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Perceived uncertainty as a key driver of household saving☆

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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 national-level data for 22 European countries in 1996–2017 using system GMM. The household saving rate is highly persistent and is driven in large part by income growth and by changes in labour income uncertainty, which can be dissected into two components: realised uncertainty and expectations about future uncertainty. Credit availability, interest rates, inflation, and other macroeconomic and expectational variables have little or no effect on saving.

1. Introduction

A deep recession accompanied by declining incomes and high unemployment in 2008–2010 could have been a good reason for dissaving. Instead though, household saving rates have grown substantially since then both in Europe and in the USA. The accumulation of savings accompanied by a high level of economic uncertainty has created a new wave of interest in the dynamics of household saving behaviour.

Christelis, Georgarakos, and Jappelli (2015) point out that three shocks occurred simultaneously during the crisis, as there was a drop in housing prices, declines in stock market indexes, and a dramatic deterioration of labour market conditions, the latter causing great uncertainty about labour income, which is the main source of income for households. This paper examines the links between household saving rates and uncertainty as a trigger of the precautionary saving behaviour that could explain high saving rates during and after the crisis. A key innovation of this paper is that it introduces two measures of perceived[1] labour uncertainty, both of which are important for household saving.

The focus of the paper is on aggregate saving, which is defined residually as disposable income including asset income, less consumption. This is the most commonly used definition of saving because of its simplicity and the availability of the data. Other approaches are also feasible, especially in the microeconomic literature, for example making a distinction between the consumption of durables, which can be considered a form of accumulation of capital, and nondurables (Campbell, 1987; Pistaferri, 2001), or

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[1] The terms "perceived" and "subjective" are used here interchangeably.

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distinguishing personal cash saving, which is the difference between total cash receipts and total cash expenditures on anything except capital expenditures (Howrey & Hymans, 1978).

Saving could be also decomposed into different components using data from different sources.[2] The problem with different data sources is that they give different results due to statistical discrepancies, conceptual differences, and differences in sectoral coverage, as Wachtel (1977) showed. Although it could be of interest to disaggregate different types of saving (Wachtel, 1979), or to disaggregate income because the marginal propensity to save out of different types of income could be different (Campbell, 1987; Taylor, 1971), this paper restricts its analysis to the response of aggregate household saving to uncertainty and other macroeconomic shocks. As Denison (1958) pointed out, it is gross saving as a whole that is crucial, and disaggregating is of interest in finding the implications for this total.

Saving rates as one of the key indicators for economic performance have been studied extensively at both the macro and micro levels; see Mikesell and Zinser (1973), Balassa (1993), Loayza, Schmidt-Hebbel, and Servén (2000), and Meghir and Pistaferri (2011) for overviews. However, the dynamics of saving since the recent crisis have made it clear that there is still only a little empirical evidence for the determinants of the saving rates and particularly for economic uncertainty as a possible explanatory variable. The paper addresses this issue by focusing on labour income uncertainty as a key driver of household saving.

The paper contributes to the literature on household saving in several ways. First of all, it explores new ways of looking at the uncertainty. It accounts for the uncertainty arising from the actual change in labour market conditions, and for the subjectively assessed expectations about what might happen in the labour market in the future. To account for that, data from the Joint Harmonised EU Consumer Survey are employed, which is rarely done in macroeconomic studies.[3]

The survey data represent a forward-looking expectational component of the uncertainty, while changes in the unemployment rate can be considered a backward-looking component as they contain information from past periods. The paper shows that both indicators of uncertainty have a pronounced and statistically significant effect on saving rates and together with income growth they can be considered the key determinants of household saving rates.

The findings reveal that household saving rates are highly persistent; it follows that the negative effect of unemployment on consumption is inflated in the long-run, not only reducing current consumption but also keeping it at low level over a long time span. Moreover, the results demonstrate how the consumption-credit environments in Europe and the USA are different, as Europeans have less debt-driven consumption than Americans do.[4]

The study uses a large up-to-date sample covering a panel of 22 European economies over multiple full business cycles in 1996–2017. The data used are aggregate national-level annual data. Given how the economic environment changed after the crisis, with low inflation, a zero lower bound, and unconventional monetary policy, it is instructive to obtain empirical evidence of what is now driving household saving rates in Europe as an economically and politically important region.

The models are estimated with system GMM, which makes it possible to account for the endogeneity of the regressors and to resolve a dynamic panel bias. Numerous robustness checks prove the validity of the results.

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

2. Brief literature review

The following section provides a brief literature review. Subsection 2.1 discusses the basics of precautionary saving theory. Subsection 2.2 is dedicated to a discussion of uncertainty and expectations, and it also provides a short overview of income growth, interest rates, and credit constraints as possible drivers of household saving.

2.1. Precautionary saving

A typical textbook explanation of precautionary saving (Leland, 1968; Sandmo, 1970) would follow from the positive third derivative of the utility function of consumption, $u(C)$, implying that $u^{\cdot}(C)$ is convex. This implies 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) 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[5] 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 due to uncertainty if consumption is reduced.[6] This observation is in line with loss aversion theory, which claims that people prefer to avoid losses rather than achieve gains (Tversky and Kahneman, 1992).

Another textbook model of precautionary saving is Carroll's (1997) buffer-stock saving theory. At the core of this theory is labour

[2] Wachtel (1977) points out that saving is essentially the sum of three different movements: the increase in financial assets, the decrease in net liabilities, and the increase in durables.

[3] There are some studies that use survey data (see for example Alessie & Lusardi, 1997; Harris, Loundes, & Webster, 2002; Jappelli & Pistaferri, 2000; Pistaferri, 2001), but these are mostly microeconomic studies.

[4] See for example Carroll et al. (2012) for empirical evidence on the large impact of credit on consumers' behaviour in the USA.

[5] Disutility due to uncertainty is defined as a reduction in utility due to consumption of the random quantity y_1 instead of the certain quantity $E[y_1]$.

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

income uncertainty combined with the impatience of consumers. If a consumer's wealth is below the target wealth-to-permanent-income ratio, 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.

Given the interaction of the impatience and the prudence of the consumer, it is not optimal for the consumer to let wealth become arbitrarily large with respect to income; however, when the level of wealth falls, prudence begins to dominate and it affects saving behaviour positively (Carroll & Toche, 2009, p. 15265).

The buffer-stock saving model is closely related to the models developed by Zeldes (1989) and Deaton (1992), with the difference that Carroll's model incorporates unemployment expectations to take account of labour income being one of the main sources of household income. In the empirical study based on the buffer-stock saving theory, Carroll, Slacalek, and Sommer (2012) document a considerable rise in private saving in the USA after the global financial crisis of 2008–2009 and explain this by the increased uncertainty and the expectations of high unemployment after the crisis.

The earlier "zero-depreciation" theory[7] of saving elaborated by Houthakker and Taylor (1970) and Taylor (1971), referred to as the HT model, is fairly close to the buffer-stock model. The basic notion underlying the HT model is that "the consumer adjusts his saving so as to bring his stock of financial assets into line with his level of income" (Taylor, 1971), meaning saving is a linear function of wealth and there is a target wealth-income level as in the buffer-stock saving model. The HT model is used quite extensively in the literature (see for example the augmented model in Juster & Wachtel, 1972b) and it was later generalised and expanded in Bergstrom and Chambers (1990, pp. 279–319) and in Taylor and Houthakker (2009).

2.2. Uncertainty and other drivers of saving rates

Theory says that uncertainty can affect the real economy, one of the key channels being precautionary saving by households.[8] For that reason it would be instructive to include uncertainty variables in the saving model, the only problem being that it is fairly challenging to find an appropriate proxy for uncertainty.

Bloom (2014) argues that uncertainty can be measured in numerous ways and he names a few types of proxy for uncertainty, the most commonly used being the volatility of an economic indicator like output, inflation, or stock market indexes.[9] In the literature on the saving rates, the most frequently used proxy for macroeconomic uncertainty is the inflation rate (Gupta, 1987; Loayza et al., 2000), or the unemployment rate if the focus is on labour income uncertainty (Bande & Riveiro, 2013; Mody, Ohnsorge, & Sandri, 2012).

Inflation can affect saving through different channels like the money illusion, intertemporal substitution or uncertainty, including indirect ones that operate through the interest rate and wealth (Wachtel, 1977)[10]. The inflation rate can be disaggregated into anticipated and unanticipated inflation as in Juster and Wachtel (1972b); uncertainty is created and savings are pumped up by unanticipated inflation, while a "fully anticipated change in inflation has no effect on real economic behaviour in the long run".

It is worth stressing that the theoretical effect of inflation on saving is ambiguous. It can discourage saving because it creates distortions in returns on saving, since taxes and interest rates are specified in nominal terms, but it can also increase saving if households perceive the economic environment to be more uncertain because of higher inflation (Wachtel, 1979).

