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NATALIA LEVENKO

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Actual and perceived uncertainty as drivers of household saving

Natalia Levenko [*]

Abstract

The paper studies the determinants of household saving in Europe with particular focus on the impact of labour income uncertainty. Panel data models are estimated on aggregate data for 24 European countries in 1996–2017 using system GMM. The household saving rate is highly persistent and is driven in large part by income growth but also by changes in labour income uncertainty, which can be dissected into its actual and perceived components. Wealth, credit availability, interest rates, and demographic variables have little or no effect on saving.

JEL Codes: E12, E21, E24

Keywords: household saving rates, European Union, financial crisis, labour income uncertainty, precautionary saving, unemployment, consumer expectations, system GMM

The views expressed are those of the author and do not necessarily represent the official views of Eesti Pank, the European Central Bank or the Eurosystem.

[*] Natalia Levenko (Tallinn University of Technology and Eesti Pank. Corresponding email: natalia.levenko@ttu.ee and natalia.levenko@eestipank.ee).

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Non-technical summary

The paper studies the determinants of household saving in 24 European countries in 1996–2017. The main findings are that household saving rates are highly persistent, and that the main drivers of saving rates are labour income uncertainty and income growth. This is consistent with the Life-Cycle/Permanent Income Hypothesis that shows household saving to be procyclical, meaning that households tend to smooth their consumption.

The paper contributes to the literature on household saving in several ways. It fills a gap in the literature on the channels through which household saving rates are affected; rich set of potential explanatory variables is used to examine possible drivers of household saving rates. One of the novelties of this paper is that it explores new ways of looking at the uncertainty, which is dissected into its objective and subjective components. The objective uncertainty arises from the actual realisation of the shock, while the subjective or perceived uncertainty can be thought of as expectations about possible shocks in the future.

The paper presents evidence that the changes in the uncertainty indicators, namely unemployment rate and expectations of unemployment, are more important for household saving behaviour than the levels of those variables. This can be explained by the ambiguity aversion theory, which claims that agents prefer known odds over ambiguity; it follows that when the *familiar* level of uncertainty changes and an *unfamiliar* portion of ambiguity is added, households have to reassess their economic position and adjust their saving behaviour.

According to the findings of this study, income growth, changes in the unemployment rate, and changes in expectations for unemployment are statistically and economically significant factors that drive the household saving rate, while variables traditionally incorporated in saving rate equations like the wealth-to-output ratio, credit availability, and the interest rate do not have any significant impact on household saving.

The results show that the negative effect that unemployment has on the economy is amplified through the household saving channel, reducing current consumption and keeping it low over a long time span. These observations may help explain the slow recovery after the crisis of 2008–2009, when the high unemployment rate was followed by low consumer confidence, high saving rates and low consumption.

Contents

1. Introduction

The period since the 2008–2009 crisis has seen a contradictory environment for household saving. A deep recession accompanied by declining income and high unemployment could be a good reason for dissaving, but despite the deterioration of economic conditions, household saving rates have grown substantially over the period in both Europe and the USA. This somewhat illogical accumulation of savings when dissaving might be expected has created a new wave of interest in the dynamics of saving rates.

One explanation for the high rates of saving during and after the crisis could be the precautionary motive. Keynes (1936) notes the need to "build up a reserve against unforeseen contingencies" as one of the essential incentives for households to save, and little has changed since the 1930s. Carroll (1997) refers to the Survey of Consumer Finances conducted by the Federal Reserve Board in 1983 in the USA, and points out that 43 per cent of the respondents said that having a buffer for emergencies was the most important reason for saving, while only 15 per cent mentioned accumulating funds for retirement as their primary motivation for saving.

In Europe the Household Finance and Consumption Survey (HFCS) conducted in 2010/2011 found that about 53 per cent of respondents cited making provisions for unexpected events as the most important reason for saving (Rodriguez-Palenzuela and Dees, 2016). The data come from the first wave of the HFCS and cover the eight first-wave euro area countries other than Finland, France and Italy.

As saving rates are arguably one of the key performance indicators of an economy, they have been studied extensively; see Mikesell and Zinser (1973), Balassa (1993), and Loayza et al. (2000a) for overviews. However, developments since the crisis have made it clear that there is still a shortage of empirical evidence on the determinants of the saving rate and particularly on uncertainty as a possible explanatory factor for household saving rates. The paper addresses this issue by focusing on labour income uncertainty as a determinant of household saving.

The crisis and the subsequent sharp increase in saving rates gave the impulse for writing this paper, but the crisis itself is not the focus of this study. The aim is to identify the determinants of saving behaviour over a long time span, without direct reference to booms or recessions, and to come closer to understanding what accounts for changes in household saving rates in Europe. It is crucial to understand saving behaviour as saving decisions affect growth through investment and consumption.

The paper contributes to the literature on household saving in several ways. First, it fills a gap in the literature on the channels through which household saving rates are affected by focusing on the importance of labour income uncertainty. A rich set of potential explanatory variables is used to control for other possible drivers of household saving rates.

Second, the paper explores new ways of looking at the uncertainty. It accounts for the objective uncertainty that comes from the actual realisation of the shock, and subjective expectations about possible shocks in the future. To account for the subjective expectations, data from European Commission surveys are employed, which is rarely done in macroeconomic studies. The paper presents evidence that the changes in the uncertainty indicators are more important for household saving behaviour than the levels of those variables.

The study uses a large up-to-date sample covering 24 European economies over a few full business cycles in 1996–2017. The method employed is system GMM, which makes it possible to account for the endogeneity of the regressors and to resolve a possible dynamic panel model bias.

The paper is organised as follows: Section 2 briefly reviews the existing literature; Section 3 describes the model, sample and data; in Section 4 the estimation method is explained concisely; Section 5 discusses the results and robustness checks; and finally, Section 6 concludes.

2. Brief literature review

Household saving rates are typically studied in the framework of the Life-Cycle or Permanent Income Hypothesis[1] (LC/PIH), which argues that the main purpose of household saving is to smooth consumption. Several empirical studies fail to find evidence supporting the LC/PIH though, such as Zeldes (1989), Deaton (1989), and Hahm and Steigerwald (1999). Further on the focus is on saving under uncertainty and it is mostly empirical studies dealing with household saving that are discussed.

2.1 Precautionary saving

A typical textbook explanation of precautionary saving (Sandmo, 1970; Leland, 1978) would follow from the positive third derivative of the utility function of consumption, $u(C)$, implying that $u'(C)$ is convex. It follows that the higher the income uncertainty is, the higher the expected marginal utility is for a given value of expected consumption. Thus when uncertainty increases, the incentive to accumulate a precautionary buffer increases as well (Romer, 1996, ch. 7).

Menegatti (2007) discusses the interpretation of precautionary savings in this context. He points out that for every given level of consumption the marginal utility associated with a higher level of consumption is less than the marginal disutility associated with a lower level of consumption. It follows that risk-averse economic agents will accumulate a reserve as an insurance against uncertainty, which is supposed to reduce the disutility if consumption is reduced[2]. This observation is in line with loss aversion theory, which claims that people prefer to avoid losses rather than achieve gains (Kahneman and Tversky, 1992).

This study takes as its starting point Carroll's (1997) buffer-stock saving theory, which can be considered a textbook model. At the core of this theory is labour income uncertainty combined with the impatience of consumers. If a consumer's wealth is below the target

[1] See Ando and Modigliani (1963), Modigliani (1966), and Friedman (1957) for the LC/PIH and Muellbauer and Lattimore (1995) for extensions of the LC/PIH.

[2] "The precautionary saving motive is the desire to reduce the disutility due to uncertainty, generated by risk aversion" (Menegatti, 2007).

wealth-to-permanent-income ratio[3], then the effect of prudence dominates the effect of impatience and the consumer saves; if wealth exceeds the target wealth ratio, impatience will dominate over prudence. Carroll (1997) calls this pattern buffer-stock saving behaviour.

Steady-state target wealth depends on unemployment risk, the interest rate, the growth rate of income, relative risk aversion, and the discount factor[4]. While an increase in unemployment risk results in a higher target level for wealth to give a larger buffer in response to greater uncertainty, income growth has the opposite effect. The interest rate, relative risk aversion and the discount factor all have a positive effect on the target level for wealth. In other words, higher income uncertainty induces a fall in consumption, as consumers have to accumulate to a higher target for wealth.

The buffer-stock saving model is very close to the models developed by Zeldes (1989) and Deaton (1992), with the difference that Carroll's model incorporates unemployment expectations to take into account that labour income is one of the main sources of household income. In the empirical study based on the buffer-stock saving theory, Carroll et al. (2012) document a considerable rise in private saving in the USA after the global financial crisis of 2008–2009. They point out that the decline in spending was registered not only for durables but also for nondurable goods, and explain this by the increased uncertainty and the expectations of high unemployment after the crisis.

2.2 Empirical studies

While the precautionary saving motive can help to explain the excess sensitivity of consumption to income (Hahm and Steigerwald, 1999) and why the retired barely spend their savings or even continue to save (Loayza et al., 2000b), it can be fairly challenging to find an appropriate measure of uncertainty. The most common proxy for macroeconomic uncertainty in earlier studies is the inflation rate (Gupta, 1987; Loayza et al., 2000a), but in two recent papers on saving with the focus on labour income uncertainty, the unemployment rate is used. Mody et al. (2012) examine a model very similar to Carroll's (1997) buffer-stock saving model, using a sample of OECD countries, while Bande and Riveiro (2013) is a panel study using data from Spanish regions in 1980–2007.

