Income and wealth effects: a thick modelling approach for euro area private consumption

Gabe de Bondt, Arne Gieseck and Zivile Zekaite [1]

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Abstract

Private consumption is the largest component of domestic demand and is itself an important driving factor behind other components of demand, such as investment and imports. This study develops a thick modelling tool for real private consumption in the euro area in the spirit of Granger and Jeon (2004). A large number of error correction models are estimated using the Generalised Method of Moments by extending a standard private consumption equation along several dimensions, exploiting inter alia euro area sector account data. This allows us to split real disposable income into labour and non-labour income as well as real wealth into financial and non-financial wealth. We show that this split of income and wealth is statistically and economically important for the analysis of private consumption and out of sample forecasting.

Keywords: private consumption, disposable income, wealth, indebtedness

JEL codes: C53, D12, E21, E27

[1] European Central Bank, Directorate General Economic Developments, Business Cycle Analysis Division. All views expressed in this paper are those of the authors and do not necessarily reflect the position of the ECB.

1. Introduction

This paper analyses income and wealth effects at the macro level on real private consumption in the euro area using a thick modelling approach. Private consumption is by far the largest component of domestic demand (accounting for about 55% of GDP across euro area countries), and as such is of key interest in any projection exercise. The equation for private consumption is central to macro-econometric models as it is typically determined by a large number of variables, including disposable income, wealth and interest rates, which feature in macroeconomic projections. As the largest component of demand, it is itself an important driving factor behind other components of demand (notably investment and imports) as well as employment.

According to standard theories, consumption expenditure is largely determined by disposable income and wealth (Fernandez-Corugedo, 2004). The empirical literature extended the baseline consumption model by considering various other determinants omitted in this simplified framework. Among these alternative variables are: interest rates, measures of household and public sector indebtedness, income uncertainty measures (Aron et al., 2012; Estrada et al., 2014). With respect to euro area countries, ECB (2016) reports evidence supportive of a negative short-run impact on consumption due to increased uncertainty, as measured by changes in unemployment rate, and a negative long-run effect of real deposit interest rate (see also Al-Eyd, 2006). Dees and Brinca (2013) investigate whether survey-based consumer confidence could help forecast real consumption expenditure. For the euro area, they show that the model with the highest explanatory power includes the lags of consumer confidence, consumption growth, changes in income and wealth, equity and oil price inflation, changes in a short-term interest rate and changes in unemployment rate. Al-Eyd et al. (2006) examine demographic and Ricardian effects on consumption, in addition to more standard determinants. They find that for some countries younger age groups are contributing positively (and significantly) to consumption growth while older groups are contributing negatively. However, these effects are not always significant. Evidence for the Ricardian effects of higher public debt are found for several countries while only limited evidence show the relevance of consumer confidence. As an alternative to modelling consumption, Hufner and Koske (2010) analyse determinants of household saving ratio in G7 countries. The estimation results show that in most countries there are positive and significant effects of current income and inflation on saving ratio. With respect to real interest rate, it is found to have a positive effect in most countries, while it affects savings negatively in Germany and France. Higher government debt leads to higher savings in the US and France, but no Ricardian equivalence evidence is found for other countries. For some countries, old age dependency ratio is also found to influence savings negatively.

Furthermore, many studies have examined disaggregated wealth effects by decomposing total wealth into two or more components. Several reasons may motivate a different response of households to changes in different types of wealth, such as differences as regards the liquidity of assets or different