The key indicator in the context of labour income is the unemployment rate. For those who are working, rising unemployment gives two signals at once, a signal that there is a higher probability of losing their 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 risk from labour income. The higher unemployment is, the higher the risk is of the main source of income being lost or of income becoming lower.

Juster and Wachtel (1972a) distinguish between the unemployment rate in levels and in first differences. The idea behind this is that these variables are proxies of different processes. When the unemployment rate is high, a large share of the population receive relatively low income; this means that the *capacity* to save (Hussein & Thirlwall, 1999) is lower and it could be expected that saving will fall. However, when the change in unemployment is positive, the fear of losing a job and uncertainty about future income become larger, so saving could be expected to rise because of precautionary motives. To summarise, the level of unemployment could be a proxy for labour income, and a change in the unemployment rate appears to be a suitable proxy for uncertainty about labour income.

Distinguishing between levels and first differences is also important because uncertainty is effectively a reflection of a change as discussed in Bachmann, Carstensen, Lautenbacher, and Schneider (2018). They show on microdata from firms that a change in sales, either good or bad, makes firms more uncertain, and perceived uncertainty increases even more if the change is temporary. Arrow et al. (1995) examine how the economy affects the environment and introduce the concept of *familiar* and *unfamiliar* changes; they argue that "changes from familiar to unfamiliar states increase the uncertainties associated with the environmental effects of economic activities" (p. 521).

Two empirical studies that focus on the macroeconomic determinants of household saving rates, Pesaran, Ul Haque, and Sharma

[7] The name of the theory refers to the assumption that households own non-depreciating financial wealth.

[8] For empirical evidence see for example Fernández-Villaverde, Guerrón-Quintana, Kuester, and Rubio-Ramírez (2015), Basu and Bundick (2017).

[9] It can also be measured as the dispersion of productivity shocks to firms or the volatility of sales and profits, which are called micro level uncertainty; as political uncertainty by calculating the frequencies of certain words such as "uncertainty" in the news; or as forecast error coming from survey data.

[10] Wachtel (1977) analyses how different components of saving are affected by inflation-induced uncertainty and shows that it reduces the propensity to incur liabilities, but has no effect on financial assets.

(2000) and Kukk and Staehr (2017), include the unemployment rate in the set of the explanatory variables but they do not find any significant effect from it. Carroll et al. (2012) combine the unemployment rate with data from surveys of consumers on the expected change in the unemployment rate, which produces one proxy for labour income uncertainty. However, it might be useful to bring in expectational variables explicitly to account for subjectively assessed uncertainty.

The reason for evaluating the impact of changes in unemployment rate and expectations of unemployment separately is that they are conceptually different. If unemployment increases, consumers feel less confident about their labour market perspectives and save more than in the previous period. This can be classified as the backward-looking component of the uncertainty as it is based on data from a past period. Along with actual developments on labour market, forward-looking expectations about future labour market conditions also affect household saving. These expectations may be labelled the forward-looking expectational component of uncertainty.

Alternatively, these two proxies may be thought of as familiar and unfamiliar uncertainty, or as a measure of realised uncertainty and a measure of expectations about future uncertainty. The line between them is very fine, though, as changes in the unemployment rate can be also considered an expectational variable if consumers have statistical expectations and make projections of earlier developments in the labour market into the future. However, these variables have different dynamics (this is to be expected as they refer to different periods,[11] see Fig. 1 for a sample of 24 EU countries), and this is an additional reason to include them both in the model.

As discussed in Subsection 2.2, a desirable buffer is defined by the income level, and while the income variable can be thought of as an indicator of the *capacity* to save (Hussein & Thirlwall, 1999), the *willingness* to save might depend on other determinants, the most important of which are macroeconomic stability or the lack of uncertainty, interest rates, and credit conditions, but which also include transfers,[12] the stage of the business cycle,[13] income distribution,[14] demography,[15] the life cycle,[16] and so on.

Changes in the interest rate can theoretically have an ambiguous effect on the saving rate, as the total of the wealth, income and the substitution effect of changes in the interest rate is not predictable (Browning & Lusardi, 1996; Wachtel, 1977).

Household saving can be subject to borrowing constraints (Attanasio & Weber, 2010). Carroll et al. (2012) explain for example 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. Davis and Palumbo (2001) explain these short-run fluctuations, however, by changes in household wealth.

3. The data, the model and the estimation method

The paper uses a panel covering 22 EU countries over multiple full business cycles in 1996–2017. The annual data used are aggregate national-level data. The sample covers Austria, Belgium, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, 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 baseline model excludes Bulgaria and Luxembourg as these countries have many outliers.

3.1. Model

The reduced-form buffer-stock saving model discussed in Subsection 2.1 includes a lagged dependent variable[17] to account for saving inertia and following the literature it is augmented with income growth, the real interest rate, inflation rate, and demographic variables as controls. All the explanatory variables enter the model in first differences (Taylor, 1971; Juster and Wachtel, 1972a,b).

The reduced-form saving rate model is:

$$\begin{aligned}\text{Saving rate}_{it} = {} & \rho\,\text{Saving rate}_{it-1} + \beta_U \Delta\text{Unemployment}_{it} + \beta_E \Delta\text{Unempl.expectations}_{it} + \beta_I \Delta\text{Income}_{it} + \beta_C \Delta\text{Credit}_{it} \\ & + \beta_R \Delta\text{Real interestrate}_{it} + \beta_\pi \Delta\text{Inflation}_{it} + \beta_X X_{it} + \eta_i + \varepsilon_{it},\end{aligned}$$

The subscript t refers to the time period and i is the country. The variable Saving rate$_{it}$ is the household saving rate as a share of disposable income. The autoregressive coefficient ρ is expected to be less than 1. The variable Δ Unemployment is the first difference of the unemployment rate in percentage points; ΔUnempl.expectations is the first difference of expectations of unemployment; Δ Income stands for the growth of household real disposable income per capita; Δ Credit is the net flow of loans for households as a fraction of output; Δ Real interest rate is the first difference of 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 ρ, β_U, β_E, β_W, β_C, β_I, β_R are to be estimated, X_{it} is a matrix of control variables (life expectancy, the old-age dependency ratio, and the young-age dependency ratio), and β_X is a vector of their coefficients.

While Carroll et al. (2012) combine the data from the surveys with actual unemployment data, this paper treats them separately, and

[11] One is the change from last year to this year and the other is the expected change in unemployment in the following 12 months.

[12] Juster and Wachtel (1972a) document the large positive effect that social transfers have on saving, suggesting that economic agents receiving transfers have a very high short-run marginal propensity to save. The same findings are obtained in Taylor (1971).

[13] See for example Abel, Rich, Song, and Tracy (2016) on the countercyclicality of uncertainty indicators.

[14] See Malinen (2013) for an empirical study on saving and inequality.

[15] One of the pioneering studies is Leff (1969).

[16] Taylor (1971).

[17] When adding the lagged dependent variable to the right-hand side of the equation, we account for the changes in the wealth stock and can avoid adding this variable explicitly like in the HT model.