Two studies that focus on the macroeconomic determinants of household saving rates, Pesaran et al. (1999) and Kukk and Staehr (2017), also include the unemployment rate in the set of the explanatory variables but the studies do not find any significant effect from it. To the best of the author's knowledge, Carroll et al. (2012) is the only study on the aggregate data that uses surveys of consumers to create a proxy for labour income uncertainty, using the answers to a question about the expected change in the unemployment rate.

Traditionally, major areas of interest are the links between household saving rates and economic growth, income growth, and the interest rate. While income variables can be thought of as indicators of the *capacity* to save (Hussein and Thirlwall, 1999), the *willingness* to save

[3] Carroll (2004) showed that a unique finite target wealth ratio exists and is stable.

[4] To make the model tractable, two assumptions are made about unemployment risk, which are that the probability of becoming unemployed is constant, and once unemployed, the consumer can never become employed again (Carroll et al. 2012). For the analytical formula see Carroll and Toche (2009).

might depend on other determinants such as the interest rate, credit conditions and macro-economic stability.

Changes in the interest rate can theoretically have an ambiguous effect on the saving rate, as the total of the wealth and substitution effects of changes in the interest rate is not predictable (Browning and Lusardi, 1996). The wealth effect implies that when the interest rate rises, consumers feel wealthier as they expect higher interest rate revenues, and so they start to consume more, thus saving less. If the substitution effect prevails, consumers prefer to postpone their consumption to take advantage of the higher interest rate, thus increasing saving.

Household saving can be subject to borrowing constraints (Attanasio and Weber, 2010). For example, Carroll et al. (2012) claim that the fall in the saving rate to a mere one per cent in the mid-2000s in the USA can be interpreted in the context of financial liberalisation or credit-loosening[5]. Credit conditions are not always taken into account, however, as it is hard to find a good proxy for them.

Other variables usually used in the saving rates regressions are the pension replacement ratio, the urbanisation rate, dependency ratios[6], the distribution of income, public saving, the female activity rate, and some others.

3. Model and data

The model estimated in this paper is an augmented buffer-stock saving model following Carroll et al. (2012). One of the novelties is that it considers uncertainty using two different measures. Uncertainty can be thought of as the actual probability of fluctuations in labour income or alternatively as the perceived uncertainty about labour income in the future.

In the context of labour income, the key indicator is the unemployment rate. Rising unemployment gives two signals at once, a signal that there is a higher probability of losing a job and a signal that there is a higher probability of lower future income as the bargaining power of employees is weakened in an environment of high unemployment. The unemployment rate is a straightforward proxy that is meant to quantify this two-dimensional objective risk from labour income. The higher unemployment is, the higher the risks of the main source of income being lost or of income becoming lower are.

If the unemployment rate is a valid proxy for objective labour income uncertainty, then expectations of unemployment are presumably a good proxy for subjectively weighted uncertainty. As the dynamics of the objective and subjective indicators of uncertainty can be quite different, it is important to distinguish between them and to evaluate their impact separately.

[5] Davis and Palumbo (2001) explain these short-run fluctuations, however, by changes in household wealth.
[6] One of the pioneer studies is Leff (1969).

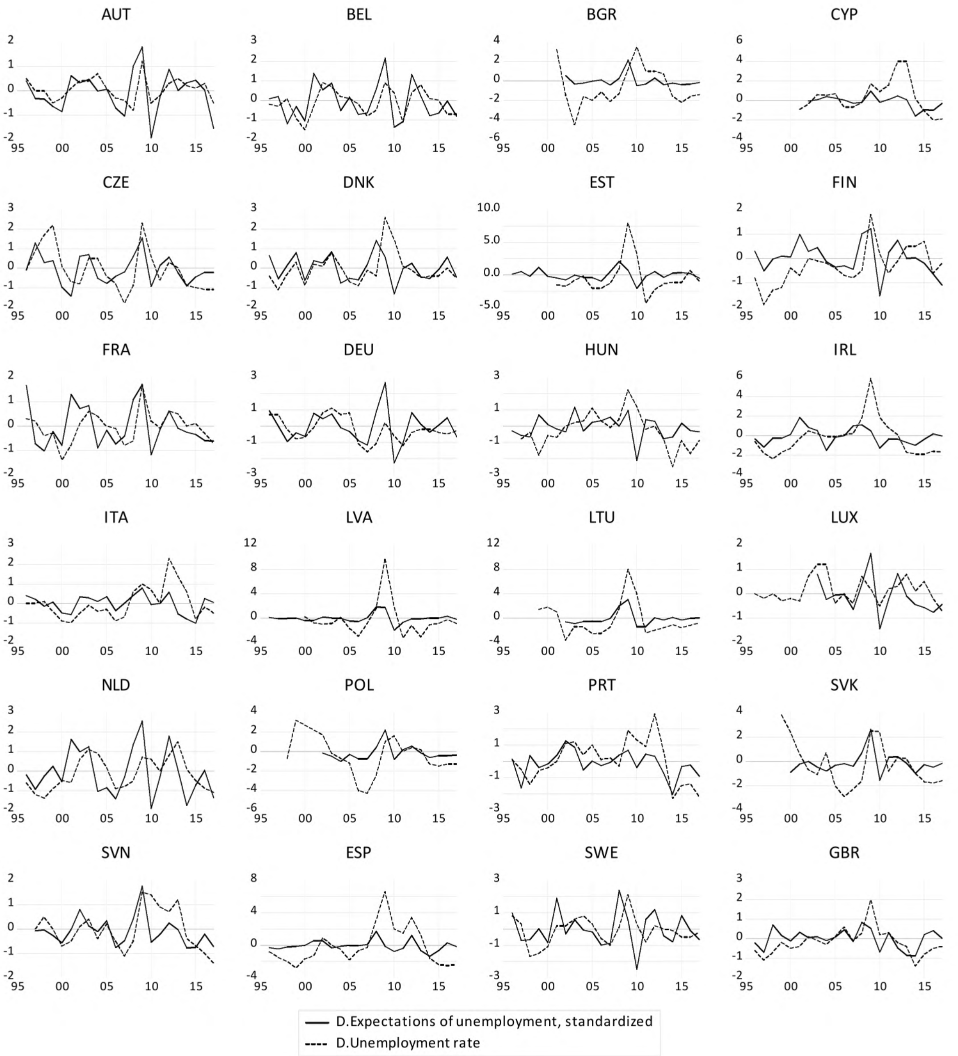

Figure 1: Changes in the unemployment rate and changes in the index of expectations of unemployment

Notes: D.Expectations of unemployment, standardised denotes the first difference of the standardised expectations of unemployment (dashed line, right axis), D.Unemployment rate denotes the first difference of the unemployment rate (solid line, left axis). For country codes see Appendix C.

Source: Eurostat

The differences between the objective and subjective indicators from unemployment and expectations of unemployment become even more salient when the state of the economy changes. Accordingly, changes in the unemployment rate and in the expectations index could be more important for the dynamics of household saving than the levels are.

The proxies for the levels of uncertainty can be considered a *familiar* uncertainty that is already taken into account, while changes in these variables are *unfamiliar* uncertainty that needs to be assessed, weighted and addressed. Figure 1 gives a better idea of the dynamics of these variables, that is changes in unemployment and changes in expectations of unemployment. A detailed description of the variables can be found in Appendix B.

Table 1: Summary statistics

	Mean	Median	Max	Min	Std. Dev.	Obs.
Household saving rate	9.9	10.6	43.3	–20.2	6.4	528
Unemployment rate	8.7	7.9	26.1	1.9	4.0	523
ΔUnemployment rate	–0.1	–0.2	9.8	–4.5	1.5	499
Expectations of unemployment	20.7	18.9	72.8	–26.9	19.8	516
ΔExpectations of unempolyment	–1.2	–2.3	60.4	–49.1	15.7	492
ΔExpectations of unempolyment, standardised	–0.1	–0.1	3.0	–2.5	0.8	492
Wealth-to-output ratio	102.8	91.3	254.8	21.1	55.3	532
ΔWealth-to-output ratio	1.8	1.6	71.8	–38.4	9.9	508
Credit flows	3.1	2.4	28.6	–9.0	3.9	526
ΔCredit flows	0.0	0.2	20.4	–20.9	2.6	502
Income per capita growth rate	2.2	1.9	22.5	–13.7	3.5	505
Real interest rate	0.8	0.5	25.2	-19.9	3.2	531

Source: Eurostat, AMECO

It can be seen that changes in the expectations of households are much more volatile[7] than changes in the unemployment rate. The coefficient of variation, which is the standard deviation divided by the mean is 103 per cent for differences in unemployment and 132 per cent for differences in the expectations of unemployment. Often these differences move together, as their correlation coefficient is 0.32, positive and statistically significant, but they can also have different directions of movement. Summary statistics for the main variables are shown in Table 1; for the dynamics of saving rates see Figure A1 in Appendix A.

