale, cures that defect. We call this the *caring mother model* because, as we explain below, the concern for an equal distribution of adult equivalent consumption always dominates the efficiency concern in this model. It amounts to specifying γ as:

$$\gamma (n_t, e_t) = (e_t)^{\frac{1}{\sigma}}. \tag{19}$$

The recursive reformulation of the Euler equation (equation 14) reduces to:

$$\frac{c_{t+1}}{c_t} = \left(\beta \frac{p_t}{p_{t+1}} (1 + r_t)\right)^{\sigma} \left(\frac{e_{t+1}}{e_t}\right). \tag{20}$$

According to this model, consumption is transferred to periods where household needs are highest, irrespective of the degree of intertemporal substitutability. Saving thus occurs during periods when income would be high and household needs low. This is the *household needs motive for saving*. If the rate of time preference equals the real interest rate, adult equivalent consumption should be equalised according to this model.

Our third and final life–cycle model, is motivated by the concern for *total* household welfare generated in a certain period, rather than the welfare of the representative person in the household, (as it was the case in the *pater familias* model). Indeed, consider two periods in which adult equivalent consumption is the same, but in one of these periods the household size is larger than in the other. Then one may consider the welfare generated for more people to be higher than in the case were fewer people are obtaining this welfare level. We call such a model the *efficient manager model*, since there is a tendency (the more pronounced if intertemporal substitutability is larger than one) to transfer consumption towards periods where n_t/e_t is higher, and this can be seen as a measure of efficiency in generating welfare by shifting expenditures toward that period. Formally, this can be implemented by specifying $\gamma(n_t, e_t)$ as follows:

$$\gamma(n_t, e_t) = (n_t)(e_t)^{\frac{1-\sigma}{\sigma}} . \quad (21)$$

The recursive reformulation of the Euler equation (equation 14) reduces to:

$$\frac{c_{t+1}}{c_t} = \left(\beta \frac{p_t}{p_{t+1}}(1+r_t)\right)^{\sigma} \left(\frac{e_{t+1}}{e_t}\right)^{1-\sigma} \left(\frac{n_{t+1}}{n_t}\right)^{\sigma} . \quad (22)$$

This model advocates to increase *adult equivalent* consumption in periods where relatively more people would enjoy the same level of adult equivalent consumption.

4.3 Precautionary saving

In the previous sections we neglected uncertainty when explaining the models. In early contributions on optimal intertemporal consumption (Hall, 1978, Sargent, 1978, Flavin, 1981, and Hayashi, 1981), uncertainty was taken account of by formulating the *expected* permanent income hypothesis. Assuming that the rate of time preference equals the real interest rate, it stipulates that consumption should be equal to expected permanent income, that is the permanent income flow that the present value of the current stock of assets and future expected earned incomes and transfers can generate. This type of consumption smoothing is a consequence of assuming that consumers are *risk averse*. They are ready to give up some consumption in order to avoid being exposed to uncertainty, and therefore try spreading consumption over the life–cycle.

The expected permanent income hypothesis could for example be rationalised by assuming that consumers have quadratic instantaneous utility functions. The introduction of uncertainty in a *general* lifetime framework, not necessarily assuming quadratic utility functions, led to the discovery of an additional factor that might, in certain cases, contribute to understanding saving behaviour, the so–called *precautionary motive for saving.* Two future income streams with the same expected current value, but differing in variance, would yield the same optimal consumption path under the expected permanent income hypothesis. This needs not always to be the case. Some people would increase current saving when uncertainty about future incomes increases, while others might prefer in such a case to consume more today, because they are less sure about what future will bring, even if both are risk averse. The former are said to be *prudent*, exhibiting a *precautionary motive for saving.*

An insight into the formal underpinning of this argument stems from inspecting the Euler equation under uncertainty. It can indeed be shown that the Euler equation (13) remains valid in expected terms in the face of income, price or interest rate uncertainty (see Deaton, 1992, and a summary in Capéau, 2014, for a formal derivation). If we denote the expected value of a random variable x, given the information at time t, by $\mathrm{E}_t\{x\}$, then the Euler equation will in such a case reduce to:

$$u'(c_t; \mathbf{x}_t) = \mathrm{E}_t\left\{u'(c_{t+1}; \mathbf{x}_{t+1})\, \beta \frac{1+r_t}{1+\pi_t}\right\} . \quad (23)$$

Assume now that future prices and interest rates are known, and that the real interest rate equals the rate of time preference $(1-\beta)/\beta$. So, uncertainty is over future incomes y_t $(t > \tau)$. We then obtain:

$$u'(c_t; \mathbf{x}_t) = \mathrm{E}\left\{u'\left(c_{t+1}; \mathbf{x}_{t+1}\right)\right\}. \tag{24}$$

By comparing this equation with the solution under certainty (equation 13), we can illustrate graphically (see Figure 9) how and under which assumptions uncertainty introduces this additional *precautionary* motive for saving. Suppose first that there is no uncertainty. In that case, the assumption of risk aversion (a concave instantaneous utility function u) would imply that consumption today, c_t, should be equal to consumption tomorrow, as can be seen from the Euler equation ($u'(c_t) = u'(c_{t+1})$). Next, introduce future income uncertainty, and let optimal consumption be $\underline{c}_{t+1}$ when future income turns out to be low, and $\bar{c}_{t+1}$ when income would be high. Denote the expected value of these consumption values by $\mathrm{E}\{c_{t+1}\}$. Assume, as in the figure, that this expected value is equal to the original optimal value of current (and future) consumption: $c_t = \mathrm{E}\{c_{t+1}\}$. If the marginal utility of consumption is strongly convex (positive third derivative of the instantaneous utility function), then $\mathrm{E}\{u'(c_{t+1})\} > u'(c_t)$, and current consumption will have to fall (*e.g.* to c_t^* in the figure), which is tantamount to saying that saving should rise, in order to satisfy the Euler equation (24).[27]

Precautionary saving does only occur if consumers are prudent (technically, having a positive third derivative of the instantaneous utility function). People obeying the expected permanent income hypothesis have quadratic instantaneous utilities, and the third derivative is zero. As we saw, there is no precautionary saving in that case. Alternatively, if the marginal utility of consumption is strongly concave (negative third derivative), then there is a preference for consuming more today in case uncertainty over future incomes increases, even if the agent is risk averse.

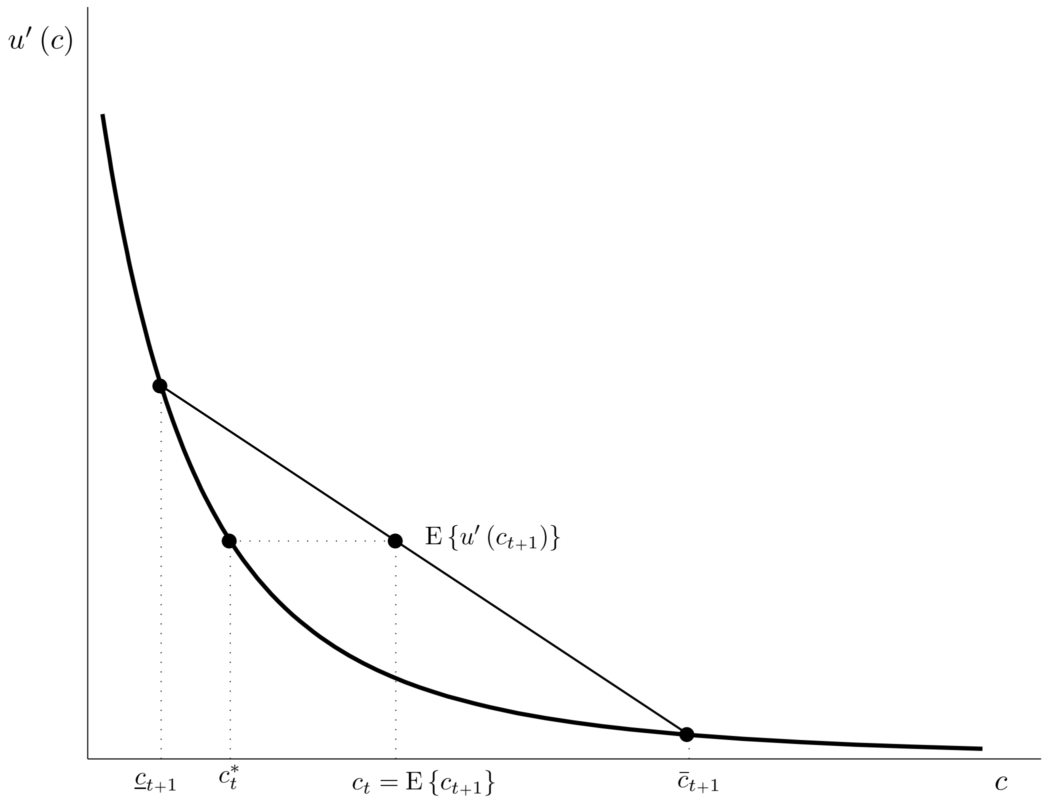
In the general formulation of the family of models that we consider here, the Euler equation under uncertainty can be formulated as:

$$\beta \mathrm{E}\left\{\left(\frac{c_t}{c_{t+1}}\right)^{\frac{1}{\sigma}} \frac{\gamma(n_{t+1}, e_{t+1})}{\gamma(n_t, e_t)} \frac{1+r_t}{1+\pi_t}\right\} = 1, \qquad \text{for } t = \tau, \ldots, \tau + T - 1. \tag{25}$$

As far as future household size is planned in advance, as it is in a number of cases, the γ–functions can be brought out from the range of the expectation operator. However, possible future events (such as sudden separation or falling suddenly in love and going to live with a(nother) partner, or unexpected infertility) would have to be considered as factors of which the likelihood to occur in the future might affect current behaviour. Jørgensen (2014) illustrates that introducing exogenous uncertainty in the

[27] Of course, if current consumption falls, and saving increases, planned future consumption should increase at some point in time. The figure is only a stylised picture, and the real equilibrium after introducing uncertainty can only be determined by solving the whole model recursively. But in the optimum, current consumption will always be lower than in the certainty case, and currently planned future consumption will increase.

Figure 9: Precautionary motive for saving



number of children *per se* would not seriously affect results. Things might become different however when household composition becomes an endogenous variable, or household size might affect income uncertainty. This is however beyond the scope of the present contribution.

4.4 Linearisation and aggregation

The Euler equation under uncertainty (25) is non–linear and presupposes an appropriate formulation of the expectations formation process. It has become common practice to log–linearise this equation (as first proposed by Hansen and Singleton, 1983, see equation (7) in Capéau and De Rock, 2014a). This practice was heavily criticised by Carroll (2001b) and Ludvigson and Paxson (2001). Carroll (1997) already showed that omitting the second order term from the linearisation was one of the reasons why it was overlooked that consumption growth tracking earned income growth can be reconciled with the life–cycle framework under uncertainty. Gourinchas and Parker (2002) notably argue that the estimated effect of household size on consumption growth would be biased using the linearisation approach, and takes over part of precautionary motive.[28] Attanasio and Low (2004) de-

[28] The recent contributions of Jørgensen (2014, 2015) argue that the bias is not so much a consequence of the linearisation, but of inappropriately taking into account implicit or explicit credit constraints in the Euler equation approach. Indeed, when households would like to increase consumption when new children arrive, but cannot because of credit constraints, one risks to underestimate for example the household composition effect.

fend the linearisation approach and argue that with a sufficiently long time period of observation and sufficient variation in the real interest rate, bias will be limited. Alan, Atalay and Crossley (2012) confirm this but are more sceptical about the applicability of their result on more realistic data structures. While we have quite some time variation in the real interest rate (see Figure 10 below), unfortunately our length of observation period (15 years) is rather short as to what these authors consider (30 to 60 years). Our point of departure is however different. In line with Browning and Ejrnæs (2009), we investigate in how far a richer specification of the effect of household demographics as commonly is the case, can explain observed patterns of consumption growth without invoking a precautionary motive for saving. Contrary to Browning and Ejrnæs (2009), we cannot completely reject the contribution of a precautionary motive (see the discussion of Figure 11 below). In that sense our results need to be interpreted with some care. We conjecture however that from a low frequency perspective as ours, the potential bias in the estimates caused by the linearisation would be limited, as life–cycle motives tend to predominate precautionary motives in the longer term.

For the family of models introduced in Section 4.2, the log–linearised version of the Euler equation reads as:

$$\ln\left(c_{t+1}\right) - \ln\left(c_t\right) = \sigma\left(\ln\beta + \ln\left(\frac{1+r_t}{1+\pi_t}\right) + \ln\left(\gamma\left(n_{t+1}, e_{t+1}\right)\right) - \ln\left(\gamma\left(n_t, e_t\right)\right)\right) + \varepsilon_{t+1}. \tag{26}$$

In this equation, ε_{t+1} embodies deviations of specific realisations of possible future values from their expected value (which on average are equal to zero), but also the error term due to the linearisation, which might be different from zero in expectation. It is the last one which causes potential biases in the estimates.

Equation (26) is supposed to hold for individual agents. By lack of true panel data, we will need to estimate it, however, at the cohort level. Aggregation should then be done carefully. In macroeconomic applications it was common practice to test this type of equations on aggregate data. That is, on per capita figures for consumption drawn from national yearly or quarterly accounts for consumption. The counterpart for our application would be to estimate the mean consumption of people belonging to a generation g in observation years t =1995/96, 1996/97, ..., 2010, making similar calculations for the household size and equivalence scale, and then estimate equation (26). However, this would introduce an aggregation bias.

An additional advantage of the log–linearised approach is that we can follow the aggregation procedure suggested by Blundell, Browning and Weber (1994), and Attanasio and Browning (1995b), which is more closely connected to the microeconomic foundation of these type of equations.[29] Indeed, as equation (26) characterises individual behaviour, it is more appropriate to aggregate the logarithmic transformations of the relevant variables. That is, we estimated, for each of the observation years t = 1995/96, 1996/97, 1997/98, and 1999 to 2010, means over all people belonging to the same

[29] See also Carroll (2014).

generation, of the log of consumption, the log of household size and the log of the equivalence scale.[30] By consumption, the household size and equivalence scale of a person, we mean the consumption, the household size and equivalence scale of the household to which that person belongs. If these means are good approximations of the population counterparts (which is a cohort at a particular age $a = t - g$), and individual behaviour satisfies (one of the) model(s) characterised by equation (26), then the aggregates of the logs should obey equation (26) too (while this need not be the case for the log of the aggregates).

We deviate again from the usual practice by calculating these numbers not for an arbitrarily chosen person in the household, but for all household members. This is in line with the argument we gave for interpreting the Euler equation as an equally valid characterisation of the behaviour of all household members (under the assumption they have identical preferences). We will denote the means of these logs as follows:

$$\ln(x)_{g,t} := \frac{\sum_{i \in g} w_{t,i} \ln(x_{t,i})}{\sum_{i \in g} w_{t,i}}, \tag{27}$$

where i refers to an *individual* in the survey; $i \in g$ means that this individual belongs to generation g (*i.e.*, is born in year g); $w_{t,i}$ is the sample weight of the household to which that individual belongs; and $x_{t,i}$ is the value in year t of the variable x for the household to which individual i belongs, with x being consumption, household size and equivalence scale.

5 Empirical implementation and implications for saving

5.1 Data selection and model specification

We have nested the log–linearised version of the Euler equations for the three models presented in Section 4.2, into the following equation:

$$\begin{aligned} \ln\left(\tfrac{c}{e}\right)_{g,t+1} - \ln\left(\tfrac{c}{e}\right)_{g,t} &= \psi + \sigma\left[\ln\left(\tfrac{1+r_t}{1+\pi_t}\right) + \ln(e)_{g,t} - \ln(e)_{g,t+1}\right] + \\ &\quad \chi\left[\ln(e)_{g,t+1} - \ln(e)_{g,t}\right] + \zeta\left[\ln(n)_{g,t+1} - \ln(n)_{g,t}\right] + \nu_{g,t+1}. \end{aligned} \tag{28}$$

Notice that when $\chi = \zeta = 0$, the equation reduces to the log–linearised version of the *pater familias* model (equation 18). When $\zeta = 0$ and $\chi = \sigma$, we obtain the caring mother model (equation 20). Finally, when $\chi = 0$ and $\zeta = \sigma$, the equation reduces to that of the efficient manager model (equation 22). Furthermore, $\exp(\psi/\sigma) = \beta$, and $\nu_{g,t+1}$ is a random disturbance term.

[30] In Appendix IV we report the number of observations on which these estimated means are based. Technically speaking, instead of calculating the log of the mean of a variable x, we calculated means over people belonging to generation g, of the log of x, for x being consumption, household size and equivalence scale observed in year t.

We estimated equation (28) on the basis of the data from 15 consecutive Belgian household budget surveys (so $t = 1996, \ldots, 2009$, in our case) and some externally gathered data on prices and interests. Consumption c, which is a variable in real terms, was measured by converting total expenditures, as observed in the budget survey, in prices of 1996. To this end the general Belgian consumer price index was used, available from STATBEL (the online statistics database of DGSIE/ADSEI).[31]
Household size is a variable available from the household budget surveys. In some early survey years, information was available on changes in the household composition during the whole year of observation, and we calculated the mean number of persons belonging to the household over the whole year in that case. Contrary to Browning and Ejrnæs (2009), who estimated equivalence scales as a function of the number of persons and their age, at cost of a more restrictive instantaneous utility function as ours, we fixed them in advance using the modified OECD–equivalence scale to calculate e.[32]
Figures on interest rates were drawn from two sources. For the older survey years (1996–2003) we relied on the Retail Interest Rate (RIR) series, and for the more recent years (2004-2014) we used the MFI–interest rates series (MIR). Both series are available on BELGOSTAT, the online statistics database of the National Bank of Belgium. We used the figures for interest rates on regular saving accounts.[33] Figure 10 presents the real interest rate which was constructed from these nominal interest rate figures and the consumer prices index, and which is used as an explanatory variable (in combination with the first difference of the log of the equivalence scale).