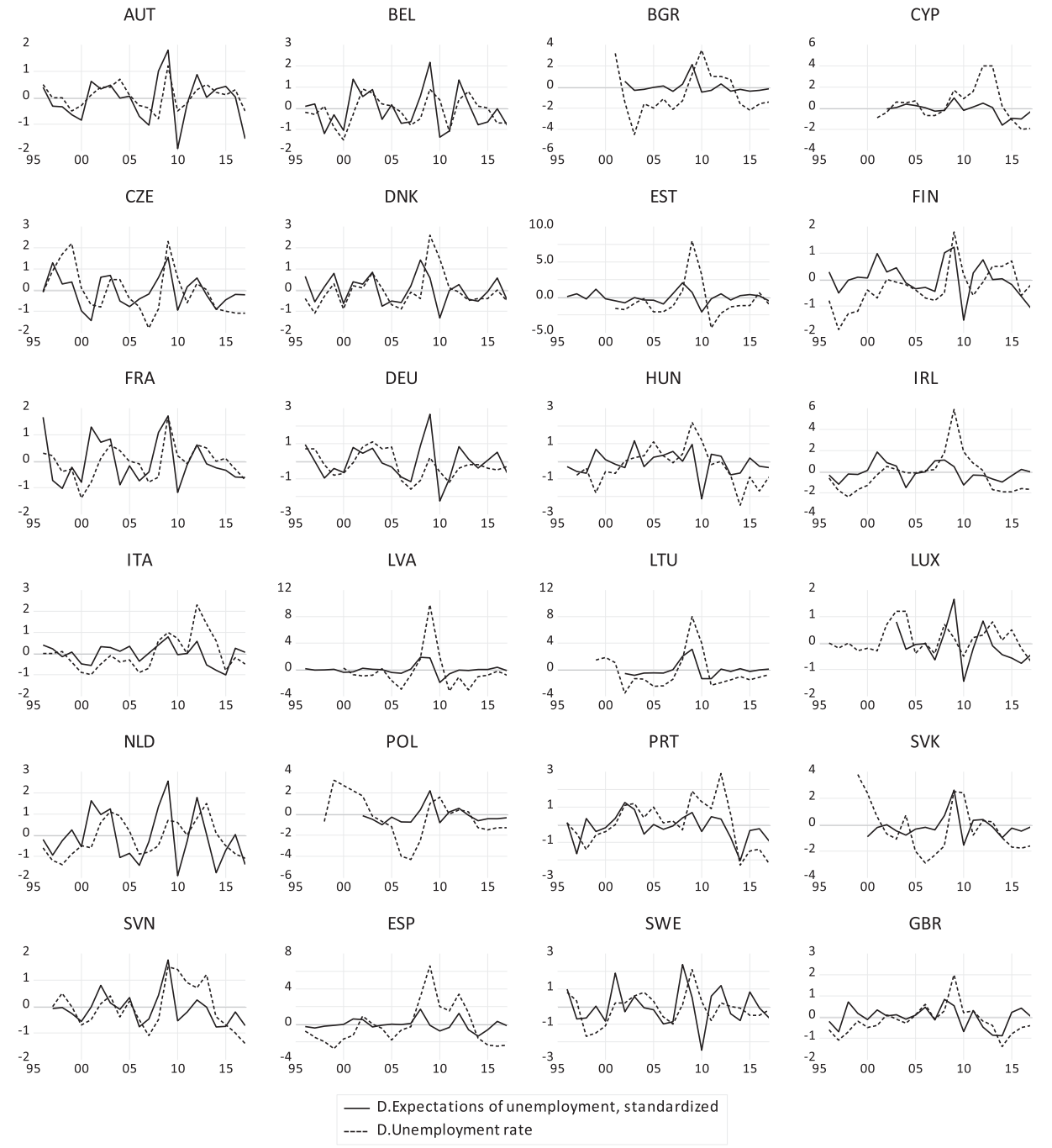

Fig. 1. Changes in the unemployment rate and changes in the index of expectations of unemployment.
Notes: The variable "D.Expectations of unemployment, standardised" denotes the first difference of the standardised expectations of unemployment (dashed line), while the variable "D.Unemployment rate" denotes the first difference of the unemployment rate (solid line). For country codes see Appendix A. *Source*: Eurostat.

that results in there being two different measures of uncertainty. This is done to distinguish between two layers of uncertainty, and both proxies of uncertainty are expected to have a positive sign, meaning more uncertainty leads to a higher saving rate. The credit flow variable is a proxy of credit availability and the coefficient of the variable is 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 undetermined. 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

Table 1
Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Saving rate	484	10.1	5.2	−8.5	21.3
ΔUnemployment	460	−0.1	1.5	−4.4	9.8
ΔUnempl.expectations	461	−0.1	0.8	−2.5	3.1
Credit flow	487	3.1	4.0	−9.0	28.6
Income growth	465	2.1	3.4	−13.7	22.5
ΔReal interest rate	470	−0.2	2.8	−22.4	28.6
ΔInflation	458	−0.2	2.1	−14.4	5.4
ΔLife expectancy	474	0.3	0.3	−0.8	2.2
ΔYoung dependency ratio	484	−0.2	0.4	−1.9	0.9
ΔOld dependency ratio	484	0.4	0.3	−0.4	1.3

Notes: See the description of variables in Appendix B.
Source: Eurostat, AMECO, ECB

the substitution effect of the higher interest rate prevails over the wealth and income effects, then the estimated coefficient of the interest rate will have a positive sign, otherwise the sign will be negative. Summary statistics for the main variables are shown in Table 1.

The paper uses a rich set of explanatory variables to ascertain the determinants of the household saving rates; these variables include the Gini index, the pension replacement ratio, the female participation rate, the output growth rate, the output gap, and others. Additional uncertainty variables from the EU Consumer Survey and volatility measures are used for robustness checks.

Period dummies are not included in the baseline model as they may lead to overfitting; instead, the country-invariant VIX index and the mean average forecast error (MAFE) from the ECB Survey of Professional Forecasters are included in the model to account for time effects that are not country-specific. All variables except the control variables are instrumented, and two external instruments are used.

3.2. Estimation method

The model presented in the previous subsection is a dynamic panel data model. Nickell (1981) shows that in dynamic panels the error terms and lagged dependent variable are typically correlated and so fixed effects estimators are asymptotically biased downwards. With T growing, the Nickell bias becomes less pronounced (Bun & Kiviet, 2001; Judson & Owen, 1999), but it never disappears if standard estimators such as fixed effects or pooled least squares are used (Baltagi, 2013, ch. 8).

Another concern arising from the model specification is that most of the explanatory variables are not strictly exogenous, meaning that reverse causality bias is present. The problem of endogeneity can be solved by using instrumental variables. This suggests a conventional remedy for both problems would be generalised method-of-moments (GMM) estimators developed by Hansen (1982), Holtz, Newey, and Rosen (1988), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).[18] 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.[19] Blundell and Bond (2000) showed 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 combines the results of a transformed equation in differences instrumented using lagged levels, and the original equation in levels instrumented using lagged differences[20].

The present dataset exhibits a relatively large number of periods $T = 23$ and a fairly small number of groups $N = 22$. If all the possible lags are used, the number of instruments will approach or exceed the number of observations. To avoid overfitting of the 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. Furthermore, only lags from two to three are used, while lags up to eight are used for a robustness check.

The baseline model is estimated with one-step system GMM, and the two-step estimator is used when testing for robustness.[21] The bias in the two-step standard errors are corrected by Windmeijer's (2005) correction procedure. Two external instruments are used, these being the volatility of expectations of unemployment measured as the standard deviation of monthly balances of survey answers,

[18] See Baltagi (2013) ch. 8 for a summary of the methods appropriate for estimating dynamic panel data models.
[19] The disadvantages of the first-difference transformation are that it eliminates country-specific information and it magnifies gaps in the unbalanced panels (Arellano & Bover, 1995).
[20] 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.
[21] 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, Demetriades, & Law, 2009; ch. 8). All three statistics and their respective p-values are reported for each model specification.

and the volatility of income measured as the standard deviation of the quarterly compensation of employees deflated with the HICP.

4. Results

4.1. Baseline model

Table 2 presents the estimates of the baseline model and four different subsamples to assess whether possible heterogeneity affects the results unduly. According to the baseline model presented in column (2.1), household saving rates have high inertia and are driven by uncertainty and income growth.

Column (2.1) reports the estimations of the baseline sample with 22 countries; Column (2.2) reports the results without the years of crisis 2007–2009; in Column (2.3) the subsample without France, Germany and United Kingdom is estimated; Column (2.4) shows a subsample without Denmark, Finland and Sweden; Column (2.5) estimates a subsample without Italy, Spain and Portugal.

The coefficient for the lagged saving rate is statistically significant at the one per cent level in the baseline model and in all subsamples. These findings are mainly in line with the literature.[22] The persistence of the saving rates can be explained with Denison's law. Denison (1958) and later David and Scadding (1974) show on US data that private saving rates are extremely stable and there is no long-run trend in the saving rate, and that this is more pronounced in good years.

The estimated effects of the changes in the unemployment rate are also significant in all the model specifications at the one per cent level; the expectational variable is significant, both statistically and economically, but it is a little less precisely estimated. This is to be expected as unemployment expectations are apparently a noisier measure of uncertainty than the unemployment rate.

Income growth is positively correlated with the saving rate and the coefficient is highly significant in the baseline model and in all subsamples. The finding that the saving rate grows together with income can be explained by the high persistence of consumption habits (Taylor, 1971); a more trivial explanation would be the diminishing utility of consumption with respect to income.

The credit variable has the expected minus sign but large standard errors in all the model specifications, so effectively it has a coefficient of zero. The inflation rate and the real interest rate have no effect on the saving rate of households.

The quantitative effect of the statistically significant drivers of the saving rate is fairly large. If the change in the rate of unemployment is 1.5 percentage points, which is one standard deviation of this sample, the change in the saving rate will be 1.2 percentage points; if expectations of unemployment change by one standard deviation, the saving rate will change by 0.6 percentage point. During the years of the recent recession, the average change in the unemployment rate was 1.5 percentage points and the change in the expectations of unemployment was on average 1.2 percentage points, which means that the change in the level of uncertainty has contributed to an increase of 2.1 percentage points in household saving rates, which is one fifth of the average saving rate.