Besides changes in the rate of unemployment and changes in the expectations of unemployment, the model includes variables for the wealth ratio and credit flow, both coming directly from the reduced-form saving regression in Carroll et al. (2012). Following the literature, the model is augmented by household income growth and the real interest rate. Consumption, and hence saving, is known to be persistent, and for that reason the lagged saving rate is included in the model as well.

Period dummies are not included in the baseline model as they may lead to overfitting; instead, the time-invariant VIX index is included in the robustness check to account for time fixed effects; see Appendix B for the description of the variable. Four of the six variables in the baseline model are in first differences and the wealth and credit variables have unit-root while the uncertainty proxies are differenced as their changes are arguably more important for household saving than the levels are. As a robustness check, the levels of both proxies of uncertainty are added to the model.

[7] The different volatilities may be explained in terms of ambiguity aversion or the Ellsberg paradox. It is argued that economic agents prefer to take a risk when the odds are known than when knowledge of the probabilities of future events is limited (Ellsberg, 1961).

The reduced-form model is[8]:

$$Saving\ rate_{it} = \rho Saving\ rate_{it-1} + \beta_U \Delta Unemployment_{it}$$
$$+\beta_E \Delta Expectations_{it} + \beta_W \Delta Wealth_{it} + \beta_C \Delta Credit_{it} \quad + \beta_I Income\ growth_{it} +$$
$$\beta_R Real\ int.rate_{it} + \beta_X X_{it} + \eta_i + \varepsilon_{it},$$

The variable $Saving\ rate_{it}$ is the household saving rate as a share of disposable income. The autoregressive coefficient ρ of the lagged saving rate is expected to be less than 1. The variable Δ*Unemployment* is the first difference of the unemployment rate in percentage points, a proxy for actual labour income uncertainty; Δ*Expectations* is the first difference of expectations of unemployment, and is a proxy for perceived labour income uncertainty; Δ*Wealth* is the first difference of household wealth as a percentage share of output; Δ*Credit* is the first difference of the net flow of loans for households as a fraction of output; *Income growth* stands for the growth of household real disposable income per capita; *Real int. rate* is the real short-term interest rate; η_i is an unobserved country-specific time-invariant effect, which allows for heterogeneity across the countries; and ε_{it} is an error term. The coefficients $\rho, \beta_U, \beta_E, \beta_W, \beta_C, \beta_I, \beta_R$ are to be estimated, X_{it} is a matrix of additional regressors incorporated in some model specifications, and β_X is a vector of their coefficients. The subscript *t* refers to the time period and *i* is the country; there are 24 countries and 22 time periods in the sample. See figures for the explanatory variables in Appendix A.

Both proxies of uncertainty are expected to have a positive sign, meaning more uncertainty leads to a higher saving rate. Carroll et al. (2012) point out that the precautionary motive diminishes as wealth rises, so the saving rate is a diminishing function of wealth and wealth is presumed to be negatively correlated with saving rates. Credit flow being a proxy of credit availability is also expected to have a negative sign, meaning credit easing is supposed to reduce household saving.

The effects of income growth and the interest rate on the saving rate are theoretically ambiguous. Higher income growth can be accompanied by higher saving rates, but the effect can also be negative if consumers perceive higher income growth to be permanent. If the substitution effect of the higher interest rate prevails over the wealth effect, then the estimated coefficient of the interest rate will have a positive sign, but if the wealth effect prevails over the substitution effect, then the sign will be negative.

Levels of unemployment, expectations of unemployment, wealth and credit flows are used for the robustness check. The first differences of these variables are employed in the baseline model. Changes in expectations of employment are standardised, which in practice means rescaling. This is done for two reasons. First, the standardisation makes the proxy for the range of expectations closer to the range of the unemployment variable, and secondly, it makes the interpretation of the results more intuitive.

[8] The original model (Carroll et al., 2012) includes four variables: the saving rate as a percentage of disposable income; market resources measured as 1 plus the ratio of household net worth to disposable income; the Credit Easing Accumulated index, constructed using the Senior Loan Officer Opinion Survey data weighted by the debt-income ratio; and unemployment risk, expressed as the level of unemployment plus the fitted value from the regression of the four-quarter-ahead change in the unemployment rate on consumer expectations about changes in unemployment.

The sample covers 24 European countries: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Four EU countries – Croatia, Greece, Malta and Romania – are not included in the sample due to a lack of data. The period is 1996–2017, but for the majority of the countries in the sample the dependent variable, which is the household saving rate, is available only until 2016.

4. Estimation method

The model presented in the previous section is a dynamic panel data model, implying that the Nickell bias becomes a built-in property for it if it is estimated with a fixed effects estimator. Nickell (1981) shows that in dynamic panels with a fixed number of periods, the error terms and lagged dependent variable are correlated and so fixed effects estimators are asymptotically biased downwards. With T growing, the Nickell bias becomes less pronounced (Bun and Kiviet, 2001; Judson and Owen, 1999), but it never disappears if standard estimators such as fixed effects or pooled least squares are used.

Another concern arising from the model specification is that explanatory variables are not strictly exogenous, meaning that reverse causality bias is present. The problem of endogeneity can be solved by using instrumental variables, but this treatment cannot overcome the Nickell bias. A conventional remedy for both problems, as well as for treating heterogeneity, would be generalised method-of-moments (GMM) estimators, designed by Hansen (1982), Holtz-Eakin et al. (1988), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998)[9]. The GMM estimator is also known to be consistent when heteroscedasticity of the unknown form is present (Baum et al., 2003).

Arellano and Bond (1991) suggested an estimator that differences the model to eliminate the time-invariant individual effects, where the differenced regressors are then instrumented with the lagged levels of the regressors. The disadvantages of the first-difference transformation are that it eliminates country-specific information and it magnifies gaps in the unbalanced panels (Arellano and Bover, 1995). Blundell and Bond (2000) have shown that when the modelled process is highly persistent or there is a high level of heterogeneity between groups, difference GMM may perform very poorly as the lagged levels will be weak instruments for the differenced variables. They introduced system GMM, an estimator that employs both a transformed equation in differences instrumented by lagged levels, and the original equation in levels instrumented by lagged differences. Using Monte Carlo simulations, Blundell, Bond and Windmeijer (2001) show that the system GMM estimator performs better than the difference GMM estimator in finite samples, improving the precision and reducing bias. In Stata, system GMM can be run by the command *xtabond2*.

Originally, GMM estimators are designed for large N of thousands of observations and small T of only a few periods, and by default, system GMM uses all the available lags. Large N and small T would suggest that the method is appropriate for microeconomic data, but this

[9] See Baltagi (2013) ch. 8 for a summary of the methods appropriate for estimating dynamic panel data models.

method has been used on macroeconomic data too. See for example Baltagi et al. (2009), who use the Arellano-Bond estimator on a panel from 42 developing countries; Baltagi and Levin (1986), who estimate demand for cigarettes on a panel from 46 American states; and some other studies employing AB or system GMM on panel data with small N, including Bond et al. (2003), Heid et al. (2012), Doytch and Uctum (2011), Kukk and Staehr (2017), Voitchovsky (2005), and Mian et al. (2017).

The present dataset exhibits a relatively large number of periods $T = 23$ and fairly small number of groups $N = 24$. If all the possible lags are used, the number of instruments will approach the number of observations. To avoid the overfitting of instrumented variables, the number of instruments used in the model is reduced. Instead of creating one instrument for each time period, variable, and lag distance, instruments are created for each variable and lag distance [Stata command *collapse*]. Further, only lags from two to three are used [Stata command *laglimits*], and lags up to eight are used for a robustness check.

The baseline model is estimated with one-step system GMM, which is widely used in the empirical literature, as a two-step estimator renders only very modest efficiency gains compared to the one-step procedure (Bond, 2002). The two-step estimator [Stata command *twostep*] is used for robustness checks. The bias in the two-step standard errors are corrected by Windmeijer's (2005) correction procedure [Stata command *robust*]. Two external instruments are used, these being the volatility of expectations of unemployment measured as the standard deviation of monthly balances of survey answers, and the volatility of income measured as the standard deviation of the quarterly compensation of employees deflated with the HICP. For the robustness check, the model without external instruments is estimated, and the results are largely unchanged (see Section 5).

The consistency of the system GMM estimator can be verified by using the Hansen test of over-identifying restrictions. The null of the Hansen test is that instruments and the error term are orthogonal, meaning the over-identifying instruments are valid. Another specification test used is the first-order and second-order autocorrelation tests for the error term. First-order serial correlation of the residuals is expected to be present, while second-order serial correlation is expected to be absent. The absence of second-order autocorrelation is important because it confirms the consistency of the GMM estimator (Baltagi, 2008, ch. 8). All three statistics and their respective p-values are reported for each model specification.

5. Results

Table 2 presents the estimates of the baseline model and of five different subsamples. According to the baseline model presented in column (2.1), household saving rates have high inertia and are driven by uncertainty and income growth. Each driver of saving rates is discussed in detail below.