5.2 Empirical results

Our regression results are presented in the left hand panel of Table 1. The estimated intertemporal substitution elasticity is rather low, and equals about 0.55. The discount factor is not significantly different from one, which is surprisingly high. However, it is possible that the constant term absorbs some of the linearisation bias.

[31] Source: Spreadsheet "Consumptieprijsindex vanaf 1920 en gezondheidsindex vanaf 1994/Prix à la consommation à partir de 1920 et indice santé à partir de 1994", downloaded from `http://statbel.fgov.be/fr/statistiques/chiffres/economie/prix_consommation/` on 08/04/2014).

[32] This scale attributes to a single a scale e equal to one. In a multi–person household, one adult gets weight one in e, each *additional* adult (a person aged 14 years or more) counts for 0.5 additional units in e, and for each additional child, being a person younger than 14 years, 0.3 is added to the scale e. This equivalence scale, first proposed by Hagenaars *et al.* (1994), has replaced the older OECD scale in most OECD studies since the late 1990s. See `www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf`.

[33] The relevant RIR-series can be found in the second column (Dépôt d'épargne réglementé /Gereglementeerd spaardeposito) of the table: `www.nbb.be/belgostat` Domein/Domaine 232 Table/Tableau 158. For the MIR, these are in the last column under the heading "Remboursable avec préadvis d'une durée inférieure à trois mois/ Opneembaar met opzegtermijn tot drie maanden" of `www.nbb.be/belgostat` Domein/Domaine 4110 Table/Tableau 1. Both tables were downloaded on 18/10/2014. We also did the estimations using mortgage interest rates (available from the same sources), and an average of both these debt and credit rates. Results turned out not to be much affected by these choices.

Figure 10: Inflation, nominal and real interest rate

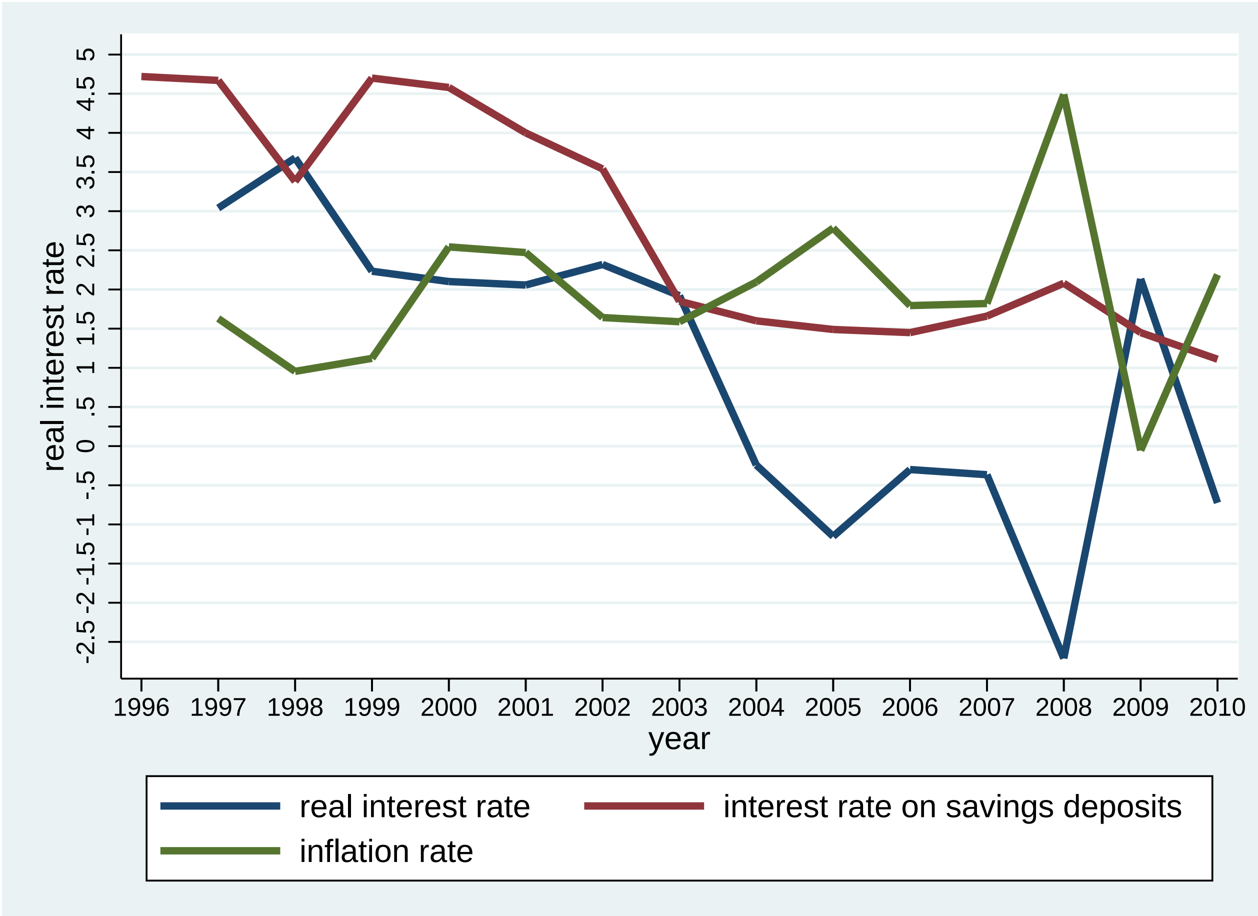


Table 1: Regression results for the Euler equation

parameter	coef.	Std. Err.	p–value	coef.	Std. Err.	p–value
σ	0.5518	0.1326	0.000	0.5096	0.1324	0.000
ζ	0.2778	0.1171	0.018	0.3715	0.1207	0.002
χ	-0.0097	0.2198	0.965	-0.2084	0.2288	0.363
ψ	-0.0013	0.0027	0.646	-0.0720	0.0224	0.001
% home owners				0.0862	0.0291	0.003
Age/10				0.0081	0.0042	0.057
$\text{Age}^2/100$				-0.0013	0.0005	0.014
β	0.9977	0.0047	0.000	.9854[a]	0.0074	0.000
	Number of obs.=1097	R^2=0.0316		Number of obs.=1097	R^2=0.0441	
	F(3,1096)=11.87	$\overline{R}^2$=0.0289		F(6,1090)=8.38	$\overline{R}^2$=0.0389	

[a] Evaluated at the sample mean for home–ownership, and for someone aged 65 years.

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Table 2: Model tests

Basic model	F–test	p–value
no contribution of efficient manager and caring mother	F(2,1093)	
to *pater familias*: $\chi = \zeta = 0$	6.82	0.0011
caring mother against *pater familias*	F(2,1093)	
$\sigma = \chi$ and $\zeta = 0$	9.29	0.0001
efficient manager against *pater familias*	F(2,1093)	
$\zeta = \sigma$ and $\chi = 0$	16.88	0.0000
Model extended with age and home–ownership	**F–test**	**p–value**
no contribution of efficient manager and caring mother	F(2,1090)	
to *pater familias*: $\chi = \zeta = 0$	7.84	0.0004
caring mother against *pater familias*	F(2,1090)	
$\sigma = \chi$ and $\zeta = 0$	12.00	0.0000
efficient manager against *pater familias*	F(2,1090)	
$\zeta = \sigma$ and $\chi = 0$	18.79	0.0000

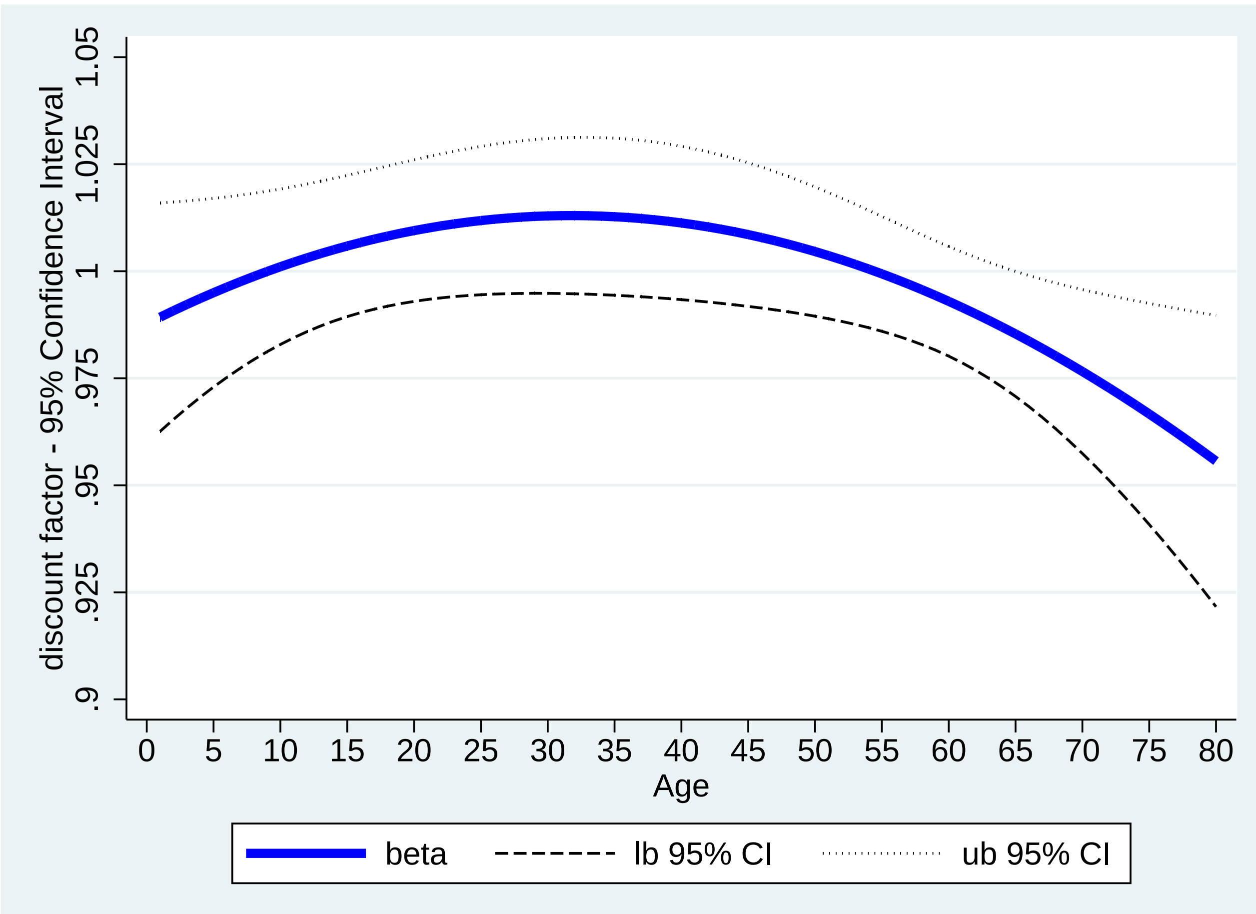
Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

In the upper part of Table 2 we test which of the three models, if any, best suits our data. We could not reject jointly the caring mother and efficient manager model against the *pater familias* model, mainly because household size seem to play a role in assessing the optimal consumption path, which would only apply to the efficient manager model. Nevertheless, none of these two would be accepted against the *pater familias* model. The estimated value of the parameter χ, referring to the caring mother model, has the wrong sign as compared to what it should be if that model would apply, and it is very close to zero, so that this model is rejected statistically. Even though household size has a significant contribution, the estimated value of the parameter ζ differs significantly from the estimated value of the substitution elasticity, while they should be equal in case the efficient manager model applies.

Summarising, it turns out that our model that has a more flexible formulation of the γ–function (i.e. $n^{\zeta/\sigma}e^{(1+\chi-\sigma)/\sigma}$) performs better. This indicates that we need a combination of all three models to explain the data. The parameter estimates of that model indicate that a 1% increase of n_{t+1}/n_t results in a 0.28% increase in c_{t+1}/c_t, while c_{t+1}/c_t should rise by 0.44% in response to a 1% increase of e_{t+1}/e_t.

The potential influence of being an owner–occupier on the optimal consumption path was tested by including, at the cohort level, the percentage of home owners at each particular age we observe that cohort, as an additional explanatory variable. In this way heterogeneity in the discount factor could be allowed for. We also allowed the substitution elasticity to vary with home–ownership, but it turned out to be insignificant. A one percentage point increase of home–ownership in a particular generation, results in an increase of 0.08% in c_{t+1}/c_t. This is low as compared to the effect of a 1% increase in n_{t+1}/n_t (0.37% increase in c_{t+1}/c_t for the parameter estimates reported in the right hand panel of Table 1), and respectively e_{t+1}/e_t (0.28% increase in c_{t+1}/c_t for the parameter estimates in the right hand panel of Table 1).

Figure 11: Discount factor and age



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Furthermore, it was investigated whether the personal characteristics age and cohort could still add explanatory power to the model. We first included several dummy–specifications for these effects, as well in the specification of the substitution elasticity, as in the discount factor.[34] We always rejected the hypothesis of significant contribution. Nevertheless, adding a non–linear (more specifically)

[34] Detailed results are available upon request.

quadratic trend in age could not be rejected (see the right hand panel of Table 1). Hence, the evidence on the contribution of age to the discount rate is mixed depending on whether one uses a dummy specification (no age effect) or a quadratic specification (acceptance of an age effect).

As above, we again tested the three models against each other for the specification of the regression equation extended with home–ownership and a quadratic age effect in the specification of the discount factor (lower panel of Table 2). The conclusions are the same as for the basic regression equation: none of the three models is outdoing the other two. The more flexible model performs better.

Finally, Figure 11 draws the resulting age pattern of the discount factor. On average, the discount factor remains very close to one, but it exhibits a decline at the very end of the life–cycle. This stands to reason, as we did not account for lifetime uncertainty, which would result in a declining discount factor (Yaari, 1965). Impatience is lowest (and the discount factor highest, yielding a value of 1.013) at an age of 32 years. Then the discount factor decreases slowly (and thus impatience rises) to reach a value of 0.967 at the age of 75. The decline of the discount factor is so small that the upper bound of the 95% confidence interval at the age of 75 is almost equal to the lower bound of the confidence interval at the age of 32. The effect of age on consumption growth is small relative to the contribution of other factors: an increase of the age with five years results in an increase of c_{t+1}/c_t of at most 0.0041%.

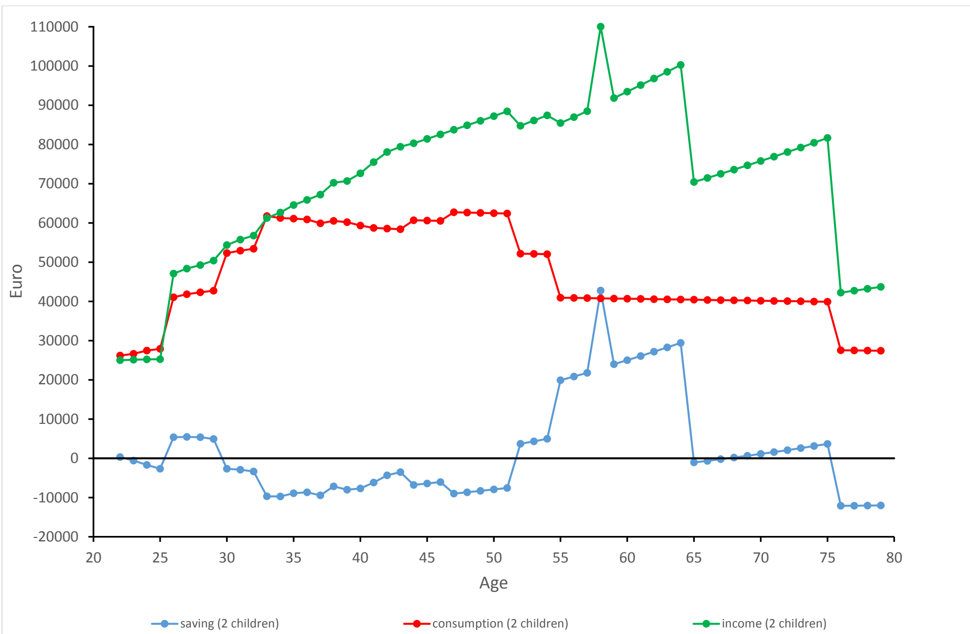
Browning and Ejrnæs (2009) argue that additional non–linear age effects would reject the hypothesis that household size and composition can sufficiently capture or replace effects which are usually attributed to the precautionary motive. However, the most important consequence of needing to include individual characteristics into the Euler equation, is that it breaks down our assumption of identical preferences of household members, and thus the microeconomic foundation of our model. It urges the need to develop models in which intra–household intertemporal decision making is taken account of. We come back to this issue in our concluding remarks.

5.3 Implications for saving

To illustrate the lessons that can be learned from our model for saving behaviour, we simulate its predictions for a fictitious individual. The numbers that are chosen are meant to be realistic, but are not crucial for our obtained conclusion. The individual is assumed to be single in the beginning of her life–cycle, and working. Wages are indexed and, on top of that, real wages are assumed to increase at a rate of 0.5% on a yearly basis due to labour productivity growth. At the age of 26, she starts cohabiting with a working partner of the same age. Together they earn 1.75 times the income she had as a single before. At the age of 30 years a first child is born, yielding a child allowance of 2000 € on a yearly basis. A second child is born when she is 33 years old, and gives right to an additional 3000 € per year. Children leave the household at the age of 22, that is when the person we are following is 52, and respectively 55 years old. The first child leaving causes a drop in child allowances of 3000 €, and the remaining 2000 € is lost when the second child leaves the house. At the age of 58 years, an inheritance of 20000 € is acquired. At the age of 65, the partners retire, falling back on 1.2 times the wage a single could earn at that moment. At the age of 76 the person's partner dies, and she falls back on 60% of the wage a single could earn at that moment.[35]

In Figure 12 we depict the optimal saving (light blue line), consumption (light red line) and income (green line) paths for the household in which this person lives. As can be seen, during moments that there is no change in household composition, consumption remains almost flat (slightly decreasing at the end of the life–cycle, slightly increasing at the beginning, to be precise). That is because the rate of time preference almost equals the real interest rate (the product of one plus the real interest rate and the discount factor is *e.g.* 0.998 during the last twenty years of the life–cycle, and larger than one up to the age of 32 years).