A change of one standard deviation in income growth, or around 3.4 percentage points, will induce a change in saving rates of 1.9 percentage points. The effects of both drivers of household saving, uncertainty (taking into account both proxies) and income growth, are of roughly the same magnitude and are economically significant.

The high persistence of saving behaviour implies that every driver has a long-term effect on saving rates that considerably exceeds the short-term effect. Given the autoregressive coefficient of 0.78 in the baseline model, the long-run effects of all drivers of household saving rates are more than 4 times larger than their short-run effects.

Columns (2.2)–(2.5) report the results for different subsamples. 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) shows the results without three years of the crisis and they are very similar to the results of the baseline estimates.

Column (2.3) reports the results without three large economies, namely France, Germany and United Kingdom; column (2.4) excludes three Nordic countries, Denmark, Finland and Sweden; finally, column (2.5) reports the results for the subsample without Italy, Portugal and Spain. The results suggest that the results of the baseline model are stable for the different subsamples.

The point estimates of the variables in the subsamples are compared to the baseline model estimates using the *Z*-test for the equality of the regression coefficients (Paternoster, Brame, Mazerolle, & Piquero, 1998). This test shows that the coefficients of all the subsamples are not significantly different from the baseline estimates (the results are not reported here).

4.2. The contribution of uncertainty measures to the changes in household saving rates by country

To get an idea of the relationship between labour income uncertainty measures and household saving rates in particular countries, the contributions of the changes in the unemployment rate and changes in the unemployment expectations are calculated and plotted against changes in the saving rates from year to year.[23] The results are presented separately for three country groups of core Western

[22] Swamy (1968) reports an average coefficient for 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. (2000) 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 after the crisis at 0.36. 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.

[23] The contributions of the uncertainty measures are calculated using the baseline model coefficients, see Table 2, Column (2.1).

Table 2
Baseline model and subsamples.

	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)
	Baseline	w/o crisis years	w/o largest	w/o Nordic	w/o Southern
Saving rate, lagged	0.784***	0.803***	0.770***	0.777***	0.791***
	(0.050)	(0.064)	(0.051)	(0.058)	(0.049)
ΔUnemployment	0.794***	0.657***	0.759***	0.809***	0.862***
	(0.240)	(0.170)	(0.234)	(0.257)	(0.283)
ΔUnempl.expectations	0.760**	0.711***	0.881**	0.674**	0.738**
	(0.298)	(0.202)	(0.332)	(0.295)	(0.343)
Income growth	0.560***	0.361***	0.562***	0.561***	0.604***
	(0.087)	(0.089)	(0.087)	(0.095)	(0.089)
Credit flow	−0.107	0.005	−0.113	−0.103	−0.151
	(0.091)	(0.075)	(0.096)	(0.108)	(0.108)
ΔReal interest rate	0.045	0.122	0.015	0.039	0.052
	(0.078)	(0.080)	(0.082)	(0.083)	(0.083)
ΔInflation	0.069	0.050	0.017	0.057	0.099
	(0.153)	(0.099)	(0.147)	(0.157)	(0.187)
Observations	402	336	344	340	344
Number of countries	22	22	19	19	19
Number of instruments	31	31	31	31	31
Hansen J-stat	12.280	12.630	7.480	6.167	5.540
p value	0.906	0.893	0.995	0.999	0.999
AR(1)	−2.610	−2.535	−2.588	−2.552	−2.438
p value	0.009	0.0112	0.009	0.010	0.014
AR(2)	−1.592	0.911	−1.445	−2.033	−1.751
p value	0.111	0.362	0.148	0.042	0.080

Notes: The dependent variable is the household saving rate as a share of disposable income. Panel estimates with one-step system GMM, with volatility of expectations of unemployment and income volatility as external instruments. All the estimated models include life expectancy, the young-age dependency ratio and the old-age dependency ratio as control variables, all in first differences. 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.

European countries, Central and Eastern European countries, and Southern Europe together with Ireland and Great Britain; see Figs. 2–4, and note that the scale varies across countries.

The increase in household saving rates during the great recession and subsequent decrease in them is fully or to a large extent supported in almost all countries by a rise in unemployment and in expectations of unemployment. In many countries, the contribution of the survey-based measure of uncertainty to the changes in saving rates is comparable in magnitude to the contribution of the unemployment rate. This means that ignoring the expectational component of uncertainty might be misleading for the dynamics of saving rates.

The Western European countries that saw the largest shifts in household saving behaviour in 2008–2009 were the Nordic countries and the Netherlands (see Fig. 2). In Austria and Germany the rise in uncertainty among consumers was as large as it was in Finland or Denmark, but this did not translate into increased saving rates; indeed the households in these countries dissaved during the crisis, demonstrating more orthodox, textbook behaviour.

In the Central and Eastern European countries the magnitude of the fluctuations in saving rates is on average larger than it is in the core European countries, and the patterns of movements in saving rates are very different. However, the changes in the uncertainty level during the great recession are fully transmitted into the changes in saving behaviour with the exception only of Slovenia, which demonstrates saving behaviour that is more typical for Austria or Germany.

Fig. 4 shows that with the exception of Italy, where the saving pattern is procyclical, uncertainty about labour income contributed most substantially to the rise in saving during the great recession, after which the lower saving rates are associated with falling unemployment rates and more optimism.

A quick visual analysis suggests that unemployment expectations have a more pronounced effect in the core European countries and in some Central and Eastern European countries such as Czechia, Slovakia and Hungary, while in the Southern Europe, where unemployment rates are on average higher, unemployment is much more important in driving the saving rates of households.

4.3. Results using additional explanatory variables

The aim of the analysis in this subsection is to ascertain whether there are signs of omitted variable bias or instability of the regression coefficients. Different specifications of the model are examined and the results are reported in Table 3.

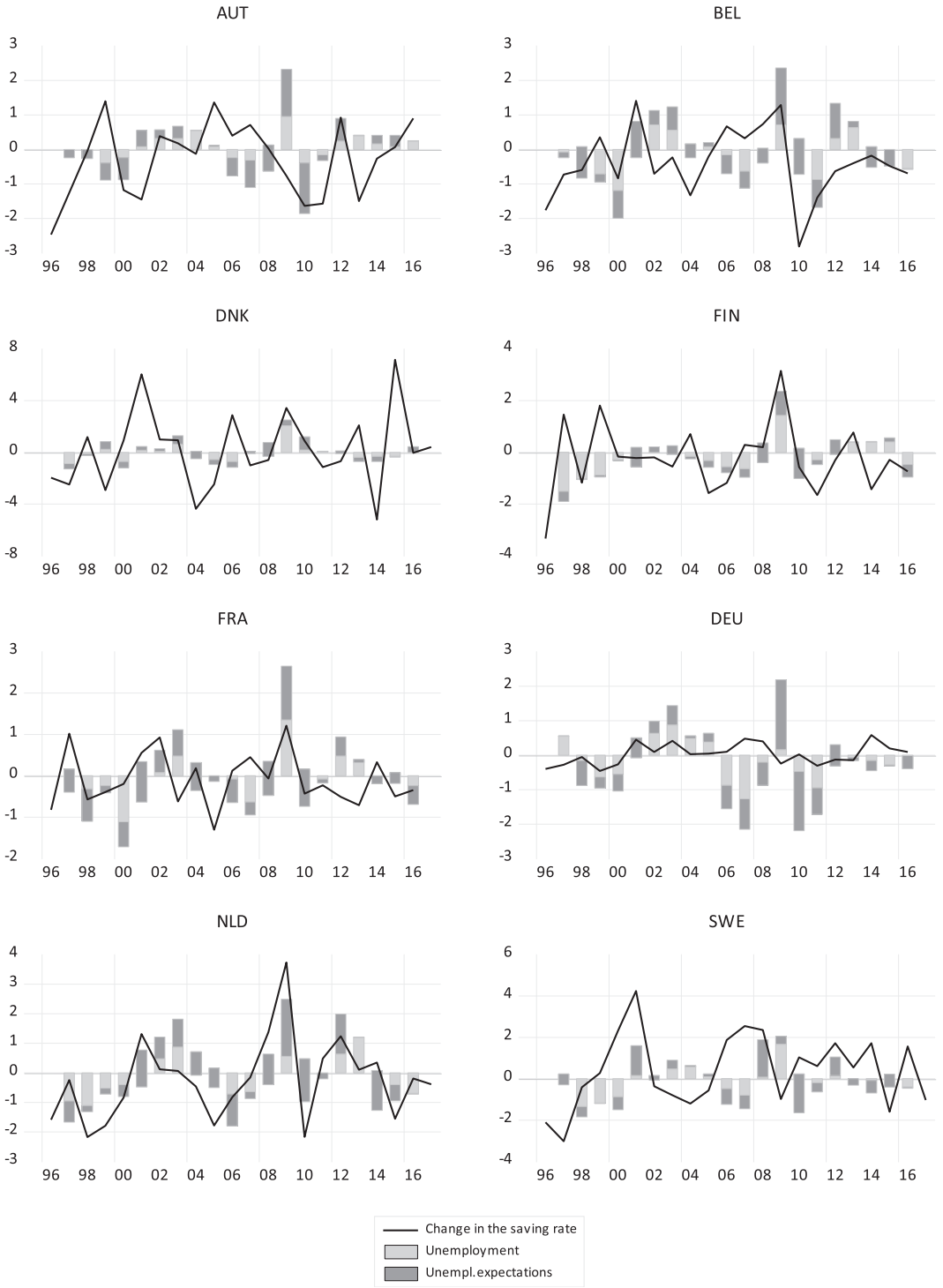

Fig. 2. The contribution of uncertainty measures to the changes in household saving rates in Western European countries.
Notes: The change in the saving rate is the first difference of the household saving rates. Unemployment and Unempl.expectations refer respectively to the contribution in percentage points of the changes in the unemployment rate and to the contribution in percentage points of the survey-based measure of uncertainty to the changes in household saving rates.
Source: Eurostat, author's calculations