distribution of assets across income groups, perceived persistency of changes in different types of wealth, etc. (Altissimo et al., 2005). Disaggregated wealth effects on private consumption in the euro area as a whole are examined in Sousa (2009). The results show that net financial wealth has a significant and economically important effect on consumption in the short-run as well as in the long-run with. With respect to gross housing wealth, the estimated long-run elasticity is much smaller but statistically significant. Long-run disaggregated wealth effects are also much larger than short-run effects indicating persistence in consumption. With respect to gross financial wealth, liquid assets, such as deposits and currency, are found to have stronger effects on consumption than less liquid assets. Slacalek (2009) compares financial and non-financial wealth effects across 16, mainly European, countries. The euro area countries display smaller long-run wealth effects on private consumption than other economies in this sample. With respect to financial and housing wealth, the former tends to be larger but the latter increased in importance since late 1980s. While for individual European countries, housing wealth effect is stronger in about half of countries; however, for the euro area as a whole financial wealth is more important in terms of the marginal propensity to consume. Other studies approximate financial and housing wealth using stock and house prices indices. Real house prices are shown to be more important for consumption in the long run as compared to real stock prices for a group of euro area countries (ECB, 2016). More discussion of empirical evidence with respect to differential financial and non-financial wealth impact on consumption is provided in Altissimo et al. (2005) (see also Kerdrain, 2011).

We contribute in two ways to the macro literature on private consumption. The first contribution is that we exploit both non-financial and financial quarterly euro area sector accounts data, which allows us to decompose disposable income into labour and non-labour components as well as to split total wealth into financial and non-financial wealth (mainly housing wealth). It is – to the best of our knowledge – for the first time that disposable income is split into labour and non-labour income. The more granular analysis of income is important for at least two reasons. Firstly, euro area households' non-labour income currently accounts for about a half of households' total resources. Secondly, labour and non-labour incomes are likely to have a differential impact on consumption. The marginal propensity to consume out of labour and non-labour is not necessarily the same. In fact, we show that there are indeed remarkable differences between the two components of disposable income. We consider three different income splits, because it is a priori not obvious how to decompose labour and non-labour. We also add evidence to the relative importance of financial versus housing wealth effects. The findings of the literature are rather mixed and we find stronger wealth effects for financial wealth, at least in the long run. In addition, financial accounts include stock data and allow for both a detailed analysis of household financing and for the calculation of leverage and debt ratios as explanatory factors for private consumption.

Second, this paper applies for the first time for euro area private consumption a thick modelling approach. In more detail, a large set of candidate error correction models are generated in the first step by exploiting

a vast number of potential explanatory variables for private consumption including decomposed disposable income and wealth. Using both in-sample and out-of-sample criteria, we identify several well-specified equations for real private consumption, which include an encompassing set of explanatory variables and can explain past developments in private consumption well. To the extent that most of the explanatory variables used in this approach are themselves part of macroeconomic projections, the equations can also be used to generate a set of forecasts for private consumption. The thick modelling tool can thus help ensure a robust projection for private consumption growth in the euro area by providing a range of forecasts from a number of pre-selected consumption equations.

This paper is structured as follows. Section 2 describes the modelling of real private consumption in the euro area. It first introduces the considered consumption determinants, followed by a description of the applied thick modelling approach. In section 3, we provide a brief overview of the estimation results. Section 4 concludes.

2. Data and model specification

2.1 Data

The source for all quarterly time series for the period 1999Q1 – 2017Q2 is the European Central Bank's Statistical Data Warehouse (SDW). Income, wealth and debt variables are from the integrated euro area accounts data for the household sector, while real private consumption, government consumption, public debt and deficit series are taken from Eurostat National Accounts. With respect to survey-based measures, we use two surveys: the Survey of Professional Forecasters and European Commission Consumer Survey. All series are seasonally adjusted either at the source or by applying Census X-13 method, the latter mainly refers to series from financial account such as wealth and loans for households that are not available as seasonally adjusted. Also, nominal series are deflated using the private consumption deflator.

2.2 Benchmark specification and extensions

We use sector accounts data to split real disposable income into labour (*ly*) and non-labour income (*nly*) using three alternative approaches. In addition, real wealth (nominal household net worth deflated by the private consumption deflator) is split into non-financial assets (*nfa*), currently accounting for about two thirds of the total household wealth and mainly consisting of housing wealth, and financial net wealth (*fnw*), the remaining one-third of the total wealth. To the best of our knowledge, there are no existing studies splitting disposable income into labour and non-labour components to explain consumption

growth as the majority of studies focus on disaggregated wealth effects (Slacalek, 2009, Sousa, 2009; Kerdrain, 2011).