Figure 12: Optimal saving, consumption and income path for the baseline simulation



The major fluctuations in consumption are driven by changes in household composition: the cohabitation with a partner at age 26, the first and second child, at age 30, respectively 33; the children leaving the house at age 52, respectively 55, and the loss of the partner at age 76. Expected income shocks, such as the inheritance at age 58 or the fall in income due to retirement, do not affect consumption, but are absorbed by saving. Living together with a working partner increases saving, which is due to the fact that household needs are more easily met when cohabiting. Adding non–earning household members (children) increases household needs, and since the estimated substitution elasticity is lower

[35] More details on this simulation exercise are available from the authors.

than one, our estimated model has the property of shifting consumption towards periods of more urgent needs. When the children grow older (than 14 years), satisfying their needs becomes more demanding and consumption increases. When they leave the house, and the partner dies, household consumption falls. For our specific simulation, the household starts to deplete assets, and saving thus becomes negative, from the moment the first child is born up to the moment that this child leaves the household. At the very beginning of the life–cycle borrowing occurs, up to the moment the person starts cohabiting (recall that we have no liquidity constraints in our model).

The Figures 13–16 represent results for a number of specific *ceteris paribus* analyses. That is, each time, we consider the change in exactly one of the variables in our base scenario used in the simulation exercise. In Figure 13, we focus on the implications of changing the household composition. That is, we assume that the mother bears an additional child at age 37, everything else remaining the same. So, we do not include the potential effect of additional child allowances, but keep earned income and transfers fixed to their levels in the two children scenario. The dark blue and red line in the upper panel represent the newly simulated saving and consumption behaviour, while the light blue and red lines repeat the results of the baseline simulation.

As can be seen on the figure, the household shifts consumption to the periods when three children are present in the house, at the cost of the periods when the person is single, cohabiting without children, or the first two children are born (compare the light and dark red line in the figure). This is reflected in higher saving figures at the beginning and the end of the life–cycle (compare the light and dark blue line).

The light and dark green lines marked by circles in the bottom panel give the evolution of disposable income in the two scenarios (two and three children). Despite keeping *earned* income and transfers identical in both scenarios, *disposable income* is different due to the changes in saving behaviour. Since the relative difference is not that big, we also represent the absolute difference in both scenarios (light green line marked by squares, and measured on the right axis). Due to higher saving at the beginning of the life–cycle in the three children case, disposable income, which includes interest income from past savings, is higher in the beginning of the life–cycle (see the dark green line, or the light green line marked by squares). In case three children are planned, the household saves up to the moment the second child is born, whereas the two child household already starts depleting assets from the moment the first child is born. From the moment the third child is born, the rate of assets depletion becomes more intense for the three child household, and the disposable income of the two children household eventually will exceed that of the three children household at the age of 52. When all children left the household, the difference in disposable income starts to diminish again, due to lower consumption of the household members at the end of the life–cycle in case they raised three children rather than two.

Figure 13: Sensitivity of saving, consumption and income to changes in household composition

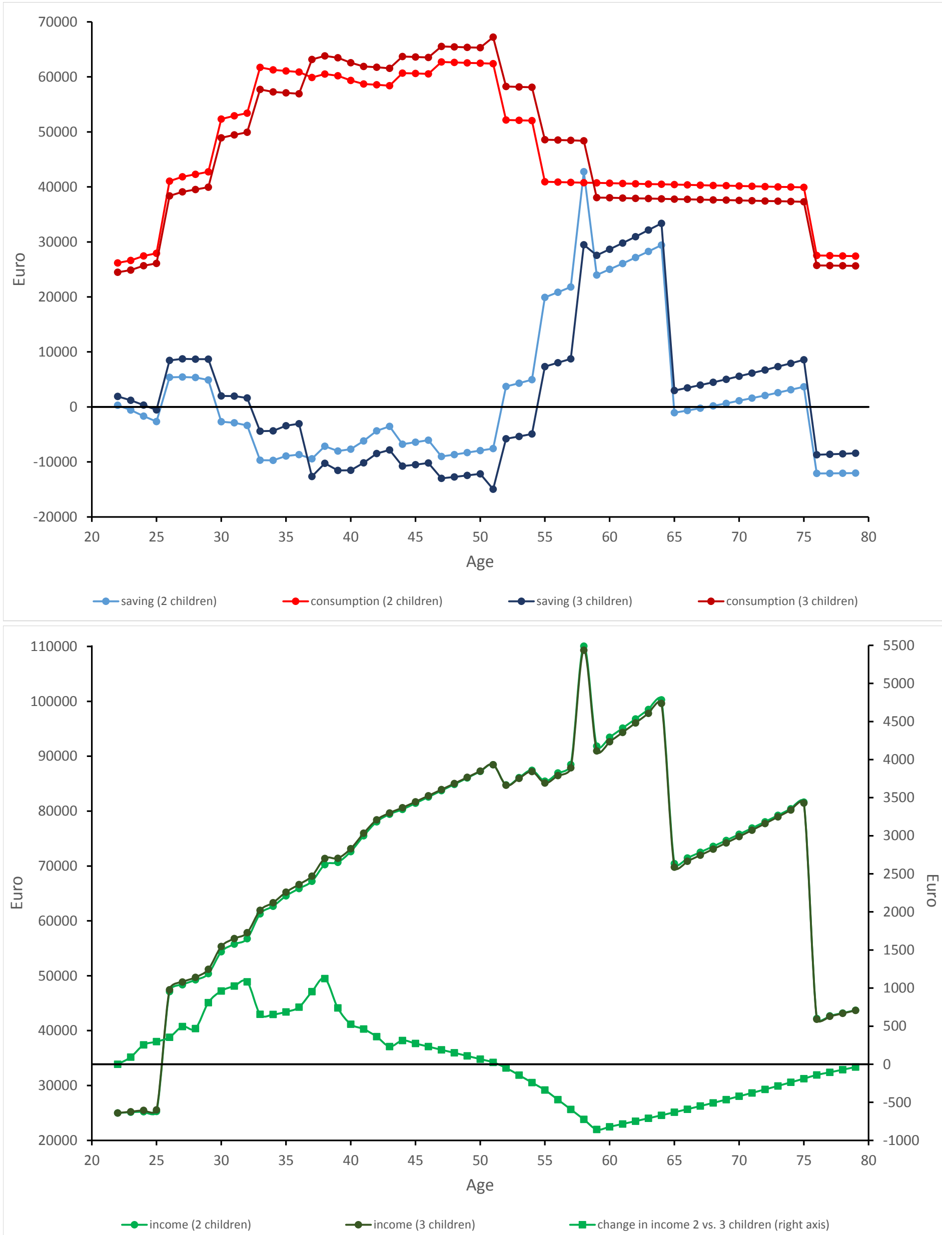
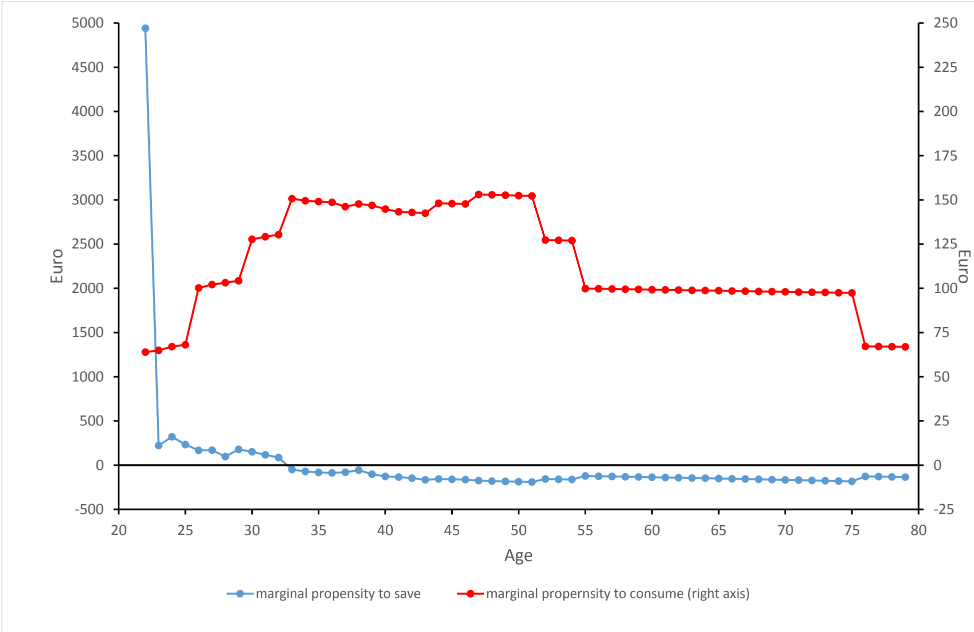


Figure 14 presents results for a similar *ceteris paribus* analysis, but this time for a helicopter drop of 5000 € in the first period (instead of having an extra child). We represent in the figure the *change* in saving and consumption in response to the income shock, and this is therefore the counterpart in a fully dynamic model of the *marginal propensity* to consume (respectively save) out of income: it represents the change in consumption (respectively saving) *at each point in the life–cycle* when current disposable income increases. The extra money turns out to be almost completely absorbed by saving in the first period which increases by almost 4940 €. This additional saving is spread out over increased consumption during the entire life–cycle. Consumption is rising more at periods of higher household needs. Note that the same effect *on consumption* would be obtained if earned income at another moment of the life–cycle would have been risen such that lifetime income would increase by 5000 €.

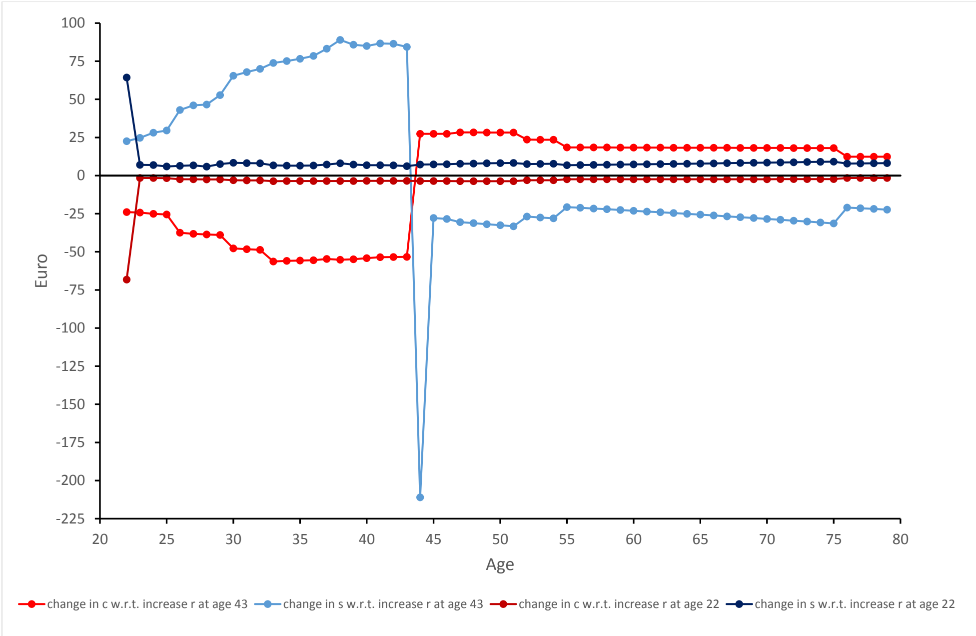
Figure 14: Marginal propensity to save and consume out of disposable income



Next, in Figure 15 the impact of a change in the interest rate is depicted. We investigated two scenarios: a one shot increase in the interest rate at the beginning of the life–cycle (dark coloured lines), and one at the moment when the person is 43 years old (light coloured). The last one implies a gradual increase in saving up to the moment of the upward jump in the interest rate, and a sharp fall just after the interest rate increased, to return to a saving level that is lower than with the original interest rates. Consumption is relocated towards the end of the life–cycle. For the periods that consumption falls, this reduction is larger the greater needs are. This is however compensated by the sharp upward jump after the interest increased, which is at a moment when household needs are still below their maximal value, which occurs between the age of 47 and 51.

Interestingly, an augmentation of the first period interest rate has a negative impact on consumption over the whole life–cycle. That is partly because the present value of future earned incomes declines as interest rises, and this effect is larger the earlier in the life–cycle this increase happens. But this is only part of the explanation, since future consumption becomes also relatively cheaper in periods following the rise in interest rates. A one shot increase in the interest rate at a particular moment in time incites a relocation of consumption from the periods preceding the change, towards periods after the rise. In case of an increase of the interest rate in the first period of the life–cycle, only the first period consumption is preceding the shock, and the increase in saving during that one period is not enough to guarantee higher consumption during subsequent years, since it bears only during one period a larger interest. This seems to be a general property of the present model, and not to be dependent on the size of the interest rate increase.

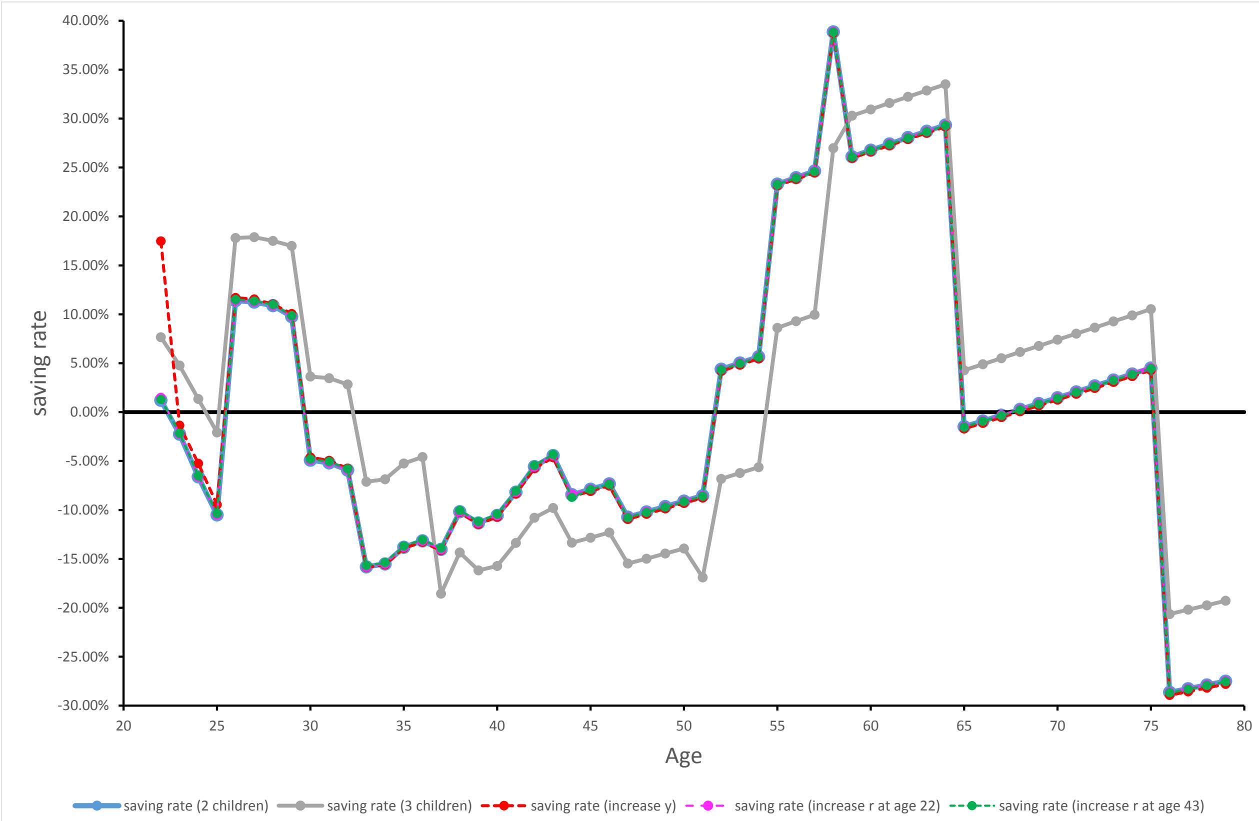
Figure 15: Sensitivity of saving (s) and consumption (c) to a change in interest rate at different ages



Finally, Figure 16 shows the impact of the three sensitivity exercises on the saving rate. As it turns out, changes in the interest rate hardly affect the saving rate. We noticed already in Figure 13 that expected income shocks are absorbed by saving, so that on the longer term, the saving rate remains largely unaffected by such a shock. For example, a temporary income shock at the beginning of the life–cycle has only a temporary effect on the saving rate. On the contrary, a change in household composition affects the optimal saving rate during the whole life–cycle substantially. Notice that in this model, despite saving closely tracking income, the saving rate need not be constant in the optimum. Given our estimates, the saving rate is low at periods when household needs are largest. The saving rate is higher at the beginning of the life–cycle than at the end. In the beginning of the life–cycle, the saving rate is decreasing over time during periods when household composition is constant, while the reverse is the case at the end of the life–cycle. In the present simulations, this is largely a consequence of the relative magnitude of the rate of time preferences and the real interest rate, but this is no analytic result.