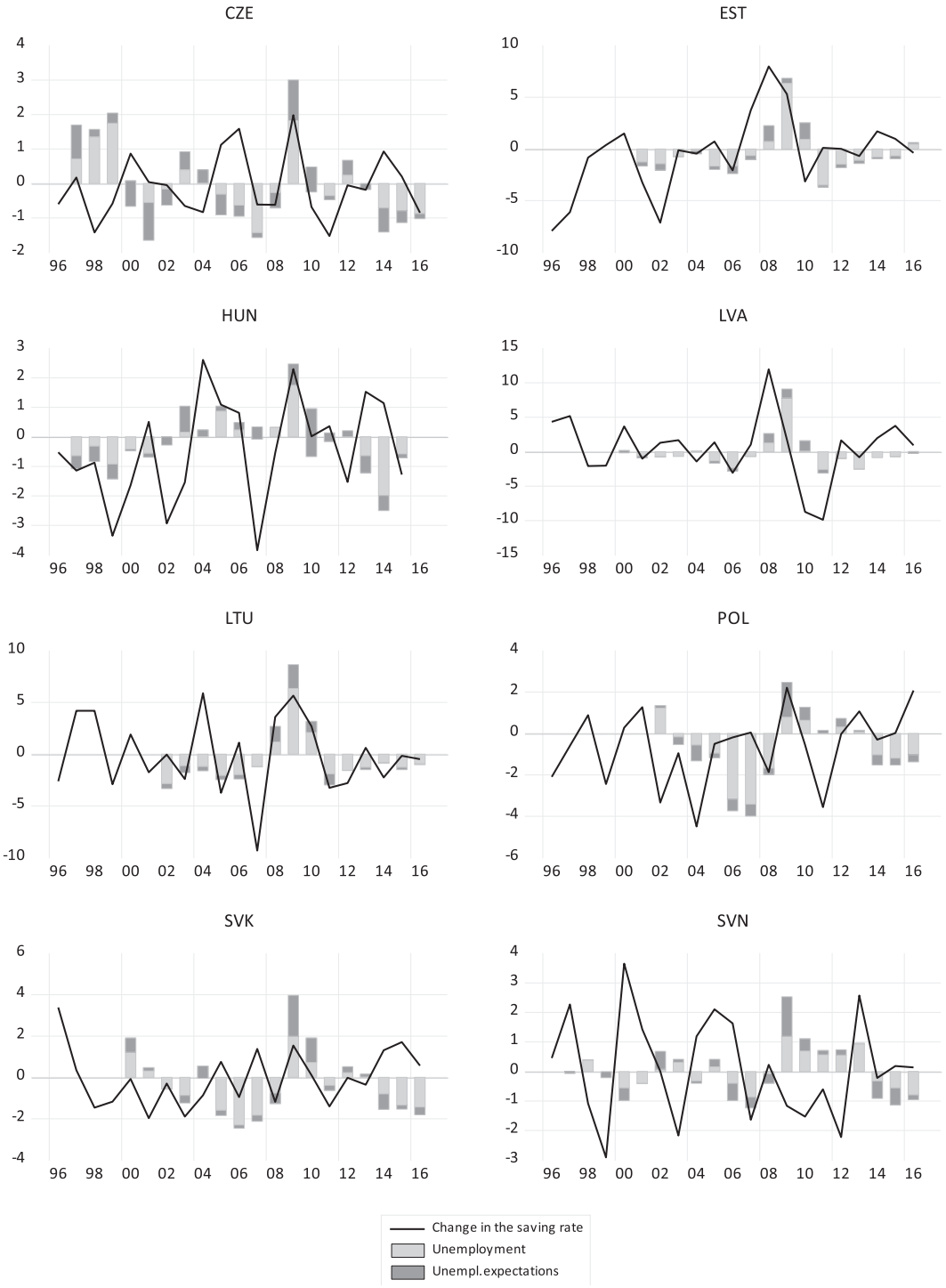

Fig. 3. The contribution of uncertainty measures to the changes in household saving rates in Central and Eastern European countries.
Notes: See notes to Fig. 2.
Source: Eurostat, author's calculations

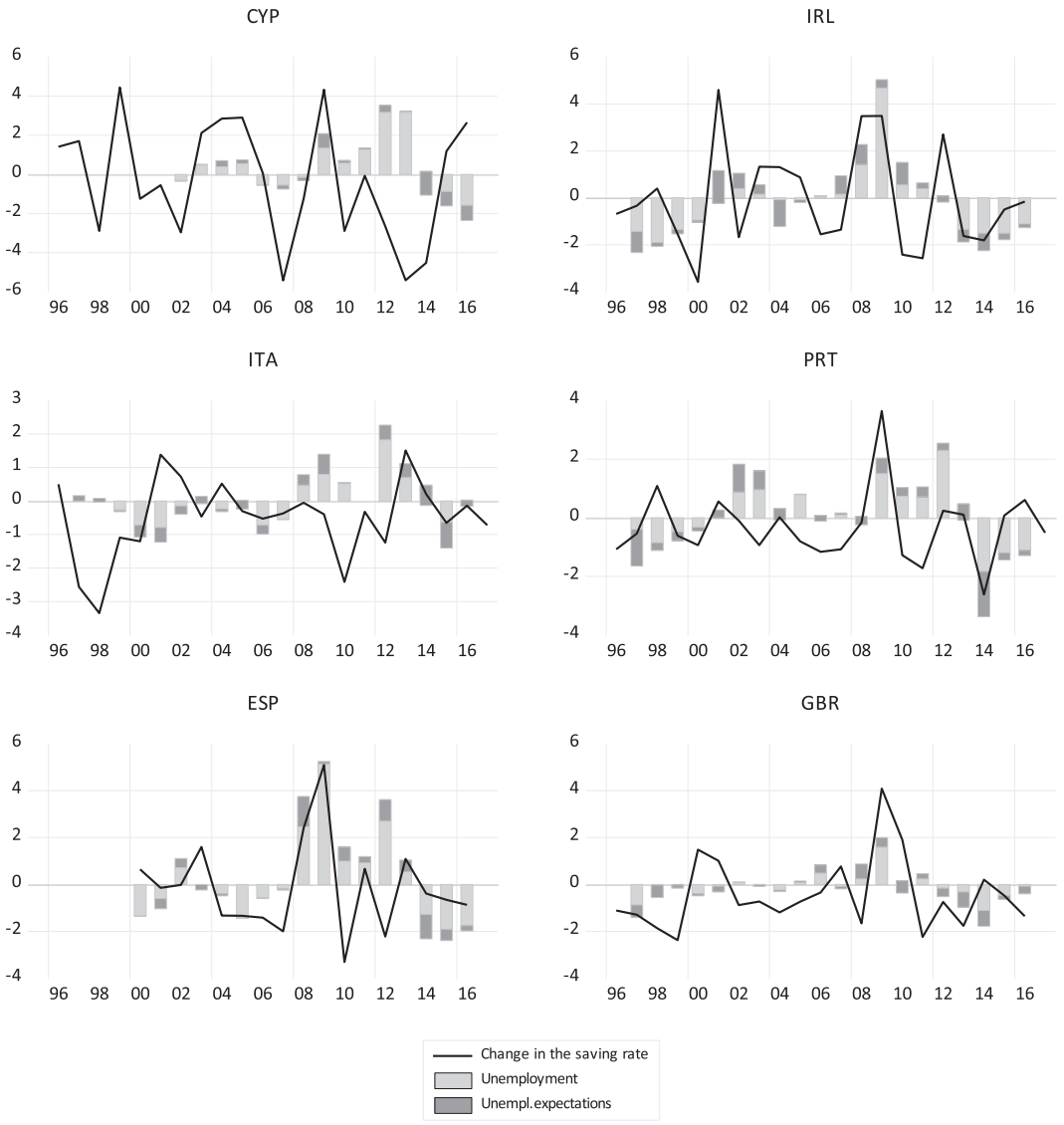

Fig. 4. The contribution of uncertainty to the changes in household saving rates in Southern European countries, Ireland and Great Britain.
Notes: See notes to Fig. 2.
Source: Eurostat, author's calculations

For convenience, column (3.1) repeats the estimations of the baseline model. The Gini index is added to the model in column (3.2). The female participation rate is used to account for different saving patterns across genders, as shown in column (3.3). Following Juster and Wachtel (1972b), the level of unemployment is added to the model in column (3.4).[24] Additionally, the model is augmented with social transfers (3.5). A few other macroeconomic variables are also added to the model (the results are not reported here). Age structure is accounted for by three control variables, which are life expectancy (Taylor, 1971) and the dependency ratios.