The first and most elementary approach to decompose real disposable income defines labour income as total compensation of employees minus direct taxes paid by households on income and wealth. Then, non-labour income is simply derived as the difference between disposable income and labour income. It is reasonable to deduct all income tax from the total compensation of employees and consider remaining income in gross terms because the share of income tax paid by households on wage earnings is typically much greater than that paid on property or transfer income.

The second and more specific measure of labour income is calculated by subtracting direct taxes and net social security contributions from total compensation of employees and adding net social benefits and other current transfers. As previously, non-labour income is the remaining part of disposable income. In this case, labour income is measured as net of taxes and social contributions, i.e. it is a measure of net wages. As social benefits include unemployment and old age related transfers to households, among others, it is likely that the marginal propensity to consume (MPC) out of such income is similar to the MPC out of wage income. Hence, net social benefits are allocated to labour income. Net other current transfers, which consist of various types of payments, such as non-life insurance claims/premiums, grants, donations, penalties, etc., are also included to labour income in order to have non-labour income matching property income as close as possible.

As a third and most detailed split, labour income is calculated as the sum of total compensation of employees and mixed income (i.e. income of self-employed) less net social contributions and labour income share of direct taxes. The share of taxes paid on labour income is approximated by the share of labour income (compensation and mixed income) in the pre-tax income of households before taking into account social security contributions. In this case, non-labour income is further split into property income, from which direct taxes are also deducted on a pro rata basis, and transfer income (a remaining component). Property income is the sum of gross operating surplus (excl. mixed income), net interest income, net other property income and net other current transfers. Finally, transfer income is calculated as disposable income less labour and property income. Essentially, it is equal to after-tax net social benefits.

Chart 1 plots total income together with its components based on the three decompositions as well as total wealth together with non-financial assets and financial new wealth. With respect to the first and second approach, labour income makes up on average 63% of total household real income in 2017Q2. The labour share has been relatively stable over time, albeit it has increased from 59% in 1999. Hence, the non-labour income share has declined slightly and is approximately 37%. Regarding the third income split, labour income accounts for about half of total disposable income (52%). Property and transfer income make up 21% and 27% of the total, respectively. In this case, labour and property income shares

decreased somewhat while transfer income share increased since 1999. Since the first and second approaches to the income split provide more similar time series for labour income than the third, they will be consequently analysed together in subsequent sections, while the third split will be discussed separately. Finally, the major component of real wealth has always been non-financial assets as shown in the bottom right panel in **Chart 1**. Its share increased from 61% to 67% of the total household wealth since 1999. Non-financial wealth, in turn, has on average since 1999 related to 94% of housing wealth and the remaining 6% to other fixed assets. Roughly half of housing wealth consists of dwellings and the other half of land.

[Insert Chart 1 here]

All other determinants of private consumption that we consider are assumed to affect private consumption only in the short run. These variables are grouped in five categories. The first one contains real interest rates and interest rate spreads (*rr*), including several measures of the external finance premium (EFP). Each benchmark equation has one interest rate measure included in addition to income and wealth variables. Among interest rates considered, we include mortgage, consumer loan, deposit, 3-month EURIBOR rates and 10-year government bond yields. In addition, spreads between longer-term rates on loans and short-term rates related to deposits are calculated to reflect external financing costs for households. The external finance premium captures an adverse impact of credit constraints or more generally the credit channel of monetary policy transmission (de Bondt, 1999; Geiger et al., 2014). The remaining 4 categories (x_i) include: (i) measures of consumer indebtedness (LEV); (ii) measures of government indebtedness capturing Ricardian equivalence effects (GOV); (iii) income uncertainty (IU); (iv) other variables. The potential determinants from these four groups are added on to the benchmark specification in various combinations. The benchmark equation for consumption growth is an error correction model presented in Equation (1). Note that wealth variables are lagged in the long-run vector as they reflect stocks as of the end of the period. Hence, current consumption is assumed to be dependent on the stock of financial and non-financial wealth as recorded in the previous quarter.