We can conclude that anticipated business cycle effects caused by shocks in earned income and transfers have mainly a short term impact on saving and the saving rate. Expected changes in the interest rates have a large impact effect on saving and consumption and a persistent long term effect caused by the long term impact of such an interest change on (the present value of) earned income and transfers. The saving rate is hardly affected by expected interest rate changes. The longer term dynamics of the model are however in the first place driven by (expected) changes in household composition. These also affect the saving rate on the long term, contrary to changes in interest rates and income.

Figure 16: Sensitivity of saving rate for all scenarios



6 Concluding remarks

In the present paper we have investigated age and cohort effects in the saving pattern of Belgian households. We constructed a pseudo–panel dataset on the basis of a concatenation of 15 waves of the Belgian household budget surveys (1995/96, 1996/97, 1997/98, and 1999 to 2010) collected yearly by the Belgian statistical office DGSIE/ADSEI–SPF/FOD Economie. In this way we could follow the average consumption, income and saving path of persons belonging to the same generation, as they age. From a time series analysis we concluded that the age profile of the saving rate seems to be connected with household size and composition.

Subsequently, we presented a class of intertemporal utility models that allow to give a microeconomic foundation for the impact of household size and composition on consumption and saving behaviour. We find evidence that Belgian households reallocate income to expenditures for consumption at moments when needs are highest (when children are growing adult and still live at home). Expected changes in income have primarily a short run effect on saving, while an expected temporary change in the interest rate in the middle of the life–cycle has both, a short run impact and longer term effects. *Preceding* the moment of increase in the interest rate, saving increases, such that a larger stock of assets is held at the moment of the increase. After the shock, a large drop in saving occurs (assets are depleted), allowing for an upward jump in consumption, and then consumption is maintained at the higher level.

There is however also mild evidence for including non–linear age effects as additional explanatory variables in the Euler equation that characterises the optimal consumption and saving path. More in particular, the discount factor seems to decline at the end of a person's life–cycle. According to Browning and Ejrnæs (2009) this might indicate that household size and composition, as specified by our model, cannot capture sufficiently the dynamics in observed households' consumption and saving behaviour, and, presumably, a precautionary motive for saving can add to the explanatory power of the model.

Importantly however, including personal characteristics in the Euler equation breaks down the microeconomic foundations of our model, which rest on the assumption that all household members have identical intertemporal preferences. If this is not the case, and one wants to leave room for personal characteristics in the specification of the Euler equation, then one has either to assume that there is one particular member of the household whose personal characteristics are to be taken into account, or analysis at the household level should be subsumed in an intertemporal model of the intra–household decision making process.

The first track was silently adopted by the bulk of the existing literature, by introducing individual characteristics of one particular individual in an analysis at the household level. We tried in the present contribution to avoid this practice, without needing therefore to develop an intertemporal intra–household decision making model. This came at cost of making the assumption of identical intertemporal preferences among household members.

An alternative reduced form approach (that is, not derived from a model on intertemporal decision making) in the spirit of the Deaton–Paxson cohort analysis allows to estimate the contribution of an individual household member at each particular age, on household saving. Deaton and Paxson (2000) showed for example how to estimate the contribution of the presence of individual household members of a particular age on household saving.[36]

Structural intertemporal models of intra–household decision making are still in its infancy (see *e.g.* Mazzocco, 2007 and 2008, Adams, Cherchye, De Rock and Verriest, 2014, and Lise and Yamada, 2014). While Mazzocco (2008) showed that it is possible in some cases to estimate such models with consumption information only at the household level, true panel data, and individual information on labour supply of the household members seem to be indispensable. Whether it is possible to identify the elements of such a model with the kind of pseudo–panel data of which we disposed for the present study, is an open question in the literature.

[36] See equation 13 of Capéau and De Rock, 2014a.

References

[1] Adams A., L. Cherchye, B. De Rock & E. Verriest (2014) "Consume now or later? Time inconsistency, collective choice and revealed preference," *American Economic Review* vol. 104, 4147–4183.

[2] Alan S., Th. Crossley & H. Low (2012) "Saving on a rainy day, borrowing for a rainy day," IFS Working Paper W12/11.

[3] Alan S., K. Atalay & Th. Crossley (2012) "Euler equation estimation on micro data," Koç University–Tüsiad Economic Research Forum Working Papers Series, no. 1221, Koç University: Tüsiad.

[4] Alessie R., M.P. Devereux & G. Weber (1997) "Intertemporal consumption, durables and liquidity constraints: A cohort analysis," *European Economic Review* vol. 41(1), 37–59.

[5] Ando A., L. Guiso L. & I. Visco (eds.) (1994, repr. 2006) *Saving and the Accumulation of Wealth. Essays on Italian Household and Government Saving Behavior*, Cambridge University Press, Cambridge.

[6] Attanasio O.P., J. Banks, C. Meghir & G. Weber (1999) "Humps and bumps in lifetime consumption," *Journal of Business & Economic Statistics* vol. 17(1), 22–35.

[7] Attanasio O.P. & M. Browning (1995a) "Consumption over the life cycle and over the business cycle," *American Economic Review* vol. 85(5), 1118–1137.

[8] Attanasio O.P. & M. Browning (1995b) "Is consumption growth consistent with intertemporal optimization? Evidence from the Consumer Expenditure Survey," *Journal of Political Economy* vol. 103(6), 1121–1157.

[9] Attanasio O.P. & H. Low (2004) "Estimating Euler equations," *Review of Economic Dynamics*, vol. 7(2), 405–435.

[10] Attanasio O.P. & G. Weber (2010) "Consumption and saving: Models of intertemporal allocation and their implications for public policy," *Journal of Economic Literature* vol. 48(3), 693–751.

[11] Barrett G., Th. Crossley & K. Milligan (2010) "An international comparison of savings rates from microdata and national accounts," Presentation NBER summer 2010.

[12] Basselier R. & G. Langenus (2014) "Recent changes in saving behaviour by Belgian households: The impact of uncertainty," *Economic Review* (National Bank of Belgium), December 2014, 53–62.

[13] Battistin E., A. Brugiavini, E. Rettore & G. Weber (2009) "The retirement consumption puzzle: evidence from a regression discontinuity approach," *American Economic Review* vol. 99(5), 2209–2226.

[14] Blundell R., M. Browning & C. Meghir (1994) " Consumer demand and the life–cycle allocation of household expenditures," *Review of Economic Studies* vol. 61(1), 57–80.

[15] Browning M. (2002) "The saving behaviour of a two–person household," *Scandinavian Journal of Economics* 102(2), 235–251.

[16] Browning M., P.–A. Chiappori and Y. Weiss (2014) *Economics of the Family*, Cambridge University Press: Cambridge.

[17] Browning M. & T.F. Crossley (2001a) "The life–cycle model of consumption and saving," *The Journal of Economic Perspectives* vol. 15(1), 3–22.

[18] Browning M. & T.F. Crossley (2001b) "Unemployment insurance benefit levels and consumption changes," *Journal of Public Economics* vol. 80(?), 1169–1192.

[19] Browning M. & T.F. Crossley (2009) "Shocks, stocks, and socks: smoothing consumption over a temporary income loss," *Journal of the European Economic Association* vol. 7(6), 1169–1192.

[20] Browning M., A. Deaton & M. Irish (1985) "A profitable approach to labor supply and commodity demands over the life–cycle," *Econometrica* 53(3), 503–543.

[21] Browning M. & M. Ejrnæs (2009) "Consumption and children," *Review of Economics and Statistics* vol. 91(1), 93–111.

[22] Browning M. & A. Lusardi (1996) "Household saving: Micro theories and micro facts," *Journal of Economic Literature* vol. 34(4), 1797–1855.

[23] Burbidge J. & J.B. Davies (1994) "Household data on saving bahavior in Canada," in: J. Poterba (ed.) *International Comparisons of Household Saving*, Chicago University Press: Chicago, 11–56.

[24] Campbell J.Y. & A. Deaton (1989) "Why is consumption so smooth?" *Review of Economic Studies*, vol. 56(3), 357–373.

[25] Campbell J.Y. & N.G. Mankiw (1989) "Consumption, income, and interest rates: Reinterpreting the time series evidence," in O. Blanchard and S. Fischer (eds.) NBER *Macroeconomics Annual*, MIT Press: Cambridge MA, 185–216.

[26] Campbell J.Y. & N.G. Mankiw (1991) "The response of consumption to income: A cross-county investigation," *European Economic Review*, vol. 35(4), 723—756. MIT Press: Cambridge MA, 185–216.

[27] Cannari L. (1994) "Do demographic changes explain the decline in the saving rate of Italian households?" in: Ando A., L. Guiso L. & I. Visco (eds.) (1994, repr. 2006) *Saving and the Accumulation of Wealth. Essays on Italian Household and Government Saving Behavior,* Cambridge University Press, Cambridge, 106–127.

[28] Capéau B. (2014) "Intertemporal utility optimisation," mimeo.

[29] Capéau B. & B. De Rock (2014a) "A cohort approach to asses the effect of demographics on saving behaviour. An overview paper," First report January 2014 of the NBB–BNB–project: Analysis of saving behaviour on the basis of a concatenation of Belgian Household Surveys.

[30] Capéau B. & B. De Rock (2014b) "Cohort, age and time effects on saving behaviour," Intermediary report July 2014 of the NBB–BNB–project: Analysis of saving behaviour on the basis of a concatenation of Belgian Household Surveys.

[31] Capéau B. & J. Pacolet (2008) "Gezinssamenstelling en intertemporele consumptieprofielen. Een exploratie op basis van de huishoudbudgetonderzoeken 1995/96–2004," mimeo, HIVA – K.U.Leuven: Leuven.

[32] Capéau B., K. Heylen & J. Pacolet (2010) "Wie is de eigenaar van de eigen woning?" mimeo, HIVA – K.U.Leuven: Leuven.

[33] Carroll C.D. (1992) "The buffer–stock theory of saving: Some macroeconomic evidence," *Brooking Papers on Economic Activity* vol. 2, 67–135.

[34] Carroll C.D. (1997) "Buffer–stock saving and the life–cycle/permanent income hypothesis," *Quarterly Journal of Economics* vol. 112(1), 1–55.

[35] Carroll C.D. (2001a) "A theory of the consumption function, with and without liquidity constraints," *Journal of Economic Perspectives*, vol. 15(3), 23–45.

[36] Carroll C.D. (2001b) "Death to the log-linearized consumption Euler equation! (And very poor health to the second-order approximation)," *Advances in Macroeeconomics (The B.E. Journal of Macroeconomics)*, vol. 1(1), 1–38.

[37] Carroll C.D. (2002) "Why do the rich save so much?" in: J.B. Slemrod (ed.) *Does Atlas Shrug? The Economic Consequences of Taxing the Rich*, Harvard University Press: Harvard, 465–484.

[38] Carroll C.D. (2014) "Representing consumption and saving without a representative consumer," in: D.W. Jorgenson, S.J. Landefeld & P. Schreyer (eds.) *Measuring Economic Sustainability and Progress*, University of Chicago Press: Chicago and London, 115–134.

[39] Deaton A. (1985) "Panel data from time series of cross sections," *Journal of Econometrics* 30(1-2), 109–126.

[40] Deaton A. (1991) "Saving and liquidity constraints," *Econometrica* vol. 59(5), 1221–1248.

[41] Deaton A. (1992) *Understanding Consumption*, Clarendon Press: Oxford.

[42] Deaton A. (1997) *The Analysis of Household Surveys. A Microeconometric Approach to Development Policy*, John Hopkins University Press: Baltimore.

[43] Deaton A. & J. Muellbauer (1980) *Economics and Consumer Behavior*, Cambridge University Press: Cambridge.

[44] Deaton A. & C. Paxson (1994) "Saving, growth, and ageing in Taiwan," in: D.A. Wise (ed.) *Studies in the Eeconomics of Aging*, Chicago University Press for the National bureau of Economic Research: Chicago, 331–357.

[45] Deaton A. & C. Paxson (2000) "Growth and saving among individuals and households," *The Review of Economics and Statistics* vol. 82(2), 212–225.

[46] Deboosere P., R. Lesthaeghe, J. Surkyn, D. Willaert, P.-M. Boulanger, A. Lambert & L. Lohlé–Tart (2009) *Ménages et Familles en Belgique – Huishoudens en Gezinnen in België*, SPF–FOD Economie, DGSIE–ADSEI: Bruxelles/Brussel.

[47] Decoster A., E. Schokkaert & K. Spiritus (2013) "Intergenerationele ongelijkheid in welvaart – feiten en waarden," paper presented at Studiedag–Journée d'étude, Belgisch Instituut Openbare Financiën – Institut Belge des Finances Publiques « Le coût du vieillissement démographique : quelle solidarité entre les générations ? »– « De kosten van de vergrijzing: Welke solidariteit tussen de generaties? », 25 februari 2013 – 25 février 2013, `Decoster, Schokkaert, Spiritus, intergenerationale ongelijkheid in welvaart.pdf`

[48] Dynan K.E., J. Skinner & S.P. Zeldes (2004) "Do the Rich Save More?" *Journal of Political Economy* vol. 112(2), 397–444.

[49] Ebert U. (1997) "Social welfare when needs differ: An axiomatic approach," *Economica* vol. 64(254), 233–244.

[50] Epstein L.G. & S.E. Zin (1989) "Substitution, risk aversion, and the temporal behavior of consumption and asset returns: a theoretical framework," *Econometrica* vol.57 No.4, 937–969.

[51] Flavin M. (1981) "The adjustment of consumption to changing expectations about future income," *Journal of Political Economy* vol. 89(5), 974-1009.

[52] Freyland F. (2005) "Household composition and savings: An empirical analysis based on the German SOEP data," MEA Discussion Papers 88–2005, Mannheim.

[53] Friedman M. (1957) *A theory of the consumption function*, Princeton University Press: Princeton.

[54] Gourinchas P.-O. & J.A. Parker (2002) "Consumption over the life cycle," *Econometrica* vol. 70(1), 47–89.

[55] Hagenaars A.K., K. de Vos & M.A. Zaidi (1994) "Poverty statistics in the late 1980s: Research based on micro–data," Office for Official Publications of the European Communities, Luxembourg.

[56] Hall R.E. (1978) "Stochastic implications of the life cycle-permanent income hypothesis: theory and evidence," *Journal of Political Economy*, vol. 86(6), 971–987.

[57] Hansen L.P. & K.J. Singleton (1983) "Stochastic consumption, risk aversion and the temporal behavior of asset returns," *Journal of Political Economy*, vol. 91(2), 249–265.

[58] Hayashi F. (1981) "The permanent income hypothesis: Estimation and testing by instrumental variables,"*Journal of Political Economy*, vol.90(5), 971–987

[59] Hayashi F. (1985) "The effect of liquidity constraints on consumption: a cross–sectional analysis," *Quarterly Journal of Economics* vol. 100(1), 165–181.

[60] Hayashi F. (1987) "Tests for liquidity constraints: A critical survey and some new observations," in: T. Bewley (ed.) *Advances in Econometrics,* Fifth World Congress vol. II, Cambridge University Press: New York, 91–120.

[61] Heckman J. (1974) "Life cycle consumption and labor supply: An explanation of the relationship between income and consumption over the life cycle," *American Economic Review* vol.64(1), 188–194.

[62] Heylen F. (2004, 2nd ed.) *Macro–economie*, Garant: Antwerpen/Apeldoorn.

[63] Jappelli T. & F. Modigliani (2005) "The age–saving profile and the life–cycle hypothesis," in: F. Modigliani, *The collected papers of Franco Modgliani* Vol. 6, MIT press: Cambridge, Massachusetts, 141–172.

[64] Jørgensen T.H. (2014) "Euler equation estimation: children and credit constraints," Discussion Papers Department of Economics, University of Copenhagen, No. 14–25.

[65] Jørgensen T.H. (2015b) "Life–cycle consumption and children: Evidence from a structural estimation," Discussion Papers Department of Economics, University of Copenhagen, No. 15–08.

[66] Kimball M.S. (1990) "Precautionary saving in the small and in the large," *Econometrica* vol. 58(1), 53–73.

[67] Lewbel A. (1989) "Household equivalence scales and welfare comparisons," *Journal of Public Economics* vol.39(3), 377–391.

[68] Lewbel A. (1997) "Consumer demand systems and household equivalence scales," in: M.H. Pesaran & P. Schmidt (eds.) *Handbook of Applied Econometrics,* Vol.II:*Microeconomics*, Blackwell Publishers: Oxford, 167–201.

[69] Lise J. & K. Yamada (2014) "Household sharing and commitment: Evidence from panel data on individual expenditures and time use," mimeo.

[70] Ludvigson S. & C. Paxson (2001) "Approximation bias in linearized Euler equations," *The Review of Economics and Statistics*, vol. 83(2), 242–256.

[71] Mazzocco M. (2007) "Household intertemporal behaviour: A collective characterization and a test of commitment," *Review of Economic Studies*, vol. 74(3), 857–895.

[72] Mazzocco M. (2008) "Individual rather than household Euler equations: identification and estimation of individual preferences using household data," mimeo.

[73] Modigliani F. & R.H. Brumberg (1954) "Utility analysis and the consumption function: an interpretation of cross-section data," in: K.K. Kurihara (ed.), *Post-Keynesian Economics*, Rutgers University Press: New Brunswick, 388–436.

[74] Nagatani K. (1972) "Life cycle saving: Theory and fact," *American Economics Review* vol. 62(3), 344–353.

[75] Pacolet J. & A. Van Steenbergen (2007), "Bestaat de spaarparadox in België?" in B. Cantillon, K. Van den Bosch & S. Lefebure (eds.), *Ouderen in Vlaanderen 1975–2005*, ACCO: Leuven, 203–230.