To make sure that the results are not driven by the crisis period, when unemployment and expectations of unemployment were very high, the years 2007–2009 are excluded from the sample. Column (2.2) presents the results without the crisis years, and they are largely the same as the results of the baseline model. The stability of the model is estimated in different subsamples. Column (2.3) presents the results without the three largest European economies, Germany, France and Italy; column (2.4) has the results without three volatile economies, Bulgaria, Estonia and Ireland; and column (2.5) is without the Nordic countries, Denmark, Finland and Sweden. Some other subsamples are estimated, but the results are mainly the same.

Table 2: Baseline model and subsamples

	(2.1) Baseline	(2.2) w/o 2007–09	(2.3) w/o largest	(2.4) w/o volatile	(2.5) w/o Nordic
Saving rate, lagged	0.784***	0.724***	0.777***	0.807***	0.803***
	–0.078	–0.049	(0.074)	–0.095	(0.072)
ΔUnemployment	0.730**	0.758***	0.764**	0.678**	0.716**
	(0.306)	(0.138)	(0.316)	–0.314	(0.289)
ΔExpectations	0.789***	0.764***	0.792**	0.576**	0.973***
	(0.274)	(0.220)	(0.293)	–0.258	(0.266)
ΔWealth-to-output	–0.030	–0.039	–0.028	–0.032	–0.052
	–0.027	–0.029	(0.030)	–0.023	(0.040)
ΔCredit flow	0.0378	0.055	–0.006	–0.069	0.051
	(0.402)	(0.116)	(0.349)	–0.326	(0.378)
Income growth	0.313***	0.240**	0.322***	0.392***	0.316***
	–0.082	(0.115)	(0.076)	–0.074	(0.083)
Real interest rate	–0.114	–0.091	–0.135	–0.083	–0.076
	–0.091	(0.134)	(0.092)	–0.07	(0.098)
Observations	447	375	385	402	382
Number of countries	24	24	21	21	21
Number of instruments	28	28	28	28	28
Hansen J-stat	14.15	18.73	8.78	13.20	9.31
J-stat p value	0.82	0.54	0.99	0.01	0.49
AR(1)	–2.72	–2.89	–2.70	–2.71	–2.51
AR(1) p value	0.01	0.00	0.01	0.87	0.98
AR(2)	–0.80	1.35	–0.79	–1.06	–0.68
AR(2) p value	0.42	0.18	0.43	0.29	0.01

Notes: The dependent variable is the household saving rate as a share of disposable income. Panel estimates with one-step system GMM with two external instruments: volatility of expectations and income volatility. Lags 2 to 3 are used for the transformed equation and lags 1 to 2 are used for the equation in levels. Robust standard errors are in parentheses. Superscripts ***, **, * indicate levels of statistical significance at 1, 5 and 10 per cent respectively.
Column (2.2) reports the estimations of the subsample without the three years of crisis 2007–2009; in Column (2.3) the subsample without Germany, Italy and France is estimated; Column (2.4) shows a subsample without Bulgaria, Estonia and Ireland; Column (2.5) has a subsample without Denmark, Finland and Sweden.

The point estimates of the subsamples are compared to the baseline model estimates using the Z-test for the equality of the regression coefficients (Paternoster et al., 1998) with the formula

$$Z = \frac{\beta_{baseline} - \beta_{subsample}}{\sqrt{SE^2_{\beta_{baseline}} + SE^2_{\beta_{subsample}}}},$$

where Z is a test statistic following normal distribution, $\beta_{baseline}$ is a coefficient of the baseline model, $\beta_{subsample}$ is a coefficient coming from the estimation of a subsample, $SE_{\beta_{baseline}}$ is the standard error of the baseline estimate, and $SE_{\beta_{bsubsample}}$ is the standard error of the subsample. This test shows (the results are not reported here) that the coefficients of all the subsamples are not significantly different from the baseline estimates.

The coefficient for the lagged saving rate is statistically significant at the one per cent level in the baseline model and in all subsamples. The estimated effects of both proxies of labour income uncertainty are significant in the baseline model and in all the subsamples at least at the five per cent level. The wealth and credit variables have large standard errors in all model specifications. Income growth is positively correlated with the saving rate and the coefficient is significant in all subsamples but the interest rate does not seem to have any significant effect on the saving rate of households.

Empirical studies on macroeconomic data usually discuss saving rates in terms of smoothing consumption or in the context of monetary policy. It is possible, however, to approach this topic from a behavioural economics standpoint, for example by looking at it in terms of mental accounting theory (Thaler, 1985, 1990), which argues that households can save and borrow at the same time. The idea that economic agents can handle their budgets as a set of sub-budgets may partly help to explain why some macroeconomic variables, like wealth or credit conditions, may not have a significant impact on aggregate saving. It should also be noted that in the specification where the lagged dependent variable is included, Carroll et al. (2012) do not find wealth, or market resources in their specification, has any effect on the saving rate either.

The point estimate of the lagged saving rate is roughly 0.78. This indicates high persistence for the saving rate, and this result is mainly in line with the literature. Swamy (1968) reports an average coefficient of the lagged saving rate of 0.936 for developed countries and 0.778 for less developed countries; the estimation method is referred to as three-pass least squares and the sample contains 19 countries. The estimates for the lagged saving rate in Loayza et al. (2000a) are 0.59 for the whole sample and 0.67 for the OECD countries, using a system GMM estimator and a sample of 69 countries. According to Kukk and Staehr (2017), the coefficient of the lagged saving rate in ten CEE countries before the crisis was 0.65, but it is considerably lower for the whole sample at 0.36 using the Arellano-Bond estimation method, which reflects how the very deep crisis in the CEE countries continued to affect the economies after the crisis. Bande and Riveiro (2013) consider Spanish regions and the point estimate for the lagged saving rate is around 0.64 (OLS and GMM). The estimate by Carroll et al. (2012) for the USA is 0.574 (OLS). Horioka and Wan (2007) report a lagged saving rate coefficient that varies in the range of 0.774 to 0.476 depending on the model specification; the method used is GMM on panel data from Chinese provinces.

The high persistence of saving rates behaviour implies that every saving rate driver has a long-term effect on saving rates that exceeds the short-term effect more than four-fold given a coefficient of 0.78[10]. This means that if unemployment grows by 1 percentage point, saving rates will increase 0.7 percentage point during the same period and around 3.3 percentage points in the long run. The data for expectations are standardised, so if the change in expecta-

[10] The following discussion is based on the baseline model estimates.

tions of unemployment is one standard deviation, meaning consumers expect unemployment to grow in the next period, then the saving rate will increase by 0.8 percentage point in the short run and around 4 percentage points in the long run. It follows that both variables of interest have a substantial economic effect given that the average saving rate in the sample is 9.9 per cent.

Like in Carroll et al. (2012), the coefficient of the wealth variable has a negative sign but it is not statistically significant[11]. Interestingly, the proxy for credit conditions does not seem to affect the dynamics of household saving rates, but in contrast, income growth has a pronounced effect on saving rates. An increase in income of 1 percentage point entails an increase of 0.3 percentage points in saving rates in the same period and growth of about 1.5 percentage points in the saving rate in the long run. This finding is consistent with the LC/PIH as it shows that households tend to smooth their consumption.

Table 3 reports a few other specifications of the model with additional regressors, which are the output gap to account for the phase of business cycle; the inflation rate as another proxy of uncertainty; the Gini index reflecting the inequality of the income distribution; young-age and old-age dependency ratios to take into account the age structure of the population; and levels of wealth, unemployment, and credit flows[12].

The results are largely unchanged, as the saving rate is highly persistent, the coefficients of the uncertainty proxies are statistically and economically significant, and the coefficients are mostly of the same magnitude as in the baseline model. Meanwhile, the coefficients of the other variables except for income growth are typically insignificant. For convenience, column (3.1) repeats the estimations of the baseline model.

According to the LC/PIH, the young borrow and elderly dissave. In this context, it might seem surprising that dependency ratios, which show the shares of young and elderly people in the population, do not impact the saving rate. It should be kept in mind though that income is a function of the age structure of the population (Campbell and Mankiw, 1989), and so dividing the saving rate by disposable income means the age structure is already accounted for.

It is worth noting that the coefficient of the interest rate turns statistically significant at the 10 per cent level in the specifications reported in columns (3.2) and (3.3). The sign of the coefficient indicates that the negative wealth effect prevails over the positive substitution effect, so when the interest rate rises, households tend to spend more in expectation of higher future interest rate income. This effect is, however, quite poorly determined, given that in other specifications of the model the interest rate is not significant. It can be thought of as a corroboration of the claim that consumers are impatient (Carroll et al., 2012), meaning that if there is no uncertainty consumers will borrow and consume more than their income.

[11] In the original model, Carroll (1997) uses the wealth-to-income rate. Given that the saving rate is taken into account as a ratio to disposable income, wealth-to-income is replaced by the wealth-to-output ratio to eliminate the positive correlation between the left-hand and right-hand variables.

[12] A few more variables were added to the model as well (the results are not reported here), see the variable list in Section 3.