The results in the specifications with the additional variables are largely unchanged, as the coefficients of the uncertainty proxies and income growth are statistically and economically significant, and they are broadly of the same magnitude as in the baseline model.[25] Meanwhile, the coefficients of the other main and additional variables are insignificant.

[24] However, when the income variable is present, the unemployment rate in levels does not appear to have an effect on the saving rate.
[25] The point estimates of the variables in different model specifications are compared to the baseline model estimates using the *Z*-test as in the previous subsection. This is done for all model specifications in this and the following subsections.

Table 3
Baseline model and additional variables.

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
	Baseline	Gini index	Female particip.rate	Unemploy-ment level	Transfers
Saving rate, lagged	0.784***	0.820***	0.765***	0.776***	0.779***
	(0.050)	(0.069)	(0.056)	(0.050)	(0.048)
ΔUnemployment	0.794***	0.694***	0.668**	0.862***	0.936***
	(0.240)	(0.151)	(0.259)	(0.265)	(0.331)
ΔUnempl.expectations	0.760**	0.857**	0.839**	0.837**	0.932**
	(0.298)	(0.342)	(0.322)	(0.387)	(0.414)
Income growth	0.560***	0.532***	0.544***	0.547***	0.579***
	(0.087)	(0.088)	(0.107)	(0.094)	(0.090)
Credit flow	−0.107	−0.118	−0.061	0.044	−0.115
	(0.091)	(0.099)	(0.090)	(0.140)	(0.094)
ΔReal interest rate	0.045	0.007	0.062	0.064	0.086
	(0.078)	(0.065)	(0.093)	(0.086)	(0.078)
ΔInflation	0.069	0.014	0.123	0.150	−0.040
	(0.153)	(0.099)	(0.118)	(0.216)	(0.120)
ΔGini coefficient		0.336			
		(0.381)			
ΔFemale participation rate			−0.309		
			(0.254)		
Unemployment, level				0.193	
				(0.185)	
ΔTransfers					−0.535
					(0.479)
Observations	402	388	383	402	402
Number of countries	22	22	22	22	22
Number of instruments	31	34	34	34	34
Hansen J-stat	12.28	6.612	11.60	10.19	13.22
p value	0.906	0.999	0.965	0.985	0.927
AR(1)	−2.610	−2.362	−2.594	−2.614	−2.626
p value	0.009	0.018	0.009	0.008	0.008
AR(2)	−1.592	−1.377	−1.871	−1.349	−1.608
p value	0.111	0.169	0.061	0.177	0.108

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 of unemployment and income volatility. All the estimated models include three control variables of life expectancy, the young-age dependency ratio and the old-age dependency ratio, all in first differences. 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.

4.4. Results using additional variables of uncertainty

A few additional measures of uncertainty are added to the model to ensure that the measures of uncertainty used in the baseline specification are the most appropriate ones, see Table 4. These measures are inflation volatility, output volatility, and the volatility of unemployment expectations measured as the standard deviation of the expectations variable. Two country-invariant volatility measures, the Volatility Index (VIX) and the Mean Average Forecast Error (MAFE) calculated using the data from the Survey of Professional Forecasters are also used.

The results suggest that the model is stable and that the household saving rates are driven by the proxies of labour income uncertainty but not by the measures that describe general economic volatility. It is interesting that the second moment of the expectational variable, which is the standard deviation of unemployment expectations, has no effect on the saving rate and it does not kill the first moment. A change in expectations of unemployment is what matters for household saving.

4.5. Results using additional data from the survey

Unemployment expectations can potentially be correlated with other expectational variables, for example with expectations of the general economic situation or the future financial position of households, or the intentions of households to save or to purchase durables, and it turns out that they are (see Table 5). All the survey-based variables are highly correlated among themselves, and they equally correlate with the changes in the unemployment rate. The only two variables that are not correlated are the intentions of future saving and expectations about consumer prices, with the latter only marginally correlated with expectations about the future financial position.

Table 4
Baseline model and uncertainty measures.

	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)
	Inflation volatility	Output volatility	MAFE	VIX	Volatility of expectations
Saving rate, lagged	0.795***	0.770***	0.762***	0.791***	0.773***
	(0.044)	(0.048)	(0.067)	(0.044)	(0.054)
ΔUnemployment	0.759***	0.723***	0.807***	0.793***	0.757***
	(0.233)	(0.223)	(0.226)	(0.236)	(0.220)
ΔUnempl.expectations	0.745**	0.602*	0.815**	0.769**	0.693**
	(0.283)	(0.340)	(0.325)	(0.344)	(0.300)
Income growth	0.553***	0.561***	0.559***	0.550***	0.601***
	(0.088)	(0.093)	(0.100)	(0.092)	(0.089)
Credit flow	−0.097	−0.094	−0.106	−0.114	−0.105
	(0.092)	(0.099)	(0.102)	(0.088)	(0.104)
ΔReal interest rate	0.052	0.006	−0.030	0.048	0.083
	(0.075)	(0.091)	(0.093)	(0.077)	(0.112)
ΔInflation	0.036	−0.009	0.074	0.051	0.082
	(0.162)	(0.135)	(0.096)	(0.145)	(0.146)
Price volatility	0.561				
	(1.155)				
Output volatility		45.505			
		(33.039)			
MAFE			0.058		
			(0.327)		
VIX				−0.019	
				(0.026)	
Volatility of unempl.expectations					0.122
					(0.086)
Observations	402	385	379	402	402
Number of countries	22	21	22	22	22
Number of instruments	34	34	32	32	31
Hansen J-stat	10.94	13	10.13	8.411	6.681
p value	0.976	0.933	0.966	0.989	0.996
AR(1)	−2.718	−2.644	−2.494	−2.623	−2.852
p value	0.006	0.008	0.0126	0.008	0.004
AR(2)	−1.621	−1.405	−1.759	−1.376	−2.372
p value	0.105	0.160	0.078	0.169	0.017

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 of unemployment and income volatility. All the estimated models include three control variables of life expectancy, the young-age dependency ratio and the old-age dependency ratio, all in first differences. 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.

Table 5
Correlation of survey-based measures of consumer expectations and changes in the unemployment rate.

	ΔUnemploy-ment	ΔUnempl. expectations	ΔEconomic situation	ΔFinancial position	ΔConsumer prices	ΔMajor purchases
ΔUnempl.	0.313					
expectations	(0.000)					
ΔEconomic	−0.232	−0.843				
situation	(0.000)	(0.000)				
ΔFinancial	−0.284	−0.560	0.486			
position	(0.000)	(0.000)	(0.000)			
ΔConsumer	−0.347	−0.352	0.389	−0.087		
prices	(0.000)	(0.000)	(0.000)	(0.055)		
ΔMajor	−0.466	−0.464	0.446	0.586	0.251	
purchases	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
ΔIntentions	−0.393	−0.404	0.397	0.610	0.020	0.483
of saving	(0.000)	(0.000)	(0.000)	(0.000)	(0.666)	(0.000)

Notes: Probabilities that the correlation coefficient is equal to zero are given in parentheses.

Table 6
Other expectational variables.