[76] Sargent T.J. (1978) "Rational expectations, econometric exogeneity, and consumption," *Journal of Political Economy,* vol.86(4), 673–700.

[77] Shorrocks, A.F. (2004) "Inequality and welfare evaluation of heterogeneous income distributions," *Journal of Economic Inequality* vol. 2(3), 193–218.

[78] Skinner J. (2007) "Are you sure you're saving enough for retirement?" *Journal of Economic Perspectives* vol. 21(3), 59–80.

[79] Yaari M.E. (1965) "Uncertain lifetime, life insurance, and the theory of the consumer," *Review of Economic Studies* vol. 32(2), 137–150.

[80] Zeldes S.P. (1989a) "Optimal consumption with stochastic income: Deviations from certainty equivalence," *The Quarterly Journal of Economics* vol. 104(2), 275–298.

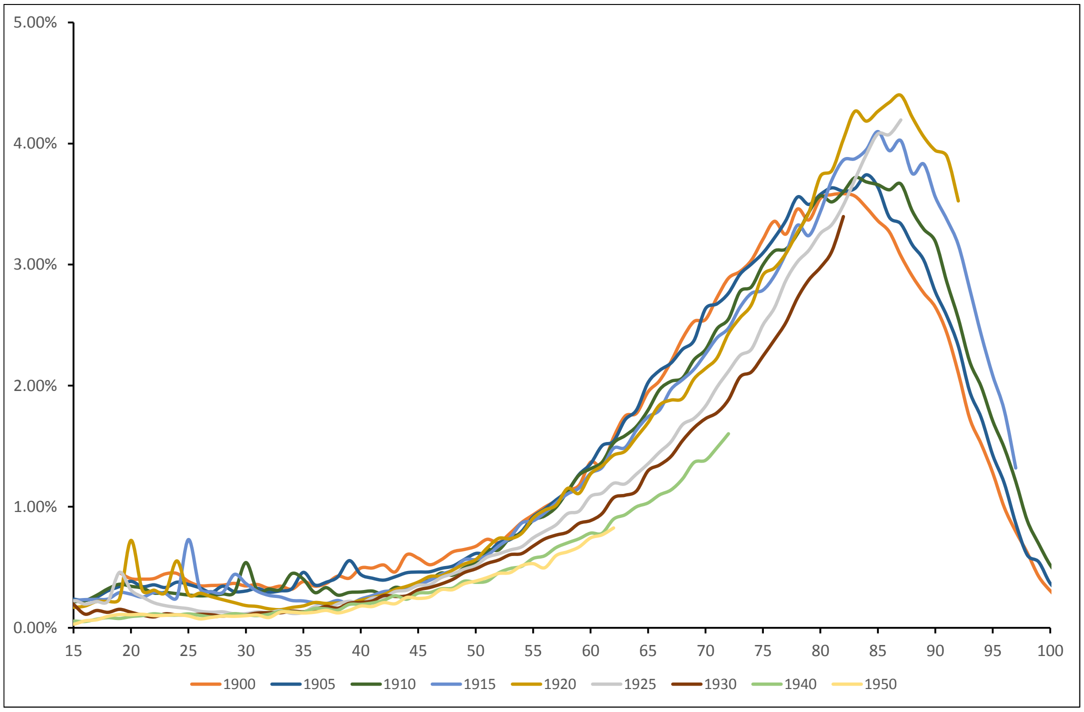
[81] Zeldes S.P. (1989b) "Consumption and liquidity constraints: An empirical investigation," *Journal of Political Economy* vol. 97(2), 305–346.

Appendices

Appendix I More people reach average life expectancy *versus* increasing life expectancy

In Figure A.I we highlight two aspects of longevity on the basis of the age specific mortality rate by cohort, which can be calculated from a life table. By age specific mortality rate by cohort we mean the probability that someone will die at a particular age conditional on belonging to a cohort born in a specific year. The first observation we draw from the figure is that the later the birth date of the cohort, the more the curve shifts to the right. The probability to die younger decreases and that of dying older increases, which implies that life expectancy at birth rises. This is well–known. A second observation, which is peculiar to this graph, is less commonly made. More people reach the mode, the age at which most people die, and this mode shifts only slightly to the right. Increasing probability to die later is only one aspect of longevity. Another factor, that gains in importance, is that more people reach the age at which most people die. Even if the top of this curve would not shift any more to the right, this could still imply increasing life expectancy, even though the relative number of people within a generation growing very old, would no longer increase. This would be the case if the gain of the number of people reaching the mode would be at the expense of those dying younger.

Figure A.I: Age specific mortality rate by cohort



Source: Own calculation on the basis of the mortality rate figures available from the life tables in the Human Mortality Database of the University of California, Berkeley (USA) and the Max Planck Institute for Demographic Research (Germany). These data are available at `www.mortality.org` or `www.humanmortality.de`. The version we drew from the net on November 10th 2014 contains life tables until 2012. That is the reason why data are truncated earlier, the later the generation is born.

Appendix II Descriptive statistics

The next tables contain descriptive statistics for the four main variables that we constructed from the data for the analysis in this paper: real household saving (rsav), real household consumption inclusive of fictive rents for owner–occupied houses (rcons), real household disposable income which excludes fictive revenues from house–ownership (rdispinc) (all in 1996 prices), and the household saving rate. For conversions into real terms, the general consumer price index from the spreadsheet "Consumptieprijsindex vanaf 1920 en gezondheidsindex vanaf 1994/Prix à la consommation à partir de 1920 et indice santé à partir de 1994" was used (downloaded from `statbel.fgov.be consumptieprijzen/prix à la consommation` on 08/04/2014).

Surprisingly, real income and consumption in 2009 (the first full year of the great recession) seem to be exceptionally high. One of the potential explanations for the 2009 figures is the effect of the index jump in the wages during the first quarter of that year which captured the high inflation of 2008 (4.5% on a yearly base), but implied a real increase in incomes for 2009, which was a year during which there occurred price deflation (-0.05%). Low income and consumption figures in 2008, the starting year of the great recession, stand to reason.

Variable	Obs	Weight	Mean	Std. Dev.	Min	Max
year=1996						
rsav	2724	4027755	4098.258	9344.219	-50587.66	115388.4
rcons	2724	4027755	24782.53	12083.67	3189.596	112316.7
rdispinc	2724	4027755	25105.75	14707.75	-982.4269	147833.5
year=1997						
rsav	2041	4039270	6148.644	19996.39	-38050.38	250701.1
rcons	2041	4039270	24660.50	11830.48	4782.835	100574.1
rdispinc	2041	4039270	26827.30	23913.65	-721.2401	286735.8
year=1998						
rsav	2213	4089466	3180.732	19004.16	-55862.59	303648.3
rcons	2213	4089466	25646.94	13450.79	2868.606	181886
rdispinc	2213	4089466	24740.77	22855.68	936.97	337684.3
year=1999						
rsav	3744	4218725.03	8001.456	24060.28	-148155.3	368401.6
rcons	3745	4219389.59	26321.04	17036.04	3612.388	173108.2
rdispinc	3744	4218725.03	30580.83	28477.03	-113188.9	509366.2
year=2000						
rsav	3816	4259763.82	7073.888	24297.25	-203294.3	477841.5
rcons	3816	4259763.82	26641.30	17273.34	3091.038	215460.9
rdispinc	3816	4259763.82	29822.42	27292.3	-140942.6	523981.4
year=2001						
rsav	3726	4268303.53	3177.184	16268.02	-112829.3	156583.3
rcons	3726	4268303.53	26282.65	16968.21	3686.406	171426.2
rdispinc	3726	4268303.53	25583.24	18298.27	-22598.57	314932.4

Variable	Obs	Weight	Mean	Std. Dev.	Min	Max
year=2002						
rsav	3721	4100320.12	4292.515	20584.29	-195178.1	838045.1
rcons	3721	4100320.12	26552.59	16553.67	2916.993	219688.4
rdispinc	3721	4100320.12	26963.47	22172.8	-83086.87	896508.4
year=2003						
rsav	3729	4169479.71	4096.752	15078.09	-84626.28	143122.9
rcons	3731	4170633.43	26196.58	15583.69	2359.918	171215
rdispinc	3729	4169479.71	26547.24	17558.74	-33408.55	177925.7
year=2004						
rsav	3785	4068598.24	3874.951	16965.24	-186549.7	114638.4
rcons	3785	4068598.24	26778.59	16619.37	3283.947	221935.1
rdispinc	3785	4068598.24	26925.4	18049.28	-147454.5	156523.3
year=2005						
rsav	3550	4384238.83	4074.881	16997.78	-110052	213316.7
rcons	3550	4384238.83	26622.75	16328.97	4782.528	145611
rdispinc	3550	4384238.83	27113.74	19639.94	-55383.66	248032
year=2006						
rsav	3783	4436428.58	4086.843	16694.56	-153579.8	298911
rcons	3783	4436428.58	26235.65	16438.33	2579.726	206966.7
rdispinc	3783	4436428.58	27081.68	19091.11	-21774.84	363982
year=2007						
rsav	3746	4438451.47	3535.331	17466.2	-257752.9	167310.57
rcons	3746	4438451.47	26606.67	18546.05	3092.029	322701.69
rdispinc	3746	4438451.47	26900.57	17857.19	-139558.2	211854.47
year=2008						
rsav	3671	4509257.66	4059.593	17748.96	-245003.3	222198.3
rcons	3671	4509257.66	25782.17	16986.05	3262.623	311940.3
rdispinc	3671	4509257.66	26599.95	18812.68	-93297.88	284907.7
year=2009						
rsav	3597	4564599.18	5205.701	16971.18	-113187.2	177855.4
rcons	3599	4567978.02	26934.2	16331.5	3089.388	172278.1
rdispinc	3597	4564599.18	28609.88	19967.31	-26223.57	271787.3
year=2010						
rsav	3574	4616022.21	4433.155	17189.25	-180565.3	406661.8
rcons	3578	4622406.98	26630.67	16827.37	3528.461	213430.2
rdispinc	3574	4616022.21	27583.65	19856.4	-39352.96	504791.1

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

For the saving rate medians are reported rather than means. In this way, high sensitivity to outliers of this statistic when calculated on the base of micro–data, is avoided. The yearly medians seem to confirm the drop in saving rate in 1998, followed by the peak years 1999 and 2000, as we noticed in Section 3.3. Potentially, these yearly jumps are affected by changes in the survey methodology over years (1999 being the year that a four month recall period for durable and irregular purchases was introduced, as compared to yearly registration of large purchases during a whole year in earlier versions of the survey). However, that the median saving rate returns after 1999 to a level comparable to the

1995/96 and 1996/97 survey years, makes that change in methodology can only serve as a partial explanation. The median saving rate for the survey year 1997/98 is nevertheless extremely low, and we have no indication that this would reflect a real economic event.

It might be tempting to compare these figures with their macro–counterpart, the saving rate of households, defined as gross (that is not corrected for depreciation) saving of households and non–profit organisations rendering services to households (B8g in the ESA 2010 national accounting system) divided by gross (without correction for depreciation) disposable income (B6g) plus adjustment for the change in net equity of households in pension funds reserves (D8). Nevertheless, it should be stressed that both are different concepts. The macro saving rate is the fraction of total (or mean) saving over total (or mean) disposable income, while the micro saving rate is the mean (or median as reported here) over all households of saving over disposable household income. Both concepts (the rate of mean saving over mean disposable income *versus* the mean of the rates of saving over disposable income), do *not* generally coincide. We therefore calculated also the counterpart of this macro–concept with the budget survey data in the penultimate column of the table below (defined as mean saving over mean disposable income) and compare it with the figures from the national accounts.

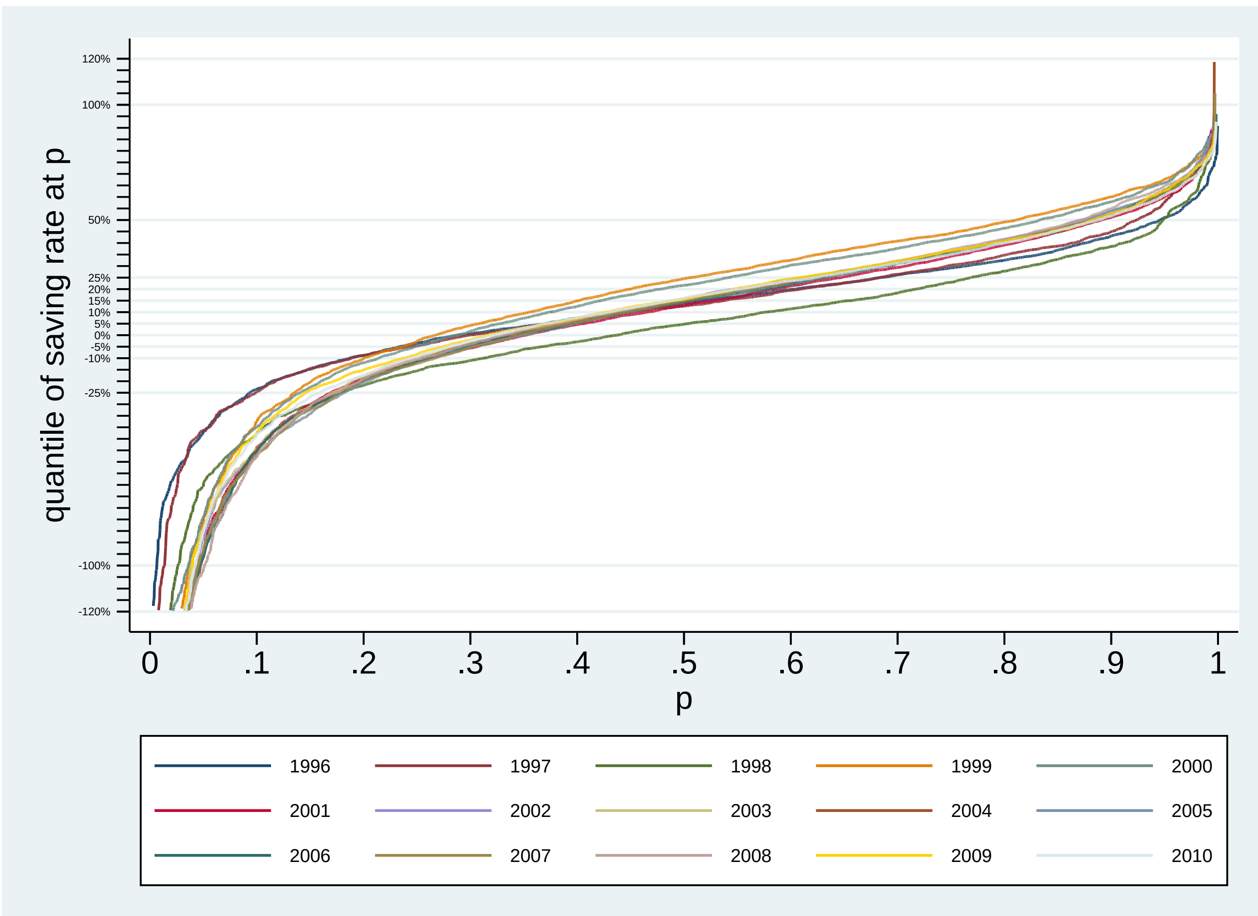
year	median saving rate (%)	lower bound 95%CI	upper bound 95%CI	mean saving/ mean disposable income	macro household saving rate[a]
1996	13.75	12.75	15.08	16.54	18.22
1997	12.57	11.80	13.82	24.93	17.54
1998	04.74	3.46	5.92	12.40	17.07
1999	24.48	22.99	25.75	30.40	17.11
2000	21.65	20.56	22.76	26.55	16.44
2001	12.94	11.60	14.23	12.09	17.67
2002	15.73	14.26	17.32	16.17	17.05
2003	15.55	14.15	16.72	15.64	16.70
2004	14.39	13.21	15.91	14.47	15.62
2005	14.80	13.49	15.90	15.31	15.41
2006	14.79	13.18	15.77	15.58	16.09
2007	14.94	13.50	16.32	13.29	16.38
2008	15.71	14.51	17.20	15.75	16.92
2009	15.60	14.53	17.23	19.33	18.43
2010	16.05	14.74	17.49	16.65	16.07

[a] Basselier and Langenus (2014) and own calcuations on the basis of the sectoral accounts S.14 (households) and S.15 (non–profit organisations rendering services to households) from the national accounts, as follows: gross saving (B8g)/(gross disposable income (B6g)+ adjustment for changes in net equity of pension funds (D8)). Source for the national accounts: `www.nbb.be/belgostat` Domein/Domaine 810 Tabel/Tableaux 28 and `www.nbb.be/belgostat` Domein/Domaine 810 Tabel/Tableau 29, downloaded on 07/12/2014. Other data are based on calculations from Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

The macro–concept mimicked with the budget survey data is still rather low in survey year 1997/98,

though higher than that of 2001. Contrary to the micro–concept, the macro–concept does however confirm the peak in the saving rate in the first full year of the great recession year, 2009, as observed in the figures constructed from the national accounts. Comparisons of saving rates from micro–data and national accounts are also discussed in Barrett, Crossley and Milligan (2010).
Basselier and Langenus (2014) study the effect of uncertainty on the household saving rate in Belgium as constructed from macro–figures (national accounts) and give empirical evidence for the precautionary motive serving as an explanation for the *post* great recession peak.

Figure A.II: Quantile plots of the saving rate by observation year



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Figure A.II presents a quantile graph of the saving rate in our data for each of the observation years. It contains the value below which the saving rate of $100p\%$ of the household population falls according to our data, for $p \in [0, 1]$. The figure confirms that the saving rate for values between the first and third quartile is considerably lower in 1997/98 as compared to other observation years, according to our data. The values of this variable in the lowest and highest quartile are however not especially extreme as compared to other observation years. So we don't think that the figures for 1997/98 are more affected by outliers than for other observation years, quite to the contrary.