$$\Delta log(c_t) = \alpha + \beta_1 \Delta log(ly_t) + \beta_2 \Delta log(nly_t) + \beta_3 \Delta log(fnw_{t-1}) + \beta_4 \Delta log(nfa_{t-1}) + \beta_5 \Delta(r_t) - \gamma\big(log(c_{t-1}) - (1 - \theta_1 - \theta_2 - \theta_3) log(ly_{t-1}) - \theta_1 log(nly_{t-1}) - \theta_2 log(fnw_{t-2}) - \theta_3 log(nfa_{t-2})\big) + \beta_i \left[\Delta x_{i_{t-j}}\right] + u_t \qquad (1)$$

With respect to household indebtedness, several household leverage indicators are constructed: ratios of household loan stock to disposable income, real GDP or housing wealth stock. In addition, an interest burden variable and a growth rate of household loans are also considered. Household balance sheet

distress, as reflected in consumer leverage or debt burden, can be expected to have a dampening impact on consumption growth (Dynan, 2012; Kim et al. 2015). All variables in this category are lagged by one period to reflect *ex ante* borrowing constraints.

Similarly, the second category contains several leverage ratios for government as well as growth rates of government consumption, loans and budget deficit. Empirical evidence in favour of the Ricardian equivalence, i.e. households consume less in response to increasing public sector indebtedness, can be found inter alia in Hufner and Koske (2010) and Estrada et al. (2014). To capture income uncertainty, we utilise a broad range of variables: survey indicators, such as expected unemployment, consumer confidence, economic sentiment, inflation expectations, etc., actual inflation rate, real effective exchange rate and exchange rate volatility, and real oil prices. Euro area evidence for the impact of variables capturing income uncertainty on private consumption can be found in Dees and Brinca (2013) and Bahmani-Oskooee et al. (2015). The final category consists of two variables: lagged consumption growth and the old-age-dependency ratio, i.e. population aged 65 and over to working age population. There is some evidence for the euro area countries with respect to demographic variables effects on consumption provided by Al-Eyd et al. (2006).

2.3 Thick modelling approach

For the forecasting of real private consumption we follow a "thick modelling" approach à la Granger and Jeon (2004), which, in turn, is similar to the Bundesbank application for the Philipp curve (Bundesbank, 2016). The starting point is a general error correction model (ECM) specification as shown in Equation (1). The term Δx_i represents alternative combinations of short-run explanatory variables. The ECM equations are estimated using data over the sample period 1999Q1 - 2017Q2 by Generalised Method of Moments (GMM). For each equation, 5 lags of the independent and dependent variables are used as instruments. For the vast majority of specifications, the actual estimation sample after accounting for data transformation and allowing for lags of instruments starts in late 2001. Typically, provided that there is cointegration among variables in the long-run vector, an ECM equation could be estimated by the Ordinary Least Squares (OLS) (Davis and Palumbo, 2001). Therefore, the GMM is chosen as an estimation method to account for a potential endogeneity issue among variables in the short run since not all of them are included in the long-run vector. Most variables are expressed in natural logarithms with the exception of interest rates, unemployment rate, leverage / debt ratios and survey measures. To ensure long-run homogeneity, the long-run parameters for income and wealth components are restricted to sum up to 1. This approach has also been applied by others (Barrell and Davis, 2007; Estrada et al., 2014).