Table 3: Baseline model and additional regressors

	(3.1) Baseline	(3.2) Additional	(3.3) Additional
Saving rate, lagged	0.784***	0.800***	0.779***
	(0.078)	(0.069)	(0.072)
ΔUnemployment	0.730**	0.700*	0.720**
	(0.306)	(0.351)	(0.345)
ΔExpectations	0.789***	0.801**	0.768**
	(0.274)	(0.347)	(0.317)
ΔWealth-to-output, lagged	–0.030	–0.071*	–0.061*
	(0.027)	(0.034)	(0.032)
ΔCredit flow	0.037	–0.187	–0.159
	(0.402)	(0.201)	(0.209)
Income growth	0.313***	0.289**	0.264**
	(0.082)	(0.111)	(0.101)
Interest rate	–0.114	–0.198*	–0.158*
	(0.091)	(0.102)	(0.088)
Output gap		–0.098	–0.062
		(0.159)	(0.153)
Gini index		–0.146	–0.181
		(0.090)	(0.123)
Inflation		–0.173*	–0.104
		(0.098)	(0.089)
ΔYoung depedency		–0.334	
		(0.361)	
ΔOld dependency		–0.582	
		(0.849)	
Observations	447	433	433
Number of countries	24	24	24
Number of instruments	28	43	37
Hansen J-stat	14.15	10.08	10.33
J-stat p value	0.823	0.999	0.997
AR(1)	–2.72	–3.16	–2.99
AR(1) p value	0.01	0.00	0.00
AR(2)	–0.80	–0.37	–0.20
AR(2) p value	0.42	0.71	0.84

Notes: The dependent variable is the household saving rate as a share of disposable income. Panel estimates with one-step system GMM with two external instruments: volatility of expectations and income volatility. Lags 2 to 3 are used for the transformed equation and lags 1 to 2 are used for the equation in levels. Robust standard errors are in parentheses. Superscripts ***, **, * indicate levels of statistical significance at 1, 5 and 10 per cent respectively.

Inflation is significant at the 10 per cent level in the model specification reported in column (3.2). The sign of the coefficient is negative, indicating that higher inflation induces lower saving. The effect of inflation is quite weak however, as the coefficient is statistically significant in only a few model specifications. The coefficient of the change in the target wealth ratio becomes significant at the 10 per cent level when the output gap, the inflation rate, the Gini index, and the demographic variables are added to the model. The sign of the coefficient of the wealth-to-output ratio is negative, which is consistent with the findings in Carroll et al. (2012), indicating that saving is a diminishing function of wealth.

It could be argued that household saving may depend on the levels of the explanatory variables rather than on changes in them. To check if this is the case, the model is estimated using levels of the main variables. The results are reported in Table 4.

Table 4: Baseline model with regressors in levels

VARIABLES	(4.1) Baseline	(4.2) Levels	(4.3) Levels&Diff-s
Saving rate, lagged	0.784***	0.730***	0.757***
	(0.078)	(0.109)	(0.077)
ΔUnemployment	0.730**		0.815**
	(0.306)		(0.336)
Unemployment		–0.243**	0.035
		(0.111)	(0.096)
ΔExpectations	0.789***		0.684
	(0.274)		(0.432)
Expectations, level		0.787**	–0.440
		(0.273)	(0.490)
ΔWealth-to-output	–0.030	–0.004	0.037
	(0.027)	(0.034)	(0.045)
ΔCredit flow	0.038	0.045	0.103
	(0.402)	(0.345)	(0.339)
Income growth	0.313***	0.014	0.202
	(0.082)	(0.196)	(0.137)
Real interest rate	–0.114	0.123	–0.143
	(0.091)	(0.145)	(0.097)
Observations	447	456	447
Number of countries	24	24	24
Number of instruments	28	28	34
Hansen J-stat	14.15	15.69	9.36
p value	0.82	0.74	0.99
AR(1)	–2.72	–1.90	–2.22
p value	0.01	0.06	0.03
AR(2)	–0.80	0.19	–0.41
p value	0.42	0.85	0.68

Notes: The dependent variable is the household saving rate as a share of disposable income. Panel estimates with one-step system GMM with two external instruments: volatility of expectations and income volatility. Lags 2 to 3 are used for the transformed equation and lags 1 to 2 are used for the equation in levels. Robust standard errors are in parentheses. Superscripts ***, **, * indicate levels of statistical significance at 1, 5 and 10 per cent respectively.

For convenience column (4.1) repeats the estimations of the baseline model. Column (4.2) reports the results when the uncertainty proxies are in levels. The wealth and credit variables are not panel stationary, and they should not be added in levels. Both unemployment and expectations are statistically significant but the coefficient of unemployment is negative, implying consumption smoothing over the business cycle. When first differences of the uncertainty proxies are added to the model however, the levels become insignificant as seen in column (4.3). The change in the unemployment expectations becomes statistically insignificant in this model specification, but the point estimate is very close to the baseline one. With a larger number of lags, the coefficient of unemployment expectations also becomes statistically significant in this specification.

The results in Tables 2, 3 and 4 suggest that the baseline model is quite stable with different specifications and subsamples. Nevertheless, system GMM is a fairly complicated method technically, and it is known to be sensitive to small changes in the model settings. For this reason the baseline model is estimated in different configurations, see Table 5 for details.

Column (5.2) in Table 5 reports the results obtained with a two-step estimator instead of the one-step estimator used in the baseline model. Paternoster and Piquero (1998) recommend using year dummies to control for time fixed effects. As it will overfit the model, the country-invariant volatility index (VIX)[13] is added as an exogenous instrumental variable in the level equation to account for the time fixed effects. The results are presented in column (5.3). The model in column (5.4) is estimated with a fixed effects estimator and clustered errors, and column (5.5) reports the results obtained with the Arellano-Bond, or difference GMM, estimator.

The only notable difference between the baseline model and the FE estimates is that the coefficient of the changes in expectations of unemployment becomes substantially smaller and statistically insignificant. However, the estimates obtained by the FE estimator suffer from endogeneity bias, meaning it is not an appropriate method when reverse causality is present. All other coefficients are very close to those of the baseline model.

Models with 4, 6 and 8 lags instead of 3 and a model without external instruments were also estimated but the results are not reported here as they are largely the same.

All the point estimates of the different model configurations are compared to the baseline estimates using the Z-test as described above. According to the test, none of the coefficients are statistically different from the baseline estimates. In summary, the baseline model is stable and the reported findings may be considered robust.

[13] See Appendix B for details.

Table 5: Robustness checks

	(5.1) Baseline	(5.2) Two-step	(5.3) VIX	(5.4) FE	(5.5) AB
Saving rate, lagged	0.784***	0.800***	0.788***	0.795***	0.765***
	(0.078)	(0.061)	(0.056)	(0.060)	(0.141)
ΔUnemployment	0.730**	0.696**	0.719***	0.607***	0.752**
	(0.306)	(0.290)	(0.235)	(0.076)	(0.284)
ΔExpectations	0.789***	0.566**	0.793**	0.252	0.760**
	(0.274)	(0.213)	(0.298)	(0.152)	(0.360)
ΔWealth-to-output	–0.030	–0.051*	–0.032	0.002	–0.024
	(0.027)	(0.027)	(0.031)	(0.009)	(0.028)
ΔCredit flow	0.037	0.072	0.011	–0.128	0.002
	(0.402)	(0.237)	(0.227)	(0.093)	(0.367)
Income growth	0.313***	0.317***	0.316***	0.406***	0.402***
	(0.082)	(0.103)	(0.080)	(0.063)	(0.115)
Interest rate	–0.114	–0.066	–0.112	0.085	–0.131
	(0.091)	(0.074)	(0.095)	(0.053)	(0.121)
Observations	447	447	447	447	423
Number of countries	24	24	24	24	24
Number of instruments	28	28	29		18
Hansen J-stat	14.15	14.15	13.65		12.20
J-stat p value	0.823	0.823	0.88		0.349
AR(1)	–2.72	–2.88	–2.77		–2.47
AR(1) p value	0.01	0.00	0.01		0.01
AR(2)	–0.80	–0.75	–0.81		–1.35
AR(2) p value	0.42	0.45	0.42		0.18

Notes: The dependent variable is the household saving rate as a share of disposable income. Panel estimates with one-step system GMM with two external instruments: volatility of expectations and income volatility. Lags 2 to 3 are used for the transformed equation and lags 1 to 2 are used for the equation in levels. Robust standard errors are in parentheses. Superscripts ***, **, * indicate levels of statistical significance at 1, 5 and 10 per cent respectively. In the two-step estimate (5.2) standard errors are Windmeijer (2005) corrected. In column (5.4) the model is estimated with a fixed effects estimator. In column (5.5) the model is estimated with the Arellano-Bond estimator.

6. Conclusions

The paper studies the determinants of household saving in 24 European countries in 1996–2017 using system GMM to account for the Nickell bias and the potential endogeneity of the regressors. The main findings are that household saving rates are highly persistent, and that the main drivers of saving rates are labour income uncertainty and income growth. This is consistent with the LC/PIH that shows household saving to be procyclical, meaning that households tend to smooth their consumption. The buffer-stock saving theory is not confirmed, as uncertainty affects saving but not through the wealth channel.

One of the novelties of this paper is that uncertainty is included both as objective uncertainty and as a subjective uncertainty that reflects how households perceive the shock. To capture two different types of uncertainty, two proxies are incorporated in the model – unemployment rate and consumer expectations of future unemployment. Both variables are used in first differences and the results show that household saving is driven by the changes, not the levels, of the uncertainty. This can be explained by the ambiguity aversion theory, which claims that agents prefer known odds over ambiguity; it follows that when the *familiar* level of uncertainty changes and an *unfamiliar* portion of ambiguity is added, households have to reassess their economic position and adjust their saving behaviour.