It is noteworthy that over 30% of the households exhibit a *negative* saving rate. Saving becomes positive at the 27–th percentile in 1999, while for the survey year 1997/1998 saving remains negative up to the 44–th percentile. For other survey years the switch from negative to positive saving rates is situated between the 30–th and 35–th percentile.

Negative saving occurs when expenditures exclusive of fictive rents for home–ownership are higher than disposable income, and thus some of the expenditures are financed through credit loans or depleting assets. Saving rates larger than one are caused by negative disposable income. Negative disposable incomes occur in case of large income losses during a particular year. This is mainly caused by the income tax settlement bill. In that case, saving rates difficult to interpret (households that have to lend more than they earn in order to finance their consumption expenditures, since they also have to borrow in order to finance income losses of the current year). In practice, these households will be dropped from the Deaton–Paxson regression analysis in the paper, due to our trimming rule (saving rate should be included in the $[-120\%, 120\%]$–interval in order to be included in the regression analysis), since their saving rate exceeds 120% in all but one case. The one exception will not affect the results however.

Appendix III Deaton–Paxson regressions

Dependent variable: saving rate					
Model statistics					
Number of obs = 109475	$F(172, 109302) = 17.79$	$Prob > F = 0.0000$	$R^2 = 0.0272$	$\bar{R}^2 = 0.0257$	Root MSE = 0.33615

Cohort effects

Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval		indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval	
birth 1931	0.0069	0.0157	0.44	0.661	-0.0239	0.0377	birth 1971	0.0488	0.0192	2.54	0.011	0.0111	0.0865
birth 1932	0.0105	0.0157	0.67	0.504	-0.0203	0.0413	birth 1972	0.0457	0.0193	2.37	0.018	0.0079	0.0836
birth 1933	-0.013	0.0158	-0.84	0.402	-0.0443	0.0177	birth 1973	0.0578	0.0194	2.98	0.003	0.0198	0.0959
birth 1934	-0.018	0.0160	-1.17	0.243	-0.0500	0.0127	birth 1974	0.0552	0.0197	2.80	0.005	0.0166	0.0938
birth 1935	0.0010	0.0161	0.06	0.948	-0.0304	0.0325	birth 1975	0.0818	0.0199	4.12	0.000	0.0429	0.1207
birth 1936	-0.005	0.0159	-0.31	0.755	-0.0362	0.0262	birth 1976	0.0837	0.0199	4.21	0.000	0.0448	0.1226
birth 1937	-0.011	0.0160	-0.71	0.476	-0.0426	0.0199	birth 1977	0.0779	0.0201	3.88	0.000	0.0385	0.1172
birth 1938	-0.020	0.0160	-1.25	0.210	-0.0513	0.0113	birth 1978	0.0918	0.0201	4.57	0.000	0.0524	0.1311
birth 1939	-0.017	0.0161	-1.09	0.277	-0.0489	0.0140	birth 1979	0.0882	0.0203	4.36	0.000	0.0485	0.1279
birth 1940	-0.018	0.0163	-1.11	0.268	-0.0501	0.0139	birth 1980	0.1075	0.0203	5.29	0.000	0.0676	0.1473
birth 1941	-0.019	0.0170	-1.12	0.264	-0.0522	0.0143	birth 1981	0.1036	0.0205	5.06	0.000	0.0634	0.1437
birth 1942	-0.030	0.0168	-1.83	0.068	-0.0635	0.0023	birth 1982	0.0955	0.0206	4.63	0.000	0.0551	0.1360
birth 1943	-0.016	0.0166	-1.01	0.313	-0.0494	0.0158	birth 1983	0.1201	0.0208	5.77	0.000	0.0793	0.1608
birth 1944	-0.022	0.0164	-1.34	0.179	-0.0542	0.0101	birth 1984	0.1066	0.0209	5.09	0.000	0.0656	0.1477
birth 1945	-0.018	0.0167	-1.12	0.262	-0.0515	0.0140	birth 1985	0.1027	0.0209	4.90	0.000	0.0617	0.1438
birth 1946	-0.018	0.0166	-1.12	0.262	-0.0512	0.0139	birth 1986	0.1191	0.0212	5.63	0.000	0.0777	0.1606
birth 1947	-0.007	0.0167	-0.47	0.640	-0.0405	0.0249	birth 1987	0.1113	0.0212	5.25	0.000	0.0698	0.1528
birth 1948	-0.002	0.0168	-0.14	0.890	-0.0354	0.0307	birth 1988	0.1072	0.0213	5.03	0.000	0.0654	0.1490
birth 1949	-0.012	0.0169	-0.73	0.467	-0.0455	0.0209	birth 1989	0.1103	0.0213	5.17	0.000	0.0685	0.1521
birth 1950	-0.017	0.0172	-1.01	0.315	-0.0509	0.0164	birth 1990	0.1089	0.0214	5.10	0.000	0.0671	0.1508
birth 1951	-0.000	0.0173	-0.04	0.970	-0.0346	0.0333	birth 1991	0.1057	0.0214	4.94	0.000	0.0638	0.1477
birth 1952	0.0086	0.0174	0.50	0.620	-0.0255	0.0427	birth 1992	0.1073	0.0215	5.00	0.000	0.0652	0.1493
birth 1953	0.0107	0.0174	0.62	0.537	-0.0234	0.0449	birth 1993	0.1223	0.0216	5.65	0.000	0.0798	0.1647
birth 1954	0.0172	0.0175	0.98	0.327	-0.0171	0.0514	birth 1994	0.1159	0.0218	5.31	0.000	0.0731	0.1586
birth 1955	0.0365	0.0176	2.08	0.037	0.0021	0.0710	birth 1995	0.0955	0.0219	4.36	0.000	0.0526	0.1384
birth 1956	0.0167	0.0177	0.94	0.346	-0.0180	0.0514	birth 1996	0.1174	0.0221	5.31	0.000	0.0740	0.1607
birth 1957	0.0155	0.0177	0.88	0.379	-0.0191	0.0502	birth 1997	0.1177	0.0223	5.27	0.000	0.0739	0.1614
birth 1958	0.0278	0.0177	1.57	0.117	-0.0069	0.0625	birth 1998	0.1250	0.0224	5.57	0.000	0.0811	0.1690
birth 1959	0.0283	0.0178	1.58	0.113	-0.0067	0.0632	birth 1999	0.1288	0.0228	5.66	0.000	0.0842	0.1734
birth 1960	0.0331	0.0179	1.85	0.064	-0.0020	0.0681	birth 2000	0.1178	0.0229	5.13	0.000	0.0728	0.1627
birth 1961	0.0335	0.0180	1.86	0.063	-0.0018	0.0687	birth 2001	0.1184	0.0233	5.08	0.000	0.0727	0.1641
birth 1962	0.0286	0.0181	1.58	0.113	-0.0068	0.0640	birth 2002	0.1352	0.0237	5.71	0.000	0.0888	0.1816
birth 1963	0.0459	0.0182	2.52	0.012	0.0103	0.0815	birth 2003	0.1563	0.0242	6.45	0.000	0.1088	0.2037
birth 1964	0.0327	0.0182	1.79	0.073	-0.0030	0.0684	birth 2004	0.1283	0.0247	5.20	0.000	0.0799	0.1767
birth 1965	0.0405	0.0184	2.20	0.028	0.0044	0.0766	birth 2005	0.1399	0.0253	5.52	0.000	0.0903	0.1896
birth 1966	0.0457	0.0185	2.47	0.013	0.0095	0.0820	birth 2006	0.1508	0.0262	5.77	0.000	0.0995	0.2021
birth 1967	0.0496	0.0186	2.66	0.008	0.0131	0.0861	birth 2007	0.1490	0.0276	5.41	0.000	0.0950	0.2030
birth 1968	0.0388	0.0188	2.06	0.039	0.0019	0.0757	birth 2008	0.1522	0.0284	5.35	0.000	0.0965	0.2079
birth 1969	0.0552	0.0189	2.93	0.003	0.0182	0.0922	birth 2009	0.1791	0.0317	5.64	0.000	0.1169	0.2413
birth 1970	0.0556	0.0190	2.93	0.003	0.0184	0.0929							

Cyclical time effects and constant

Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval		indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval	
time 1998	-0.0832	0.0042	-19.58	0.000	-0.0915	-0.0749	time 2005	-0.0055	0.0037	-1.48	0.138	-0.0128	0.0018
time 1999	0.0724	0.0036	20.28	0.000	0.0654	0.0794	time 2006	-0.0168	0.0036	-4.65	0.000	-0.0239	-0.0097
time 2000	0.0409	0.0036	11.35	0.000	0.0338	0.0480	time 2007	-0.0105	0.0036	-2.91	0.004	-0.0175	-0.0034
time 2001	-0.0070	0.0037	-1.90	0.058	-0.0142	0.0002	time 2008	-0.0001	0.0035	-0.03	0.975	-0.0070	0.0068
time 2002	-0.0017	0.0037	-0.46	0.648	-0.0090	0.0056	time 2009	0.0175	0.0035	5.03	0.000	0.0107	0.0243
time 2003	-0.0010	0.0037	-0.28	0.783	-0.0084	0.0063	time 2010	0.0026	0.0033	0.77	0.443	-0.0040	0.0091
time 2004	-0.0114	0.0037	-3.09	0.002	-0.0187	-0.0042	const.	0.0187	0.0230	0.81	0.416	-0.0264	0.0639

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Dependent variable: saving rate(ctd.)													
Age effects													
Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval		indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval	
age 01	0.0458	0.0126	3.63	0.000	0.0211	0.0706	age 41	0.1083	0.0175	6.19	0.000	0.0740	0.1426
age 02	0.0262	0.0128	2.05	0.041	0.0011	0.0512	age 42	0.1114	0.0175	6.35	0.000	0.0770	0.1458
age 03	0.0294	0.0129	2.28	0.022	0.0042	0.0547	age 43	0.0969	0.0177	5.48	0.000	0.0623	0.1316
age 04	0.0434	0.0131	3.32	0.001	0.0178	0.0690	age 44	0.0876	0.0179	4.90	0.000	0.0526	0.1226
age 05	0.0359	0.0131	2.73	0.006	0.0101	0.0616	age 45	0.1067	0.0180	5.92	0.000	0.0714	0.1420
age 06	0.0336	0.0133	2.53	0.011	0.0076	0.0596	age 46	0.0942	0.0182	5.19	0.000	0.0586	0.1298
age 07	0.0366	0.0133	2.74	0.006	0.0104	0.0627	age 47	0.1037	0.0183	5.65	0.000	0.0677	0.1396
age 08	0.0249	0.0135	1.85	0.064	-0.0015	0.0513	age 48	0.0945	0.0185	5.12	0.000	0.0583	0.1307
age 09	0.0315	0.0135	2.33	0.020	0.0050	0.0581	age 49	0.1051	0.0187	5.62	0.000	0.0685	0.1417
age 10	0.0221	0.0137	1.61	0.107	-0.0047	0.0489	age 50	0.0994	0.0188	5.29	0.000	0.0626	0.1363
age 11	0.0214	0.0138	1.55	0.122	-0.0057	0.0484	age 51	0.1181	0.0189	6.24	0.000	0.0810	0.1552
age 12	0.0168	0.0139	1.21	0.228	-0.0105	0.0441	age 52	0.1103	0.0190	5.81	0.000	0.0731	0.1475
age 13	0.0192	0.0140	1.37	0.171	-0.0083	0.0468	age 53	0.1172	0.0193	6.08	0.000	0.0794	0.1549
age 14	0.0168	0.0142	1.19	0.235	-0.0109	0.0446	age 54	0.1107	0.0194	5.71	0.000	0.0727	0.1486
age 15	0.0155	0.0144	1.08	0.280	-0.0127	0.0437	age 55	0.1129	0.0197	5.74	0.000	0.0744	0.1515
age 16	0.0198	0.0144	1.37	0.170	-0.0085	0.0481	age 56	0.0928	0.0197	4.70	0.000	0.0541	0.1315
age 17	0.0084	0.0148	0.57	0.572	-0.0207	0.0374	age 57	0.0964	0.0199	4.85	0.000	0.0575	0.1354
age 18	0.0038	0.0149	0.25	0.800	-0.0255	0.0331	age 58	0.0782	0.0198	3.94	0.000	0.0393	0.1171
age 19	-0.0082	0.0152	-0.54	0.590	-0.0380	0.0216	age 59	0.0866	0.0202	4.28	0.000	0.0470	0.1262
age 20	-0.0204	0.0156	-1.31	0.190	-0.0509	0.0101	age 60	0.0525	0.0202	2.60	0.009	0.0130	0.0921
age 21	-0.0313	0.0158	-1.98	0.047	-0.0623	-0.0004	age 61	0.0537	0.0203	2.64	0.008	0.0139	0.0935
age 22	-0.0137	0.0161	-0.85	0.394	-0.0452	0.0178	age 62	0.0592	0.0205	2.89	0.004	0.0190	0.0993
age 23	-0.0322	0.0162	-1.98	0.047	-0.0641	-0.0004	age 63	0.0603	0.0207	2.91	0.004	0.0197	0.1010
age 24	-0.0030	0.0163	-0.18	0.854	-0.0351	0.0290	age 64	0.0268	0.0208	1.29	0.197	-0.0139	0.0676
age 25	0.0125	0.0163	0.76	0.444	-0.0195	0.0446	age 65	0.0073	0.0211	0.34	0.731	-0.0342	0.0487
age 26	0.0249	0.0162	1.53	0.125	-0.0069	0.0567	age 66	0.0136	0.0212	0.64	0.522	-0.0280	0.0552
age 27	0.0469	0.0163	2.88	0.004	0.0150	0.0789	age 67	0.0055	0.0215	0.26	0.798	-0.0366	0.0476
age 28	0.0530	0.0162	3.27	0.001	0.0212	0.0849	age 68	0.0340	0.0218	1.56	0.118	-0.0087	0.0768
age 29	0.0622	0.0162	3.83	0.000	0.0304	0.0940	age 69	0.0153	0.0223	0.69	0.493	-0.0284	0.0590
age 30	0.0883	0.0164	5.37	0.000	0.0561	0.1205	age 70	0.0246	0.0228	1.08	0.281	-0.0201	0.0693
age 31	0.0803	0.0165	4.86	0.000	0.0479	0.1127	age 71	0.0316	0.0232	1.36	0.174	-0.0140	0.0772
age 32	0.0849	0.0165	5.15	0.000	0.0526	0.1172	age 72	0.0326	0.0240	1.36	0.174	-0.0144	0.0795
age 33	0.1086	0.0167	6.50	0.000	0.0758	0.1413	age 73	0.0020	0.0251	0.08	0.935	-0.0471	0.0512
age 34	0.1089	0.0168	6.48	0.000	0.0759	0.1418	age 74	0.0545	0.0262	2.08	0.038	0.0032	0.1059
age 35	0.1142	0.0169	6.75	0.000	0.0810	0.1474	age 75	0.0757	0.0281	2.69	0.007	0.0206	0.1307
age 36	0.0985	0.0169	5.82	0.000	0.0653	0.1316	age 76	0.0624	0.0298	2.09	0.036	0.0040	0.1208
age 37	0.1197	0.0172	6.98	0.000	0.0861	0.1533	age 77	0.0745	0.0335	2.23	0.026	0.0089	0.1401
age 38	0.1166	0.0171	6.80	0.000	0.0830	0.1501	age 78	0.0555	0.0387	1.43	0.151	-0.0203	0.1314
age 39	0.1109	0.0173	6.43	0.000	0.0771	0.1448	age 79	0.0542	0.0479	1.13	0.258	-0.0396	0.1480
age 40	0.1094	0.0174	6.29	0.000	0.0753	0.1434	age 80	-0.1303	0.1040	-1.25	0.210	-0.3342	0.0736

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Dependent variable: saving rate (regression with control for household size)

Model statistics

Number of obs = 109475	$F(173, 109301) = 19.89$	$Prob > F = 0.0000$	$R^2 = 0.0305$	$\bar{R}^2 = 0.0290$	Root MSE = 0.33558