	(6.1)	(6.2)	(6.3)	(6.4)	(6.5)
	Economic situation	Financial position	Consumer prices	Major purchases	Saving
Saving rate, lagged	0.809***	0.771***	0.819***	0.806***	0.775***
	(0.046)	(0.049)	(0.041)	(0.043)	(0.044)
ΔUnemployment	0.797***	0.763***	0.764***	0.744***	0.846***
	(0.242)	(0.227)	(0.201)	(0.233)	(0.275)
ΔUnempl.expectations	0.743*	0.658**	0.983***	0.738**	0.828**
	(0.427)	(0.237)	(0.303)	(0.287)	(0.348)
Income growth	0.553***	0.543***	0.522***	0.531***	0.552***
	(0.096)	(0.101)	(0.096)	(0.075)	(0.087)
Credit flow	−0.131	−0.086	−0.098	−0.091	−0.097
	(0.114)	(0.096)	(0.086)	(0.103)	(0.095)
ΔReal interest rate	0.091	0.010	0.066	0.042	0.028
	(0.076)	(0.084)	(0.071)	(0.082)	(0.066)
ΔInflation	0.079	0.023	0.035	0.083	0.096
	(0.147)	(0.133)	(0.118)	(0.140)	(0.170)
ΔExpectations of economic situation	0.005				
	(0.240)				
ΔExpectations of financial position		−0.529			
		(0.645)			
ΔExpectations of consumer prices			0.293		
			(0.265)		
ΔPlans of major purchases				−0.439	
				(0.984)	
ΔIntentions of saving					1.086
					(1.864)
Observations	387	402	401	401	401
Number of countries	21	22	22	22	22
Number of instruments	34	34	34	34	34
Hansen J-stat	9.911	7.919	6.519	11.66	12.13
p value	0.987	0.997	0.999	0.964	0.955
AR(1)	−2.647	−2.581	−2.760	−2.655	−2.581
p value	0.008	0.009	0.005	0.007	0.009
AR(2)	−1.217	−1.616	−1.446	−1.479	−1.516
p value	0.224	0.106	0.148	0.139	0.129

Notes: The dependent variable is the household saving rate as a share of disposable income. All independent variables except credit flow and income growth are in first differences. Panel estimates with one-step system GMM with two external instruments: volatility of expectations of unemployment and income volatility. All the estimated models include three control variables of life expectancy, the young-age dependency ratio and the old-age dependency ratio, all in first differences. 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.

The largest correlation coefficient is between expectations about the future economic situation and unemployment expectations. The financial position is also tightly correlated with plans for major purchases and saving intentions.

To test whether the proxy for labour income uncertainty can be substituted by a wider measure of overall optimism or other future expectations, the model is augmented with the other expectational variables discussed above, see Table 6 for the results. This analysis uses all the forward-looking questions from the same survey. The only variable omitted is a composite index of consumer expectations, which is the unweighted average of four questions.

As these variables are highly correlated, they are added to the model one variable at a time. The analysis shows that none of the additional expectational variables has any effect on saving rates and the effect of unemployment expectations remains of the same magnitude when the uncertainty proxies are added to the model one by one. If expectations of unemployment are excluded from the specification and other survey-based measures are added all together, Ireland drops out from the sample and the effect of none of the expectational variables can be precisely estimated, as shown in Column (7.2).

If Luxembourg and Bulgaria are added to the sample, then the expectations for the general economic situation, the variable that correlates the most with unemployment expectations (see Table 7), becomes marginally significant. The absolute value of the parameter is however less than half that for unemployment expectations, as seen from comparing Columns (7.1) and (7.3). If expectations for the economic situation are excluded and the baseline sample is restored with Ireland in and Luxembourg and Bulgaria out, the expectations for consumer prices become marginally significant, as Column (7.4) shows.

Table 7
Baseline model and other expectational variables.

	(7.1)	(7.2)	(7.3)	(7.4)
	Baseline	All expectational	All expectational	All expectational
Saving rate, lagged	0.784***	0.830***	0.810***	0.802***
	(0.050)	(0.049)	(0.045)	(0.051)
ΔUnemployment	0.794***	0.799***	0.818***	0.694**
	(0.240)	(0.266)	(0.261)	(0.268)
ΔUnempl.expectations	0.760**			
	(0.298)			
Credit flow	−0.107	−0.071	−0.067	−0.058
	(0.091)	(0.118)	(0.119)	(0.106)
Income growth	0.560***	0.473***	0.467***	0.484***
	(0.087)	(0.105)	(0.111)	(0.100)
ΔReal interest rate	0.045	0.002	0.057	−0.058
	(0.078)	(0.089)	(0.104)	(0.094)
ΔInflation	0.069	0.062	0.088	−0.040
	(0.153)	(0.117)	(0.111)	(0.120)
ΔExpectations of economic situation		−0.296	−0.302*	
		(0.196)	(0.168)	
ΔExpectations of financial position		−0.919	−0.207	−1.661
		(1.184)	(1.199)	(1.044)
ΔExpectations of consumer prices		−0.194	−0.071	−0.427*
		(0.308)	(0.293)	(0.235)
ΔPlans of major purchases		−0.627	−1.196	−0.499
		(0.689)	(0.710)	(0.773)
ΔIntentions of saving		3.456	3.229	3.107
		(2.230)	(3.054)	(2.290)
Observations	402	387	416	401
Number of countries	22	21	23	22
Number of instruments	31	43	43	40
Hansen J-stat	12.280	10.690	9.259	5.524
p value	0.906	0.999	0.999	0.999
AR(1)	−2.610	−2.593	−2.846	−2.771
p value	0.009	0.009	0.004	0.006
AR(2)	−1.592	−0.278	0.153	−0.746
p value	0.111	0.781	0.879	0.456

Notes: The dependent variable is the household saving rate as a share of disposable income. All independent variables except credit flow and income growth are in first differences. Panel estimates with one-step system GMM with two external instruments: volatility of expectations of unemployment and income volatility. All the estimated models include three control variables of life expectancy, the young-age dependency ratio and the old-age dependency ratio, all in first differences. 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.

The results suggest that in some specifications of the model the association between one survey-based variable or another and saving rates may be found and estimated. However, if they are added to the model together with expectations of unemployment, the unemployment expectations kill the effect of the other expectational variables, meaning labour income uncertainty is presumably the most important component of uncertainty for household saving rates.

Column (7.1) reports for the reader convenience the estimations of the baseline model. Column (7.2) reports the estimations of the baseline sample without Ireland; Column (7.3) – a sample without Ireland and with Bulgaria and Luxembourg; Column (7.4) – baseline sample. In the last model specification expectations of economic situation are excluded from the model.

Keeping in mind that the main source of income for households is labour income, it seems reasonable that precautionary saving is driven by unemployment expectations, as these are expectations of the factor that will directly affect future labour income through the higher probability of losing a job or having diminished bargaining power.

4.6. *Different configurations of the model*

The results reported in Tables 2–5 show that the baseline model is stable on different specifications and subsamples. Nevertheless, system GMM is known to be sensitive to changes in the model settings, and for this reason the baseline model is estimated in different configurations (Table 8).

Table 8
Different configurations of the model.

	(8.1)	(8.2)	(8.3)	(8.4)	(8.5)
	Two-step	AB	6 lags	No const.	LSDV
Saving rate, lagged	0.779***	0.612***	0.792***	0.791***	0.832***
	(0.060)	(0.112)	(0.041)	(0.057)	(0.029)
ΔUnemployment	0.688**	0.755**	0.582***	0.788***	0.640***
	(0.286)	(0.284)	(0.199)	(0.244)	(0.075)
ΔUnempl.expectations	0.542**	0.634*	0.586**	0.658**	0.361***
	(0.239)	(0.332)	(0.211)	(0.309)	(0.105)
Income growth	0.504***	0.475***	0.439***	0.535***	0.464***
	(0.143)	(0.139)	(0.075)	(0.097)	(0.040)
Credit flow	−0.043	−0.114	−0.084	−0.088	−0.098***
	(0.116)	(0.128)	(0.061)	(0.093)	(0.027)
ΔReal interest rate	0.059	−0.045	0.025	0.070	0.146***
	(0.108)	(0.098)	(0.102)	(0.074)	(0.032)
ΔInflation	0.036	0.018	−0.097	−0.008	0.011
	(0.225)	(0.131)	(0.141)	(0.146)	(0.049)
Observations	402	380	402	402	402
Number of countries	22	22	22	22	22
Number of instruments	31	21	58	30	
Hansen J-stat	12.28	12.62	10.25	14.65	
p value	0.906	0.319	1	0.796	
AR(1)	−2.618	−2.374	−2.534	−2.654	
p value	0.008	0.017	0.011	0.007	
AR(2)	−1.199	−1.644	−1.409	−1.762	
p value	0.231	0.100	0.159	0.078	
R-squared					0.721

Notes: The dependent variable is the household saving rate as a share of disposable income. All independent variables except credit flow and income growth are in first differences. Panel estimates with one-step system GMM with two external instruments: volatility of expectations of unemployment and income volatility. All the estimated models include three control variables of life expectancy, the young-age dependency ratio and the old-age dependency ratio, all in first differences. 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 (8.1) in Table 6 reports the results obtained with a two-step estimator instead of the one-step estimator used in the baseline model. Column (8.2) reports the results obtained with the Arellano-Bond estimator. A different number of lags[26] is used in column (8.3) and there is no constant term in (8.4). The model in column (8.5) is estimated with the least square estimator with a country dummy variable and clustered errors.