According to the findings of this study, income growth, changes in the unemployment rate, and changes in expectations for unemployment are statistically and economically significant factors that drive the household saving rate, while the wealth-to-output ratio, credit availability, and the interest rate do not have any statistically or economically significant impact on household saving. It is of note that when they are included in the same equation, proxies of uncertainty prevail over the variables like wealth, credit and the interest rate that are traditionally incorporated in saving rate equations.

The wealth variable being not statistically significant suggests that the buffer-stock saving hypothesis does not hold, meaning uncertainty does not affect saving behaviour through target wealth but affects it directly. It might also be assumed that the effect of changes in target wealth due to uncertainty might be picked up only at the household level but not at the aggregate level.

The results show that the negative effect that unemployment has on the economy is amplified through the household saving channel, reducing current consumption and keeping it low over a long time span. These observations may help explain the slow recovery after the crisis of 2008–2009, when the high unemployment rate was followed by low consumer confidence, high saving rates and low consumption.

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Appendix A

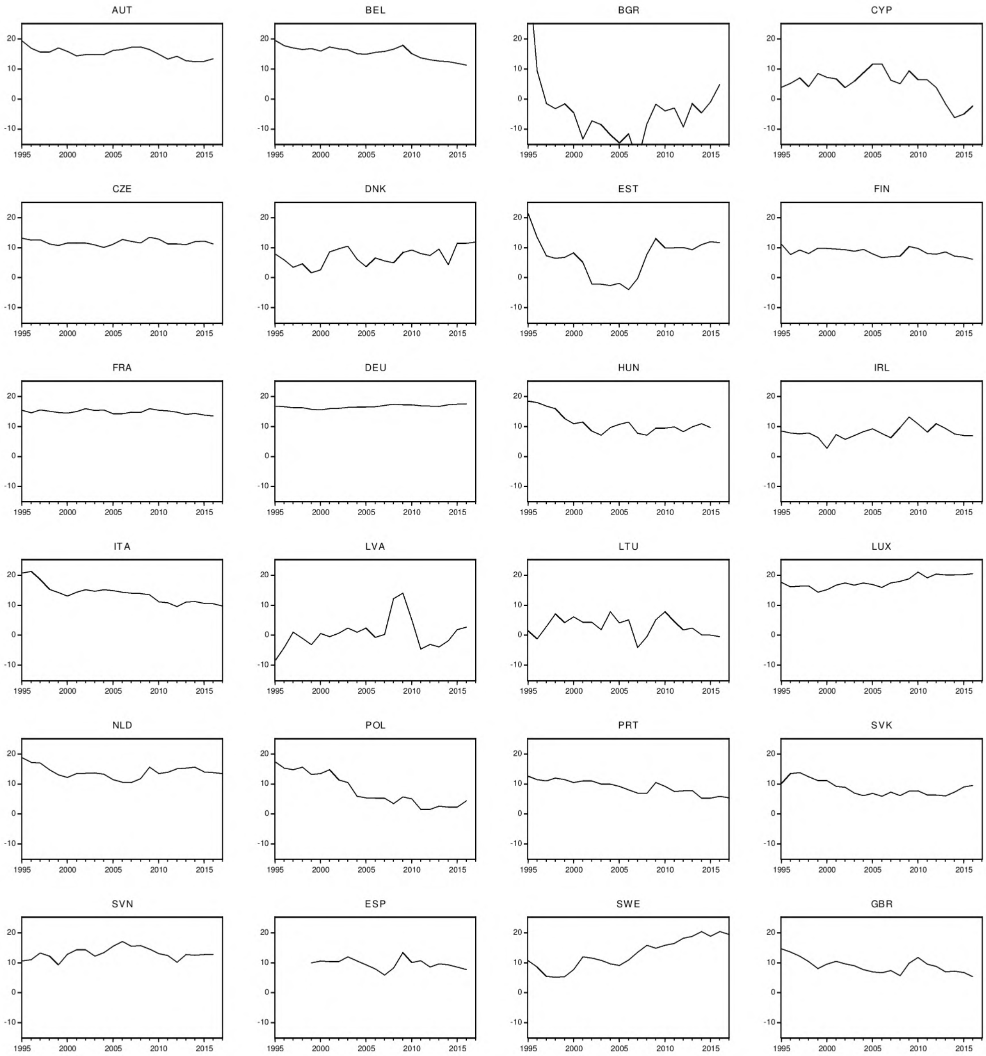

Figure A1: Household saving rates

Notes: The household saving rates are expressed as a share of household disposable income.

Source: Eurostat

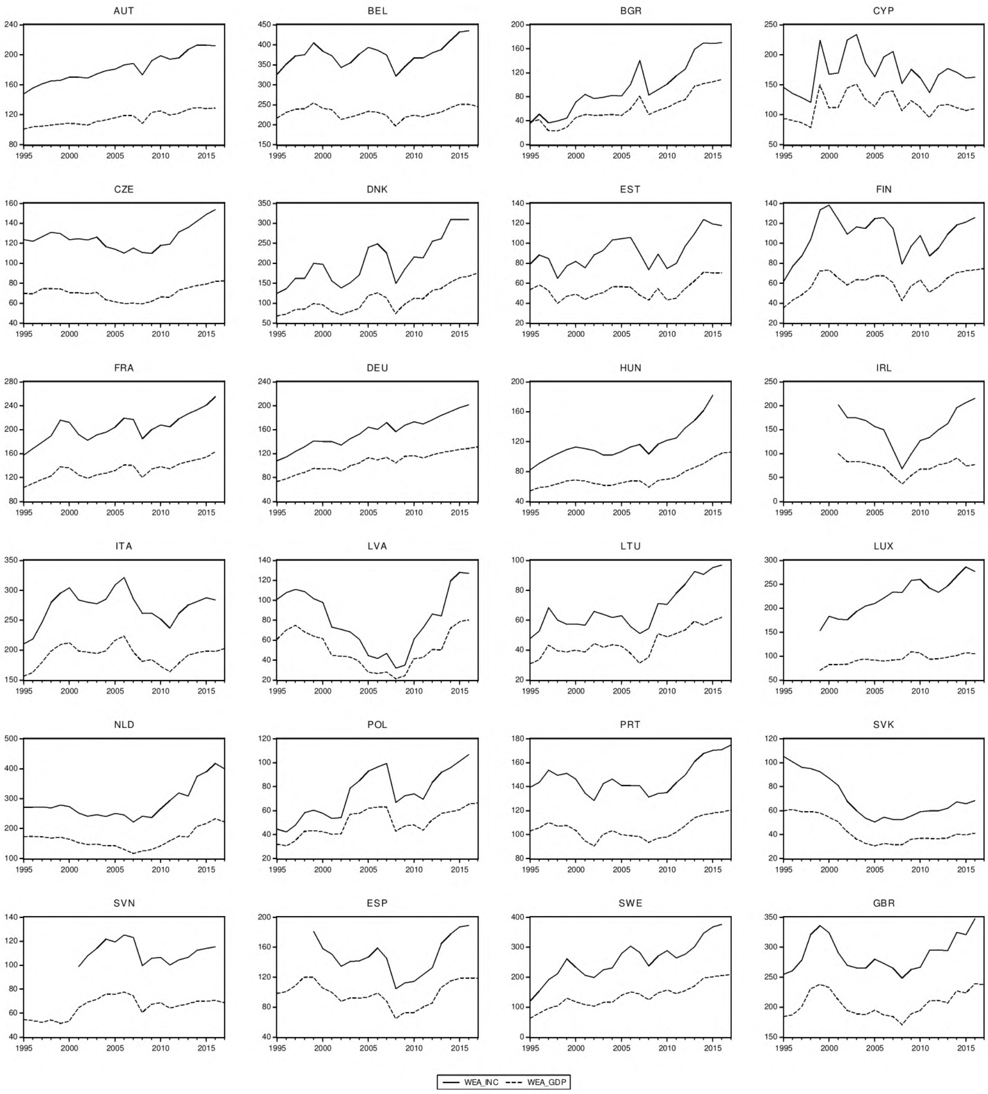

Figure A2: Wealth-to-income and wealth-to-output ratios

Notes: *WEA_INC* (solid black line) denotes the wealth-to-income ratio, *WEA_GDP* (dash line) denotes the wealth-to-output ratio.