Cohort effects and household size

Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf.	Interval	indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf.	Interval
birth 1931	0.0066	0.0157	0.42	0.673	-0.0241	0.0373	birth 1971	0.0598	0.0192	3.11	0.002	0.0221	0.0975
birth 1932	0.0097	0.0157	0.62	0.536	-0.0210	0.0404	birth 1972	0.0574	0.0193	2.98	0.003	0.0196	0.0951
birth 1933	-0.0128	0.0158	-0.81	0.419	-0.0437	0.0182	birth 1973	0.0705	0.0194	3.63	0.000	0.0325	0.1086
birth 1934	-0.0186	0.0160	-1.16	0.245	-0.0499	0.0127	birth 1974	0.0696	0.0197	3.54	0.000	0.0310	0.1081
birth 1935	0.0010	0.0160	0.06	0.951	-0.0304	0.0324	birth 1975	0.0963	0.0198	4.85	0.000	0.0574	0.1352
birth 1936	-0.0043	0.0159	-0.27	0.788	-0.0354	0.0269	birth 1976	0.0980	0.0198	4.94	0.000	0.0591	0.1369
birth 1937	-0.0102	0.0159	-0.64	0.522	-0.0414	0.0210	birth 1977	0.0923	0.0200	4.61	0.000	0.0530	0.1316
birth 1938	-0.0190	0.0160	-1.19	0.233	-0.0503	0.0122	birth 1978	0.1059	0.0201	5.28	0.000	0.0666	0.1452
birth 1939	-0.0163	0.0160	-1.02	0.310	-0.0477	0.0151	birth 1979	0.1029	0.0202	5.09	0.000	0.0632	0.1425
birth 1940	-0.0165	0.0163	-1.01	0.312	-0.0484	0.0155	birth 1980	0.1231	0.0203	6.06	0.000	0.0833	0.1629
birth 1941	-0.0171	0.0169	-1.01	0.312	-0.0503	0.0161	birth 1981	0.1187	0.0205	5.80	0.000	0.0786	0.1588
birth 1942	-0.0283	0.0168	-1.69	0.091	-0.0612	0.0045	birth 1982	0.1118	0.0206	5.42	0.000	0.0713	0.1522
birth 1943	-0.0138	0.0166	-0.83	0.406	-0.0464	0.0188	birth 1983	0.1356	0.0208	6.53	0.000	0.0949	0.1764
birth 1944	-0.0195	0.0164	-1.19	0.233	-0.0517	0.0126	birth 1984	0.1216	0.0209	5.81	0.000	0.0806	0.1626
birth 1945	-0.0160	0.0167	-0.96	0.337	-0.0487	0.0167	birth 1985	0.1179	0.0209	5.63	0.000	0.0769	0.1589
birth 1946	-0.0145	0.0166	-0.88	0.382	-0.0470	0.0180	birth 1986	0.1346	0.0211	6.37	0.000	0.0932	0.1760
birth 1947	-0.0035	0.0166	-0.21	0.832	-0.0362	0.0291	birth 1987	0.1256	0.0212	5.93	0.000	0.0841	0.1671
birth 1948	0.0017	0.0168	0.10	0.920	-0.0313	0.0347	birth 1988	0.1232	0.0213	5.78	0.000	0.0814	0.1649
birth 1949	-0.0076	0.0169	-0.45	0.651	-0.0408	0.0255	birth 1989	0.1259	0.0213	5.90	0.000	0.0841	0.1677
birth 1950	-0.0131	0.0171	-0.76	0.446	-0.0467	0.0205	birth 1990	0.1251	0.0213	5.86	0.000	0.0833	0.1669
birth 1951	0.0047	0.0173	0.27	0.788	-0.0293	0.0386	birth 1991	0.1217	0.0214	5.69	0.000	0.0798	0.1636
birth 1952	0.0135	0.0174	0.78	0.438	-0.0206	0.0475	birth 1992	0.1229	0.0214	5.73	0.000	0.0809	0.1649
birth 1953	0.0166	0.0174	0.95	0.340	-0.0175	0.0507	birth 1993	0.1381	0.0216	6.39	0.000	0.0957	0.1805
birth 1954	0.0228	0.0175	1.30	0.192	-0.0115	0.0570	birth 1994	0.1328	0.0218	6.09	0.000	0.0901	0.1755
birth 1955	0.0429	0.0175	2.44	0.014	0.0085	0.0772	birth 1995	0.1120	0.0219	5.12	0.000	0.0691	0.1549
birth 1956	0.0220	0.0177	1.25	0.213	-0.0126	0.0566	birth 1996	0.1352	0.0221	6.12	0.000	0.0919	0.1785
birth 1957	0.0221	0.0176	1.25	0.210	-0.0125	0.0567	birth 1997	0.1347	0.0223	6.04	0.000	0.0910	0.1784
birth 1958	0.0342	0.0177	1.93	0.053	-0.0005	0.0689	birth 1998	0.1426	0.0224	6.36	0.000	0.0987	0.1865
birth 1959	0.0335	0.0178	1.88	0.060	-0.0014	0.0684	birth 1999	0.1458	0.0227	6.41	0.000	0.1012	0.1903
birth 1960	0.0403	0.0179	2.25	0.024	0.0053	0.0753	birth 2000	0.1358	0.0229	5.92	0.000	0.0909	0.1807
birth 1961	0.0406	0.0180	2.26	0.024	0.0054	0.0758	birth 2001	0.1365	0.0233	5.86	0.000	0.0908	0.1822
birth 1962	0.0357	0.0180	1.98	0.048	0.0004	0.0710	birth 2002	0.1544	0.0237	6.53	0.000	0.1080	0.2007
birth 1963	0.0526	0.0181	2.90	0.004	0.0171	0.0882	birth 2003	0.1750	0.0242	7.23	0.000	0.1276	0.2225
birth 1964	0.0407	0.0182	2.24	0.025	0.0050	0.0763	birth 2004	0.1469	0.0247	5.96	0.000	0.0986	0.1952
birth 1965	0.0482	0.0184	2.62	0.009	0.0122	0.0843	birth 2005	0.1588	0.0253	6.27	0.000	0.1091	0.2084
birth 1966	0.0539	0.0185	2.92	0.004	0.0177	0.0901	birth 2006	0.1699	0.0261	6.50	0.000	0.1186	0.2211
birth 1967	0.0582	0.0186	3.13	0.002	0.0218	0.0947	birth 2007	0.1678	0.0275	6.10	0.000	0.1138	0.2217
birth 1968	0.0485	0.0188	2.58	0.010	0.0117	0.0854	birth 2008	0.1722	0.0284	6.06	0.000	0.1166	0.2279
birth 1969	0.0660	0.0188	3.51	0.000	0.0291	0.1029	birth 2009	0.2013	0.0317	6.35	0.000	0.1392	0.2634
birth 1970	0.0657	0.0190	3.46	0.001	0.0285	0.1029	hh size	0.0158	0.0008	19.26	0.000	0.0142	0.0174

Cyclical time effects and constant

Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf.	Interval	indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf.	Interval
time 1998	-0.0845	0.0042	-19.92	0.000	-0.0929	-0.0762	time 2005	-0.0060	0.0037	-1.62	0.106	-0.0133	0.0013
time 1999	0.0727	0.0036	20.39	0.000	0.0657	0.0797	time 2006	-0.0166	0.0036	-4.61	0.000	-0.0237	-0.0095
time 2000	0.0416	0.0036	11.58	0.000	0.0346	0.0487	time 2007	-0.0096	0.0036	-2.67	0.008	-0.0166	-0.0026
time 2001	-0.0071	0.0037	-1.93	0.054	-0.0143	0.0001	time 2008	-0.0001	0.0035	-0.03	0.976	-0.0070	0.0068
time 2002	-0.0007	0.0037	-0.19	0.847	-0.0080	0.0066	time 2009	0.0168	0.0035	4.83	0.000	0.0100	0.0236
time 2003	0.0004	0.0037	0.10	0.919	-0.0069	0.0077	time 2010	0.0012	0.0033	0.35	0.726	-0.0053	0.0077
time 2004	-0.0106	0.0037	-2.88	0.004	-0.0179	-0.0034	const.	-0.0601	0.0234	-2.57	0.010	-0.1059	-0.0143

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Dependent variable: saving rate (regression with control for household size) (ctd.)

Age effects													
Indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval		indep. var.	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval	
age 01	0.0437	0.0126	3.46	0.001	0.0189	0.0684	age 41	0.1252	0.0175	7.16	0.000	0.0910	0.1595
age 02	0.0224	0.0128	1.75	0.080	-0.0026	0.0474	age 42	0.1279	0.0175	7.30	0.000	0.0935	0.1622
age 03	0.0239	0.0129	1.86	0.063	-0.0013	0.0491	age 43	0.1146	0.0177	6.48	0.000	0.0799	0.1492
age 04	0.0376	0.0131	2.88	0.004	0.0120	0.0632	age 44	0.1067	0.0179	5.97	0.000	0.0717	0.1417
age 05	0.0290	0.0131	2.22	0.027	0.0034	0.0547	age 45	0.1256	0.0180	6.97	0.000	0.0903	0.1609
age 06	0.0263	0.0133	1.98	0.047	0.0003	0.0523	age 46	0.1145	0.0182	6.31	0.000	0.0789	0.1501
age 07	0.0296	0.0133	2.22	0.026	0.0035	0.0557	age 47	0.1270	0.0184	6.92	0.000	0.0910	0.1630
age 08	0.0172	0.0135	1.28	0.202	-0.0092	0.0435	age 48	0.1180	0.0185	6.39	0.000	0.0818	0.1542
age 09	0.0230	0.0135	1.70	0.090	-0.0036	0.0495	age 49	0.1311	0.0187	7.01	0.000	0.0945	0.1678
age 10	0.0144	0.0137	1.05	0.292	-0.0124	0.0412	age 50	0.1280	0.0188	6.80	0.000	0.0911	0.1649
age 11	0.0145	0.0138	1.05	0.293	-0.0125	0.0415	age 51	0.1483	0.0190	7.82	0.000	0.1111	0.1855
age 12	0.0100	0.0139	0.72	0.473	-0.0173	0.0372	age 52	0.1434	0.0190	7.54	0.000	0.1061	0.1807
age 13	0.0126	0.0140	0.90	0.371	-0.0149	0.0400	age 53	0.1528	0.0193	7.91	0.000	0.1149	0.1906
age 14	0.0107	0.0141	0.76	0.448	-0.0170	0.0385	age 54	0.1482	0.0194	7.63	0.000	0.1101	0.1863
age 15	0.0103	0.0144	0.72	0.473	-0.0178	0.0385	age 55	0.1519	0.0197	7.70	0.000	0.1132	0.1906
age 16	0.0144	0.0144	1.00	0.318	-0.0139	0.0426	age 56	0.1328	0.0198	6.71	0.000	0.0940	0.1716
age 17	0.0037	0.0148	0.25	0.802	-0.0253	0.0327	age 57	0.1384	0.0200	6.93	0.000	0.0992	0.1775
age 18	0.0009	0.0149	0.06	0.953	-0.0284	0.0301	age 58	0.1220	0.0199	6.12	0.000	0.0829	0.1611
age 19	0.0104	0.0152	-0.68	0.494	-0.0401	0.0193	age 59	0.1303	0.0203	6.42	0.000	0.0905	0.1701
age 20	0.0194	0.0155	-1.25	0.210	-0.0499	0.0110	age 60	0.0978	0.0203	4.82	0.000	0.0580	0.1376
age 21	0.0278	0.0158	-1.76	0.078	-0.0587	0.0031	age 61	0.0995	0.0204	4.88	0.000	0.0595	0.1395
age 22	0.0061	0.0160	-0.38	0.703	-0.0376	0.0253	age 62	0.1055	0.0206	5.13	0.000	0.0652	0.1459
age 23	0.0193	0.0162	-1.19	0.235	-0.0511	0.0125	age 63	0.1073	0.0208	5.15	0.000	0.0664	0.1482
age 24	0.0155	0.0164	0.95	0.342	-0.0165	0.0476	age 64	0.0748	0.0209	3.58	0.000	0.0339	0.1158
age 25	0.0355	0.0164	2.17	0.030	0.0034	0.0676	age 65	0.0555	0.0213	2.61	0.009	0.0139	0.0972
age 26	0.0504	0.0163	3.10	0.002	0.0185	0.0823	age 66	0.0626	0.0214	2.93	0.003	0.0207	0.1044
age 27	0.0733	0.0163	4.49	0.000	0.0413	0.1054	age 67	0.0554	0.0216	2.56	0.010	0.0130	0.0978
age 28	0.0792	0.0163	4.87	0.000	0.0473	0.1111	age 68	0.0835	0.0219	3.81	0.000	0.0405	0.1264
age 29	0.0880	0.0163	5.41	0.000	0.0562	0.1199	age 69	0.0654	0.0224	2.92	0.004	0.0215	0.1094
age 30	0.1124	0.0165	6.82	0.000	0.0801	0.1446	age 70	0.0749	0.0229	3.27	0.001	0.0300	0.1197
age 31	0.1023	0.0165	6.19	0.000	0.0699	0.1347	age 71	0.0822	0.0234	3.52	0.000	0.0364	0.1279
age 32	0.1068	0.0165	6.47	0.000	0.0745	0.1392	age 72	0.0834	0.0241	3.46	0.001	0.0362	0.1305
age 33	0.1284	0.0167	7.68	0.000	0.0956	0.1612	age 73	0.0544	0.0252	2.16	0.031	0.0051	0.1038
age 34	0.1274	0.0168	7.58	0.000	0.0945	0.1604	age 74	0.1067	0.0263	4.05	0.000	0.0551	0.1582
age 35	0.1321	0.0169	7.80	0.000	0.0989	0.1652	age 75	0.1273	0.0282	4.52	0.000	0.0721	0.1825
age 36	0.1158	0.0169	6.84	0.000	0.0826	0.1489	age 76	0.1155	0.0299	3.87	0.000	0.0570	0.1741
age 37	0.1360	0.0171	7.93	0.000	0.1024	0.1696	age 77	0.1275	0.0335	3.80	0.000	0.0618	0.1932
age 38	0.1330	0.0171	7.77	0.000	0.0994	0.1666	age 78	0.1103	0.0387	2.85	0.004	0.0344	0.1863
age 39	0.1274	0.0172	7.39	0.000	0.0936	0.1612	age 79	0.1072	0.0479	2.24	0.025	0.0134	0.2010
age 40	0.1259	0.0174	7.24	0.000	0.0918	0.1599	age 80	0.0773	0.1039	-0.74	0.457	-0.2810	0.1263

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Appendix IV Number of observations per cohort and age for estimating the consumption function

The next table contains the number of observations per cell (composed of a cohort at a specific age) to calculate the consumption expenditures figuring in the dependent variable of the estimated Euler equations (consumption function), and the mean household size and equivalence scale of the households to which persons of that cohort at that age belong. Most cells of the adult generations (born after 1945 and before 1975) contain over 100 observations, the more populated ones even surpassing 150 observations. For the older generations (born before 1945) and some younger generations (born between 1975 and 1987) the number of observations per cell mostly falls below 100. We excluded observations for which the cell size in one of two consecutive years is smaller than 25 from the estimation of the consumption function.

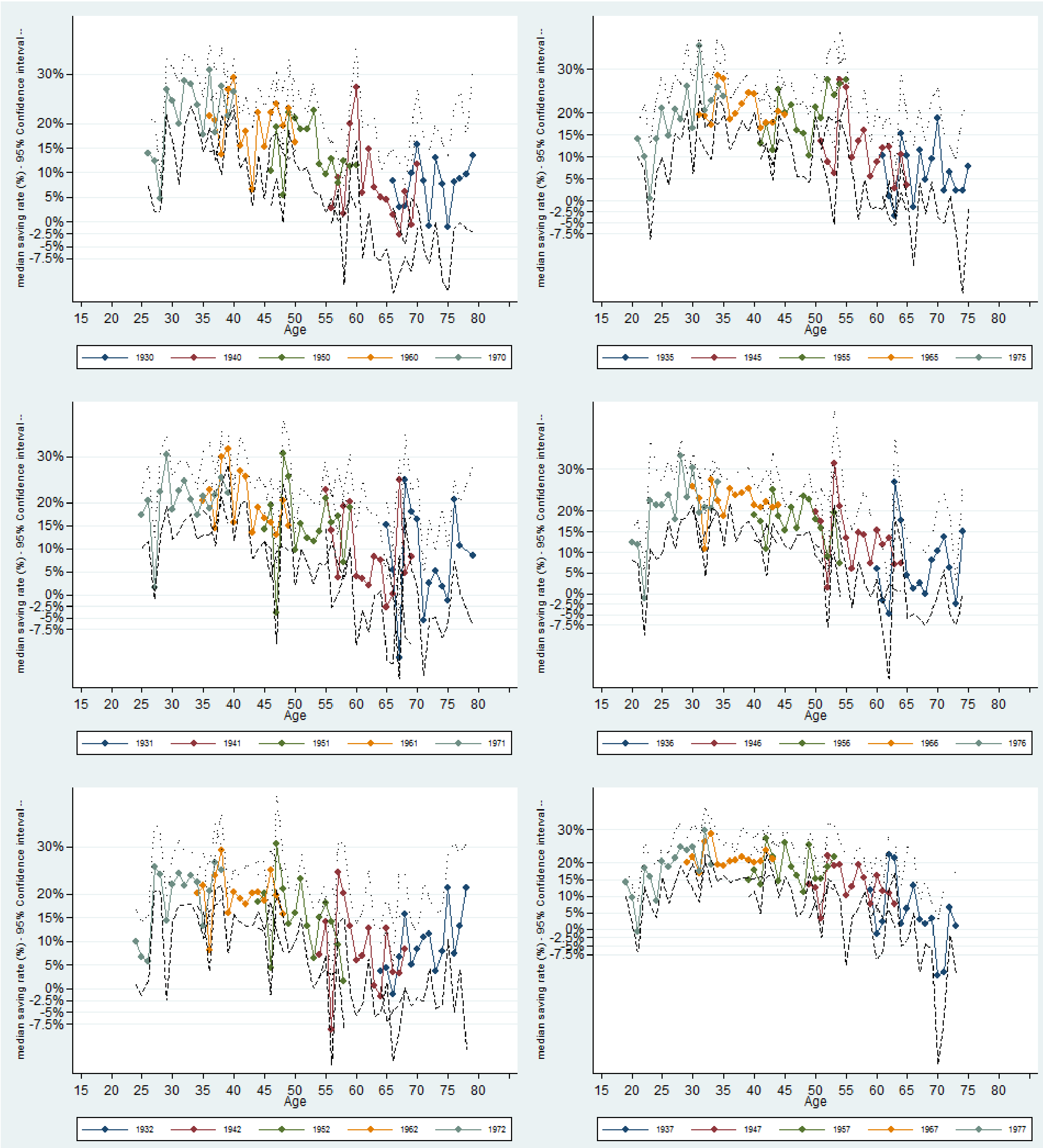
number of observations per age per cohort for constructing dependent variable in consumption regression