The only notable difference between the baseline model and the LSDV estimates is that the coefficients of the explanatory variables are somewhat smaller and the autoregressive coefficient is larger. However, this is an expected outcome as the Nickel bias present in OLS estimates drives all coefficients downwards, while autoregressive is biased upwards. The coefficients in all the other model configurations are very close to those of the baseline model.

Column (8.1) reports the estimations with the two-step estimator with Windmeijer (2005) corrected standard errors. In column (8.2) the model is estimated with the Arellano-Bond estimator. The model in column (8.3) uses 8 and 5 lags instead of 3 and 2. The model in column (8.4) supresses the constant. Finally, the model in column (8.5) is estimated with the Least Square Dummy Variable estimator.

All the point estimates of the different model configurations are compared to the baseline estimates using the Z-test as described above (results are not reported). According to the test, none of the coefficients, even those of LSDV estimates, are statistically different from the baseline estimates. In summary, the baseline model appears to be very stable and the reported findings may be considered robust.

5. Conclusions

This paper studies the determinants of household saving rates in 22 European countries in 1996–2017 using system GMM to account for the dynamic panel bias and the potential endogeneity of the regressors. The findings reveal that household saving rates are highly persistent and that there are two key determinants of saving, the first one being income growth, and the second one being labour income uncertainty or the precautionary motive.

[26] Models with 4 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.

Keynes (2016) 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. According to consumer surveys, a buffer for unexpected events is still the primary motive for saving.[27] The empirical evidence yielded in this paper confirms that the precautionary motive is indeed the one that drives household saving.

Among the novelties of this paper is the incorporation of data from micro-level surveys into a macroeconomic study introducing two channels for the labour income uncertainty that affects household saving behaviour. The core finding of this paper is that both types of uncertainty have a pronounced and statistically significant effect on saving rates, meaning that changes in the level of unemployment rate and the expectations of consumers for future changes in the level of unemployment can severely affect saving rates.

Credit conditions do not explain saving behaviour in Europe and it can be concluded that the credit-consumption environment is different to that in the USA (see Carroll et al. (2012) for the US data), at least in the past two decades. The interest rate and inflation do not have any pronounced effect on saving rates either. The results are robust to the inclusion of other macroeconomic variables and uncertainty measures.

The results show that the negative effect that unemployment is believed to have on the economic growth 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 in Europe after the crisis of 2008–2009, when the high unemployment rate was followed by low consumer confidence, which induced high levels of saving and low consumption.

Appendix D. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.iref.2019.10.005.

Appendix A

AUT	Austria
BEL	Belgium
BGR	Bulgaria
CYP	Cyprus
CZE	Czechia
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

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, taken from Eurostat [table code *nasa_10_nf_tr*]. Households refer to households and non-profit institutions serving households (NPISH). It is common practice to study households and NPISH together, as NPISH are supposed to act like households. Gross disposable income is adjusted for the change in the net equity of households in pension fund reserves. Saving rates fluctuate in the range of 8.5–21.3, with an average of 10.1 and standard deviation of 5.2 (484 observations). See Figure C1 in Appendix C.

[27] 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 & 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.

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*, question7[28] [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 (demeaned and divided by the standard deviation) using the full sample of 24 countries including Bulgaria and Luxemburg, using the means and standard deviations for the whole sample to make the interpretation of the results more intuitive. The same is done for the other expectational variables used for the robustness check (questions 2, 4, 6, 9 and 11).

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 as the standard deviation of rolling five-year windows of year-on-year HICP. Besides price inflation, 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.[29] 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.

Besides stock market volatility, a more general measure of uncertainty is employed, which is the mean average forecast error (MAFE) calculated using the data from the ECB Survey of Professional Forecasters. The forecast is for the inflation rate in the euro area and the forecast horizon is one year.

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 control and additional variables includes the young-age dependency ratio (the ratio of the population younger than 15 to the population aged 15–64 [table code *demo_pjanind*]); the old-age dependency ratio (the ratio of the population older than 64 to the population aged 15–64 [table code *demo_pjanind*]); life expectancy [table code *demo_mlexpec*]); 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*]; 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*]; the female participation rate measured as a percentage of the total population [table code *lfsi_emp_a*]; and the output growth rate in real terms [table code *nama_10_gdp*]. All these data are downloaded from the Eurostat database. The output gap is taken from the EC database AMECO and is measured as a percentage of trend GDP [table code *AVGDGT*].

Appendix C

[28] See http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/bcs_user_guide_en.pdf for details.

[29] See http://www.cboe.com/vix for details.

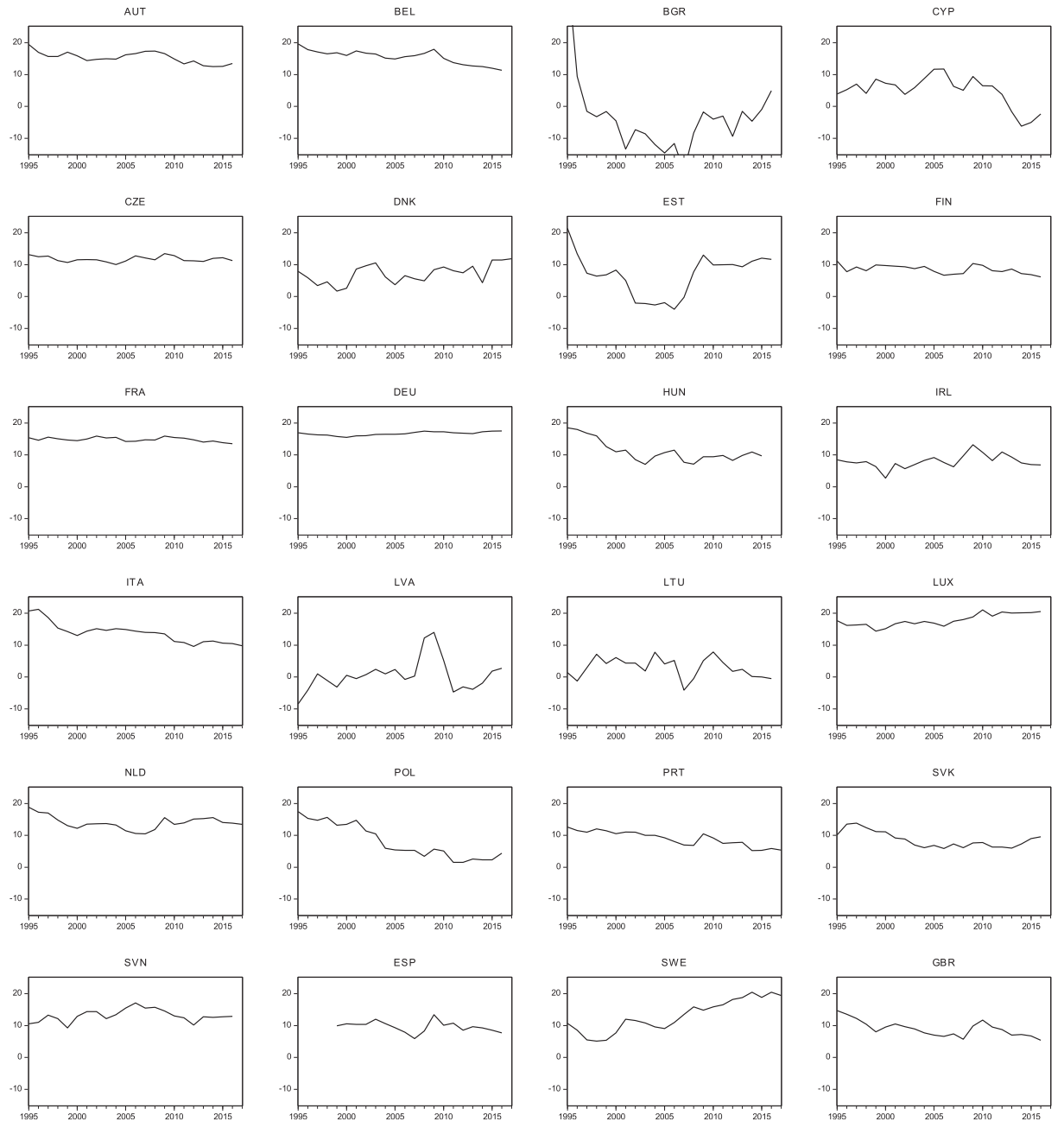

Fig. C1. Household saving rates.
Notes: The household saving rates are expressed as a share of household disposable income.
Source: Eurostat.

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