Source: Eurostat

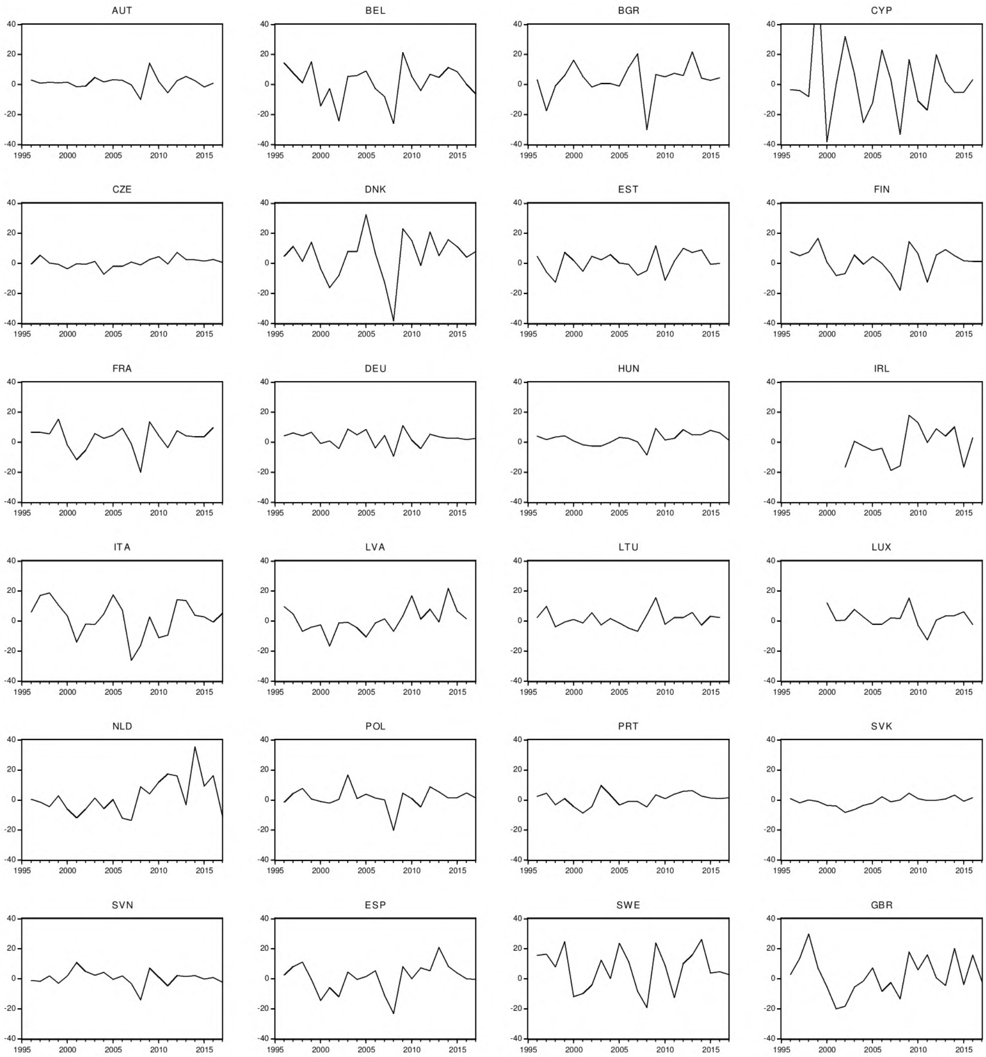

Figure A3: Changes in household net financial wealth

Source: Eurostat

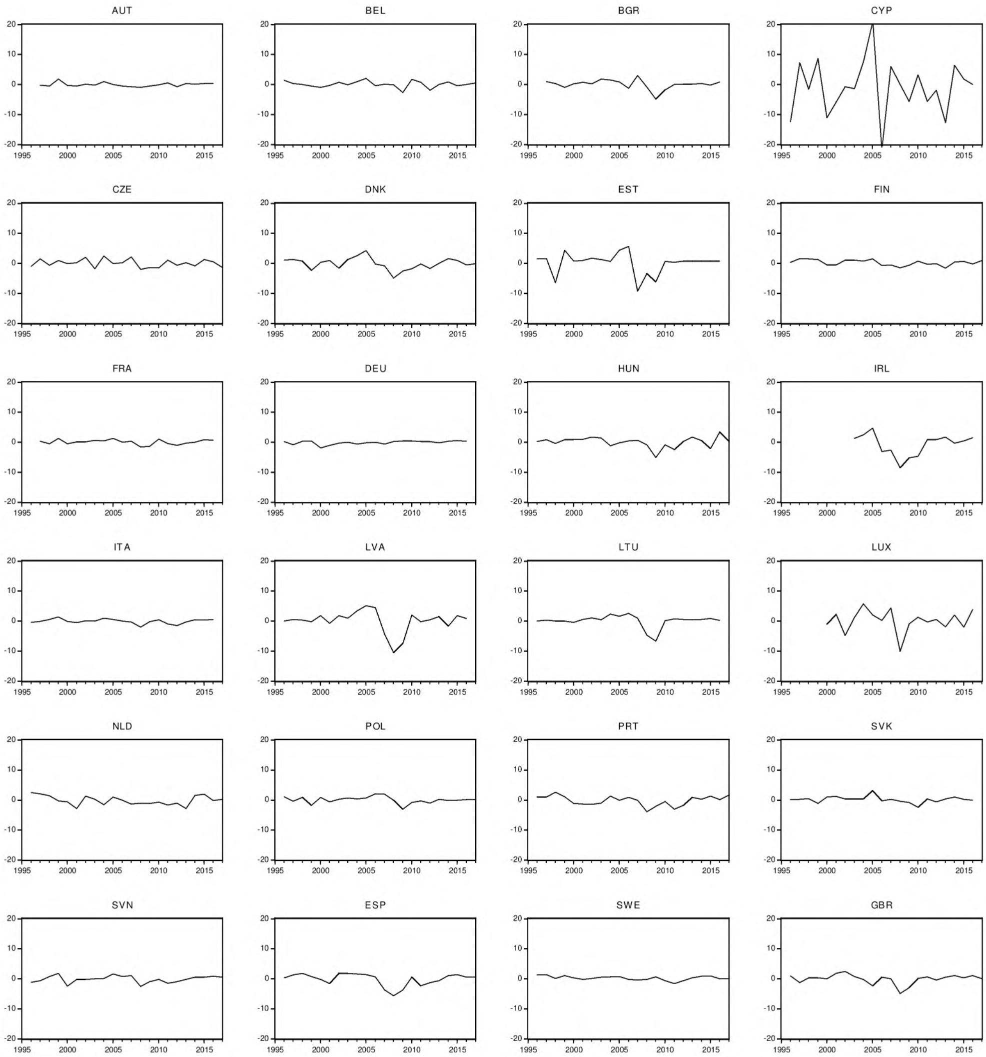

Figure A4: Changes in net credit flows
Source: Eurostat

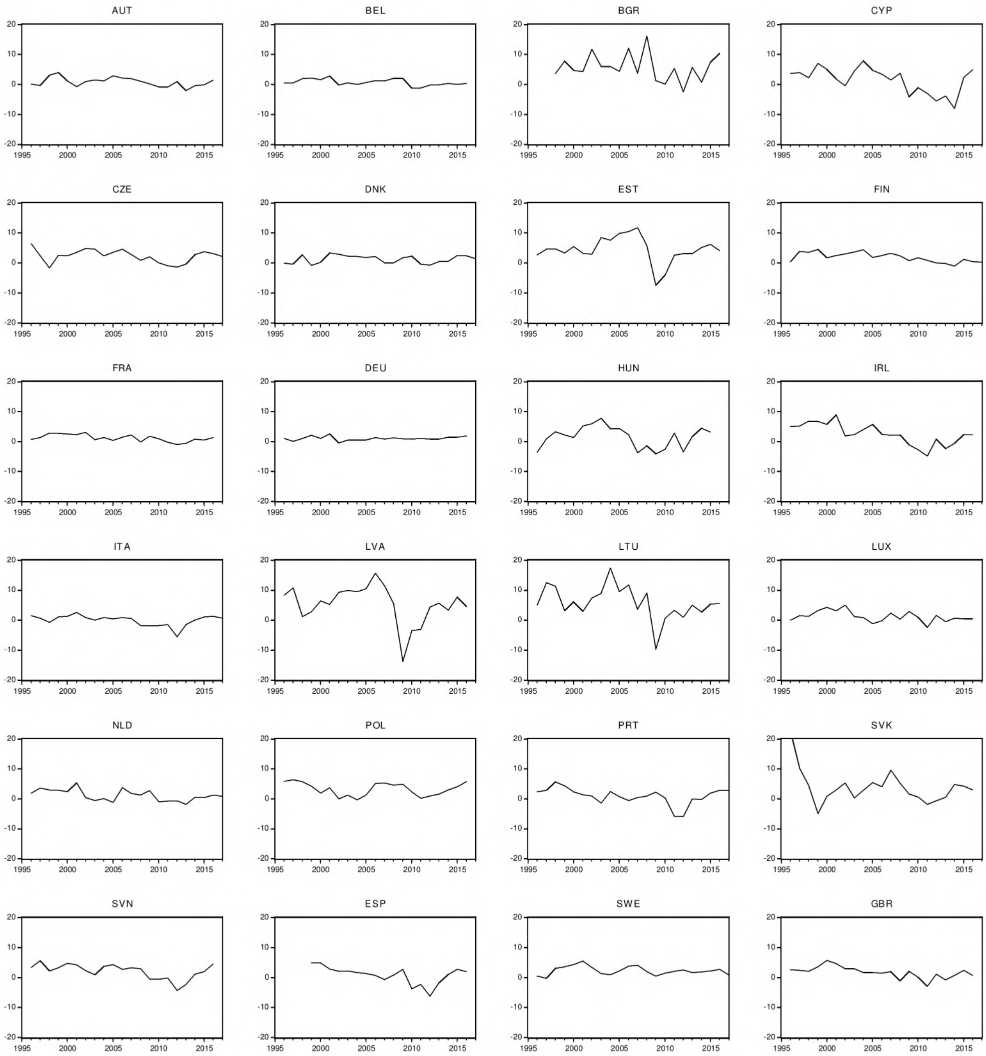

Figure A5: Income per capita growth rate
Source: Eurostat

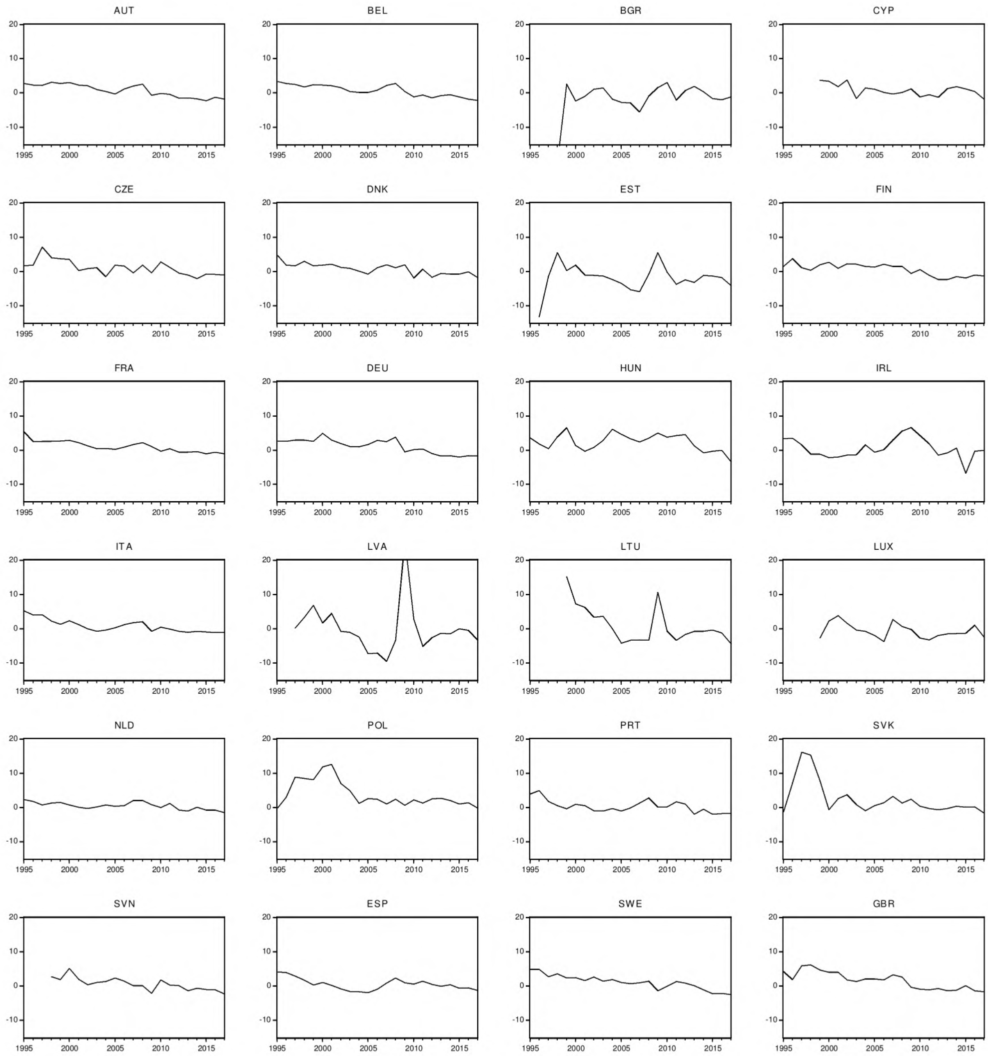

Figure A6: Short-term real interest rate
Source: AMECO

Appendix B

The household saving rate is defined as household gross disposable income less household consumption expenditure as a share of household gross disposable income, Eurostat [table code *nasa_10_nf_tr*]. *Household* is taken to refer to households and non-profit institutions serving households (NPISH). It is common practice to study households and NPISH together, as the latter are supposed to act like households. Gross disposable income is adjusted for the change in the net equity of households in pension funds reserves. Saving rates fluctuate in the range of (20.17) to 43.28 with an average of 9.88 and standard deviation of 6.43 (528 observations).

The data for the expectations of unemployment are taken from the business and consumer survey, which is a joint harmonised EU programme of the European Commission, Eurostat code *DG ECFIN*, question 7[14] [table code *ei_bsco_m*]. The question is: "How do you expect the number of people unemployed in this country to change over the next 12 months? The number will..." There are five answer choices: increase sharply, increase slightly, remain the same, fall slightly, or fall sharply, and don't know.

Aggregate balances are calculated in the following way. Where there are six options, PP denotes the percentage of respondents who have chosen "increase sharply", MM denotes the percentage of respondents who have chosen "fall sharply", E is the percentage of respondents who think that the unemployment rate will remain the same, and N is the percentage with no opinion, and so the balance is calculated as $B = (PP + ½P) − (½M + MM)$.

The average of monthly balances of answers is globally standardised, as it is demeaned and divided by the standard deviation, using the means and standard deviations for the whole sample to make the interpretation of the results more intuitive. The unemployment rate is taken from the same database [table code *une_rt_a*]. The growth rate of income is the growth rate of household disposable income per capita [table code *nasa_10_nf_tr*] deflated with the harmonised index of consumer prices (HICP) [table code *ei_cphi_m*].

For a robustness check, the volatility of inflation (change of HICP) is used as an uncertainty proxy. It is measured in two ways, as the standard deviation of month-on-month inflation rates (unconditional inflation volatility, Rother, 2004), and as the standard deviation of rolling five-year windows of year-on-year HICP.

Besides price volatility, volatility of output, measured as the standard deviation of quarterly output, and stock market volatility, expressed as the VIX and VDAX indexes, are controlled for. VIX measures the market's expectation of future volatility and is based on options for the S&P 500® Index[15]. VDAX is the VDAX NEW index, and it expresses the implied volatility of the DAX, *Deutscher Aktienindex* (German stock index). The VDAX series are markedly shorter than those of the VIX. Both stock market volatility indexes are country-invariant.