	birth year of cohort																							
Age	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986
00	123	132	102	98	106	111	110	101	107	130	125	100	94	29	.	.	.	.	.	.	.	.	.	.
01	105	96	86	102	98	103	103	106	99	90	107	110	62	83	93	.	.	.	.	.	.	.	.	.
02	.	119	108	95	96	93	103	122	100	103	82	107	111	65	65	94	.	.	.	.	.	.	.	.
03	.	.	94	107	110	105	89	92	110	117	99	94	108	119	78	65	100	.	.	.	.	.	.	.
04	.	.	.	100	95	104	98	76	82	115	111	99	99	104	122	68	76	114	.	.	.	.	.	.
05	.	.	.	.	96	79	104	104	100	103	106	109	91	101	117	129	77	77	112	.	.	.	.	.
06	.	.	.	.	.	95	78	96	108	120	84	107	91	111	111	114	104	81	78	104	.	.	.	.
07	.	.	.	.	.	.	95	95	100	92	93	112	99	104	109	117	143	127	76	79	91	.	.	.
08	.	.	.	.	.	.	.	112	83	71	106	96	104	111	97	92	128	140	145	72	72	111	.	.
09	.	.	.	.	.	.	.	.	112	101	88	79	105	107	119	115	105	131	122	140	78	68	89	.
10	.	.	.	.	.	.	.	.	.	93	69	110	94	96	108	104	118	128	148	149	142	58	64	103
11	.	.	.	.	.	.	.	.	.	.	115	97	109	96	101	113	98	107	125	113	120	148	79	60
12	.	.	.	.	.	.	.	.	.	.	.	120	84	111	112	112	110	120	118	117	108	126	144	66
13	.	.	.	.	.	.	.	.	.	.	.	.	122	101	104	98	106	121	112	107	105	120	144	144
14	.	.	.	.	.	.	.	.	.	.	.	.	.	120	111	110	117	109	124	113	109	111	112	105
15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	111	88	109	111	110	113	110	116	110	106
16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	122	106	113	107	115	119	100	104	107
17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	121	99	110	96	111	100	85	98
18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	126	92	92	89	95	126	93
19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	96	102	95	84	104	98
20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	102	79	87	76	102
21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	109	81	92	91
22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	89	83	85
23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	86	79
24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	96
	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962
11	79	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
12	55	89	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
13	81	58	97	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
14	155	68	82	83	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
15	137	140	85	57	85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16	129	131	138	76	78	96	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
17	99	110	114	117	74	57	91	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
18	107	104	124	113	121	87	59	91	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
19	94	94	110	127	120	98	71	80	87	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
20	80	79	92	90	109	117	122	76	70	80	.	.	.	.	.	.	.	.	.	.	.	.	.	.
21	103	96	79	78	89	95	86	83	65	75	74	.	.	.	.	.	.	.	.	.	.	.	.	.
22	93	82	86	104	91	90	84	96	80	69	52	62	.	.	.	.	.	.	.	.	.	.	.	.
23	92	89	90	90	97	102	78	76	75	86	65	49	76	.	.	.	.	.	.	.	.	.	.	.
24	93	76	95	98	86	91	83	86	67	76	91	69	64	69	.	.	.	.	.	.	.	.	.	.
25	102	87	78	96	100	95	118	90	92	67	96	109	55	64	72	.	.	.	.	.	.	.	.	.
26	.	129	93	96	111	99	122	109	100	108	67	103	103	70	58	67	.	.	.	.	.	.	.	.
27	.	.	109	105	103	120	104	115	106	92	102	85	118	128	67	79	75	.	.	.	.	.	.	.
28	.	.	.	131	110	113	119	136	110	115	101	96	103	122	134	84	71	103	.	.	.	.	.	.
29	.	.	.	.	131	139	102	129	132	144	145	106	109	99	122	159	69	64	92	.	.	.	.	.
30	.	.	.	.	.	113	126	106	105	134	92	118	128	114	117	141	150	86	84	104	.	.	.	.
31	.	.	.	.	.	.	126	128	110	116	101	125	119	134	118	97	147	138	101	96	113	.	.	.
32	.	.	.	.	.	.	.	126	128	122	143	114	116	126	149	130	119	126	171	92	111	132	.	.
33	.	.	.	.	.	.	.	.	115	102	100	124	133	129	109	129	145	133	149	167	80	102	133	.
34	.	.	.	.	.	.	.	.	.	123	117	112	136	119	116	150	129	107	151	129	149	99	77	124
35	.	.	.	.	.	.	.	.	.	.	94	95	119	106	115	125	153	121	156	146	162	163	95	102
36	.	.	.	.	.	.	.	.	.	.	.	134	112	125	105	133	130	149	124	139	142	180	181	100
37	.	.	.	.	.	.	.	.	.	.	.	.	112	115	121	112	119	100	123	126	126	160	162	159
38	.	.	.	.	.	.	.	.	.	.	.	.	.	125	103	124	138	101	115	141	155	153	170	150
39	.	.	.	.	.	.	.	.	.	.	.	.	.	.	114	101	140	128	128	135	156	147	130	155
40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	124	96	137	121	115	107	141	123	153
41	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	121	90	119	128	131	138	141	164
42	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	123	134	118	136	142	122
43	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	111	133	126	127	155	132
44	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	112	116	119	134	131
45	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	115	115	106	112
46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	121	104	147
47	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	122	111
48	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	125

	number of observations per age per cohort for constructing dependent variable in consumption regression birth year of cohort																						
Age	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938
35	128	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	86	135	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37	89	92	126	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
38	189	101	102	109	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
39	153	169	81	90	115	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
40	163	167	183	88	77	116	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
41	137	141	162	179	84	80	102	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
42	143	111	156	164	170	86	80	115	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
43	144	137	132	142	169	133	74	69	116	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
44	126	130	119	148	156	124	148	73	77	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.
45	138	126	117	135	159	149	126	127	70	73	103	.	.	.	.	.	.	.	.	.	.	.	.	.
46	105	128	112	140	123	137	127	135	129	70	64	69	.	.	.	.	.	.	.	.	.	.	.	.
47	115	131	141	111	91	119	113	131	137	105	63	66	86	.	.	.	.	.	.	.	.	.	.	.
48	109	130	107	129	121	106	116	131	121	120	111	68	75	81	.	.	.	.	.	.	.	.	.	.
49	108	127	111	117	98	91	91	110	112	117	112	122	76	65	83	.	.	.	.	.	.	.	.	.
50	.	110	103	114	128	106	109	104	121	116	99	105	111	67	57	101	.	.	.	.	.	.	.	.
51	.	.	128	112	107	106	120	102	114	97	107	108	106	100	67	59	76	.	.	.	.	.	.	.
52	.	.	.	116	122	107	136	130	106	113	94	111	118	113	108	73	73	82	.	.	.	.	.	.
53	.	.	.	.	115	125	100	105	101	93	99	95	109	116	113	91	77	56	68	.	.	.	.	.
54	.	.	.	.	.	114	136	105	99	105	107	105	105	122	100	112	76	70	42	58	.	.	.	.
55	.	.	.	.	.	.	108	119	95	92	102	85	98	104	113	102	102	86	55	45	45	.	.	.
56	.	.	.	.	.	.	.	103	130	94	94	111	109	101	99	108	100	112	72	53	40	59	.	.
57	.	.	.	.	.	.	.	.	103	117	105	106	124	88	100	106	87	94	94	71	63	60	58	.
58	.	.	.	.	.	.	.	.	.	127	127	121	122	120	113	107	92	105	95	67	77	80	58	56
59	.	.	.	.	.	.	.	.	.	.	109	112	100	125	122	88	96	80	74	90	75	64	63	41
60	.	.	.	.	.	.	.	.	.	.	.	123	126	123	122	127	95	106	81	68	78	86	89	61
61	.	.	.	.	.	.	.	.	.	.	.	.	115	111	115	109	107	108	124	82	74	99	103	95
62	.	.	.	.	.	.	.	.	.	.	.	.	.	115	133	112	109	107	75	104	63	85	101	96
63	.	.	.	.	.	.	.	.	.	.	.	.	.	.	116	121	99	101	89	79	78	85	83	109
64	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	113	96	104	109	79	92	102	93	107
65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	104	114	88	84	78	72	80	82
66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	104	86	88	75	85	79	91
67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	75	66	80	113	88
68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	74	55	93	98	82
69	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	64	76	76	63
70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	63	77	95
71	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	62	85
72	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	63
	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	1921							
59	65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.							
60	53	72	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.							
61	78	53	76	.	.	.	.	.	.	.	.	.	.	.	.	.	.							
62	97	70	66	83	.	.	.	.	.	.	.	.	.	.	.	.	.							
63	90	78	65	58	89	.	.	.	.	.	.	.	.	.	.	.	.							
64	98	90	74	67	67	117	.	.	.	.	.	.	.	.	.	.	.							
65	85	89	74	69	88	61	90	.	.	.	.	.	.	.	.	.	.							
66	105	88	100	85	78	76	67	83	.	.	.	.	.	.	.	.	.							
67	87	90	99	109	94	75	89	78	107	.	.	.	.	.	.	.	.							
68	85	96	85	93	95	71	92	85	76	121	.	.	.	.	.	.	.							
69	79	77	86	78	88	102	85	72	72	73	94	.	.	.	.	.	.							
70	61	64	65	77	83	93	85	75	74	95	60	76	.	.	.	.	.							
71	65	74	72	64	65	94	91	77	63	49	71	68	82	.	.	.	.							
72	81	75	59	65	60	54	93	74	74	69	65	68	47	77	.	.	.							
73	54	63	61	53	70	71	69	67	91	77	64	54	40	46	71	.	.							
74	.	64	32	66	58	62	63	63	63	58	60	61	50	51	46	52	.							
75	.	.	46	50	54	62	55	43	45	63	64	58	59	44	37	28	49							
76	.	.	.	42	51	44	53	56	40	47	64	56	57	50	43	34	44							
77	.	.	.	.	38	41	46	47	41	48	45	51	39	54	45	36	25							
78	.	.	.	.	.	44	.	47	34	39	36	50	41	50	57	44	36							
79	.	.	.	.	.	.	32	34	34	31	37	31	50	45	51	29	40							
80	.	.	.	.	.	.	.	.	.	.	.	36	.	.	.	.	.							

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Figure A.III: median saving rate with confidence intervals (1)



Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

Figure A.IV: median saving rate with confidence intervals (2)

Source: Belgian household budget surveys 1995/96, 1996/97, 1997/98, and 1999 to 2010, DGSIE/ADSEI–SPF/FOD Economie.

NATIONAL BANK OF BELGIUM - WORKING PAPERS SERIES

The Working Papers are available on the website of the Bank: http://www.nbb.be.

241. "The Influence of the Taylor rule on US monetary policy", by P. Ilbas, Ø. Røisland and T. Sveen, *Research series*, January 2013.
242. "Economic importance of the Belgian ports: Flemish maritime ports, Liège port complex and the port of Brussels - Report 2011", by C. Mathys, *Document series,* July 2013.
243. "The fragility of two monetary regimes: The European Monetary System and the Eurozone", by P. De Grauwe and Y. Ji, *Research series*, October 2013.
244. "Funding liquidity, market liquidity and TED spread: A two-regime model", by K. Boudt, E. C.S. Paulus and D. W.R. Rosenthal, *Research series*, November 2013.
245. "Robustifying optimal monetary policy using simple rules as cross-checks", by P. Ilbas, Ø. Røisland and T. Sveen, *Research series*, November 2013.
246. "Household and firm leverage, capital flows and monetary policy in a small open economy", by M. Pirovano, *Research series*, November 2013.
247. "The BIS and the Latin American debt crisis of the 1980s", by P. Clement and I. Maes, *Research series*, December 2013.
248. "The importance of the right amount of business resources for firms' exporting behavior", by I. Paeleman, C. Fuss and T. Vanacker, *Research series*, December 2013.
249. "The role of financial frictions during the crisis: An estimated DSGE model", by R. Merola, *Research series*, December 2013.
250. "Bank reactions after capital shortfalls", by C. Kok and G. Schepens, *Research series*, December 2013.
251. "Why firms avoid cutting wages: Survey evidence from European firms", by P. Du Caju, T. Kosma, M. Lawless, J. Messina and T. Rõõm, *Research series*, December 2013.
252. "The distribution of debt across euro area countries: The role of individual characteristics, institutions and credit conditions", by O. Bover, J. M. Casado, S. Costa, Ph. Du Caju, Y. McCarthy, E. Sierminska, P. Tzamourani, E. Villanueva and T. Zavadil, *Research series*, December 2013.
253. "Micro-based evidence of EU competitiveness: The CompNet database", by CompNet Task Force, *Research series*, March 2014.
254. "Information in the yield curve: A macro-finance approach", by H. Dewachter, L. Iania and M. Lyrio, *Research series*, March 2014.
255. "The Single supervisory mechanism or 'SSM', part one of the Banking Union", by E. Wymeersch, *Research series*, April 2014.
256. "Nowcasting Belgium", by D. de Antonio Liedo, *Research series*, April 2014.
257. "Human capital, firm capabilities and productivity growth", by I. Van Beveren and S. Vanormelingen, *Research series*, May 2014.
258. "Monetary and macroprudential policies in an estimated model with financial intermediation", by P. Gelain and P. Ilbas, *Research series*, May 2014.
259. "A macro-financial analysis of the euro area sovereign bond market", by H. Dewachter, L. Iania, M. Lyrio and M. de Sola Perea, *Research series*, June 2014.
260. "Economic importance of the Belgian ports: Flemish maritime ports, Liège port complex and the port of Brussels - Report 2012", by C. Mathys, *Document series*, June 2014.
261. "European competitiveness: A semi-parametric stochastic metafrontier analysis at the firm level", by M. Dumont, B. Merlevede, G. Rayp and M. Verschelde, *Document series*, July 2014.
262. "Employment, hours and optimal monetary policy", by M. Dossche, V. Lewis and C. Poilly, *Research series*, September 2014.
263. "On the conjugacy of off-line and on-line Sequential Monte Carlo Samplers", by A. Dufays, *Research series*, September 2014.
264. "The effects of state aid on Total Factor Productivity growth", by P. Van Cayseele, J. Konings and I. Sergant, *Research series*, October 2014.
265. "Assessing the role of ageing, feminising and better-educated workforces on TFP growth", by A. Ariu and V. Vandenberghe, *Research series*, October 2014.
266. "A constrained nonparametric regression analysis of factor-biased technical change and TFP growth at the firm level", by M. Verschelde, M. Dumont, B. Merlevede and G. Rayp, *Research series*, October 2014.
267. "Market imperfections, skills and total factor productivity: Firm-level evidence on Belgium and the Netherlands", by S. Dobbelaere and M. Vancauteren, *Research series*, October 2014.
268. "Import competition, productivity and multi-product firms", by E. Dhyne, A. Petrin, V. Smeets and F. Warzynski, *Research series*, October 2014.
269. "International competition and firm performance: Evidence from Belgium", by J. De Loecker, C. Fuss and J. Van Biesebroeck, *Research series*, October 2014.

270. “Acquisitions, productivity, and profitability: Evidence from the Japanese cotton spinning industry”, by S. Braguinsky, A. Ohyama, T. Okazaki and C. Syverson, *Research series*, October 2014.

271. “Total factor productivity: Lessons from the past and directions for the future”, by B. van Ark, *Research series*, October 2014.

272. “Outward Foreign Direct Investment and domestic performance: In search of a causal link”, by E. Dhyne and S. S. Guerin, *Research series*, October 2014.

273. “Economic importance of air transport and airport activities in Belgium - Report 2012”, by F. Van Nieuwenhove, *Document series*, November 2014.

274. “Fiscal policy and TFP in the OECD: Measuring direct and indirect effects”, by G. Everaert F. Heylen and R. Schoonackers, *Research series*, November 2014.

275. “Effectiveness and transmission of the ECB's balance sheet policies”, by J. Boeckx, M. Dossche and G. Peersman, *Research series*, December 2014.

276. “How do exporters react to changes in cost competitiveness?”, by S. Decramer, C. Fuss and J. Konings, *Research series*, January 2015.

277. “Optimal monetary policy response to endogenous oil price fluctuations”, by A. Stevens, *Research series*, January 2015.

278. “Comparing fiscal multipliers across models and countries in Europe”, by J. Kilponen, M. Pisani, S. Schmidt, V. Corbo, T. Hledik, J. Hollmayr, S. Hurtado, P. Júlio, D. Kulikov, M. Lemoine, M. Lozej, H. Lundvall, J. R. Maria, B. Micallef, D. Papageorgiou, J. Rysanek, D. Sideris, C. Thomas and G. de Walque, *Research series*, March 2015.

279. “Assessing European competitiveness: The new CompNet micro-based database”, by P. Lopez-Garcia, F. di Mauro and the CompNet Task Force, *Research series*, April 2015.

280. “FloGARCH: Realizing long memory and asymmetries in returns volatility”, by H. Vander Elst, *Research series*, April 2015.

281. “Does education raise productivity and wages equally? The moderating roles of age, gender and industry”, by F. Rycx, Y. Saks and I. Tojerow, *Research series,* April 2015.

282. “Assessing European firms’ exports and productivity distributions: The CompNet trade module”, by A. Berthou, E. Dhyne, M. Bugamelli, A.-M. Cazacu, C.-V. Demian, P. Harasztosi, T. Lalinsky, J. Merikül, F. Oropallo and A. C. Soares, *Research series,* May 2015.

284. “Crisis-proof services: Why trade in services did not suffer during the 2008-2009 collapse”, by A. Ariu, *Research series,* July 2015.

285. “The labour market position of second-generation immigrants in Belgium”, by V. Corluy, J. Haemels, I. Marx and G. Verbist, *Research series*, September 2015.

286. “The implications of household size and children for life-cycle saving”, by B. Capéau and B. De Rock, *Research series*, September 2015.

National Bank of Belgium
Limited liability company
RLP Brussels – Company's number: 0203.201.340
Registered office: boulevard de Berlaimont 14 – BE-1000 Brussels
www.nbb.be

Editor

Jan Smets
Governor of the National Bank of Belgium

Layout: Analysis and Research Group
Cover: NBB AG – Prepress & Image

Published in September 2015