The proxy for the household wealth level is the ratio of household financial wealth to output [table code *nasa_10_ki*]. When the wealth level is used, the logarithm is taken and then it is lagged by one period. For the robustness check, household net wealth is used rather than

[14] See http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/bcs_user_guide_en.pdf for details.
[15] See http://www.cboe.com/vix for details.

financial wealth, and it is the total amount of financial assets plus the total amount of non-financial assets as a fraction of disposable income. Using this proxy makes the sample smaller by 105 observations. Four countries (Bulgaria, Cyprus, Ireland and Spain) fall out completely due to a lack of data. The data on net wealth are taken from the OECD database [OECD, 2018, doi: 10.1787/2cc2469a-en; 10.1787/dd50eddd-en].

Credit availability is accounted for as the net flow of loans to households as a fraction of GDP, [table code *nasa_10_f_tr*], ESA 2010. A weakness of this indicator is that it reflects not only the supply side through credit constraints but also the changes in credit demand. However, it is the best proxy of credit conditions available for the given period. The debt-to-income ratio is used for the robustness check [table code *nasa_10_f_bs*]. The data source for the short-term real interest rate is the AMECO database [table code *ISRV*].

The set of additional variables includes, but is not limited to, the young-age dependency ratio (the ratio of the population younger than 15 to the population aged 15-64 [table code *demo_pjanind*]) and the old-age dependency ratio (the ratio of population older than 64 to the population aged 15-64 [table code *demo_pjanind*]); proxies of income inequality, which are the income share of the bottom 40 per cent of the population as a percentage of total disposable household income, [table code *sdg_10_50*] and the Gini index, [table code *ilc_di12*]; social benefits as a fraction of GDP, which shows transfers received by households in such circumstances as sickness, unemployment or retirement, or facing changes in housing, education or family circumstances, expressed as a share of GDP [table code *gov_10a_main*]; and the pension replacement ratio, which is a ratio of income from the pensions of those aged between 65 and 74 and the income from work of those aged between 50 and 59 [table code *ilc_pnp3*].

If not specified otherwise, the data are downloaded from the Eurostat database. All the data are tested for unit roots. The tests show that the saving rate, income growth, and the interest rate are panel stationary, while wealth variables, credit flows and demographic variables are not panel stationary but have a common unit root process; the uncertainty proxies are panel stationary but assume individual unit root processes.

Appendix C

AUT	Austria
BEL	Belgium
BGR	Bulgaria
CYP	Cyprus
CZE	Czech Republic
DNK	Denmark
EST	Estonia
FIN	Finland
FRA	France
DEU	Germany
HUN	Hungary
IRL	Ireland
ITA	Italy
LVA	Latvia
LTU	Lithuania
LUX	Luxembourg
NLD	Netherlands
POL	Poland
PRT	Portugal
SVK	Slovakia
SVN	Slovenia
ESP	Spain
SWE	Sweden
GBR	United Kingdom

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