In order to identify the final set of equations, we follow a three-step selection process among a set of over 60 000 error correction specifications. Three in-sample selection criteria are applied to eliminate ECM

models that are not well specified: all coefficients with the exception of a constant should be statistically significant at the 5% level; the adjusted R-squared should be at least 0.60; and the P-value of the Ljung-Box Q-statistics which test the "randomness" of the model residuals should be above 0.10 for the lags 1-4 as well as 12. This first step of the selection process leaves us with around 250 equations. All pre-selected equations are then estimated until 2015Q1 and are used to generate multi-step forecasts over the period 2015Q2 - 2017Q2. The relative performance of each equation is evaluated by sorting them according to the out-of-sample RMSE (from the smallest to the largest). In addition, the relative RMSE is also calculated for two benchmark models considered: a random walk (RW) and a simple AR(1) for private consumption. All ECM equations outperform both benchmarks with the worst performing equation having a relative RMSE with respect to RW and AR(1) equal to 0.73 and 0.80, respectively. Finally, each equation is examined in detail starting from the top of the list, i.e. we check whether an equation exhibits economically correct signs of the coefficients. In total, we select 16 equations. This makes up approximately 7% of equations remaining after the first step of the selection process. The relative RMSE with respect to RW and AR(1) of the last selected equation is 0.32 and 0.36, respectively, as reported in the final two rows of **Tables 1** and **2** discussed later in the text.

While it is clear that higher income and wealth growth boosts private consumption, the impact of some of additional short-run dynamics considered may be more ambiguous. We set the following priors with respect to the expected signs of short-run coefficients in advance.

- For changes in real interest rates and interest spread, we expect to find a negative impact on consumption growth. Higher real interest rates dampen consumption spending as it becomes more expensive to finance it through loans as well as it encourages saving due to higher return (ECB, 2016). Similarly, the greater is the wedge between the rates on mortgages or consumer loans as compared to a short rate paid on household deposits the lower consumption growth is expected to be.
- With respect to the measures of (lagged) consumer indebtedness, they represent an *ex ante* financial constraint on households spending. Therefore, a negative coefficient is again expected (Dynan, 2012).
- Regarding the third group of variables, increasing government debt, widening deficit as well as higher leverage should have a contractionary impact on private consumption due to expectations of higher taxes in the future (Al-Eyd et al., 2006).
- Similarly, higher income uncertainty is also expected to reduce current consumption as a result of increased precautionary savings. For instance, higher inflation, oil prices, unemployment, and exchange rate volatility as well as lower consumer confidence and economic sentiment are likely to have an adverse impact on consumption growth (Dees and Brinca, 2013; Estrada et al., 2014). However, with respect to changes in inflation expectations, we do not have a strong prior. On the

one hand, higher inflation expectations might induce higher current spending (Arioli et al., 2017). On the other hand, increased uncertainty over future income due to higher inflation may lead to an increase in precautionary savings and negative attitude towards consumption spending (Bachmann et al., 2015).

- In line with the life cycle hypothesis, we expect that an increase in old-age-dependency ratio is expected to boost consumption as older people tend to save less (Hufner and Koske, 2010). We do not impose a prior with respect to the coefficient on lagged consumption growth.

3. Estimation results

Among the selected models, the first approach to split disposable income appears in 11 of them, while the third approach in 4 and the second one in only 1. **Table 1** presents the estimation results of the selected ECM equations based on the first income decomposition (columns 1 to 11) and the second income decomposition (column 12). The estimates from equations with the third approach to income decomposition are reported in **Table 2**. One caveat to keep in mind when interpreting the results presented in this section is the relatively short estimation sample, in particular given a large number of coefficients estimated in each specification. Due to data constraints it is not possible to extend the sample backwards.

[Insert Table 1 here]

[Insert Table 2 here]

With respect to the long run, labour income and financial net wealth have a stronger impact on consumption in the long-run than non-labour income and non-financial wealth, respectively, on the basis of all 16 selected equations. Regardless of how disposable income is split, the estimated long-run coefficients of labour (net wage) income are significantly different from those of non-labour income, or, alternatively, property and transfer income. The statistical significance of this difference is tested using the Wald test and the coefficients that are statistically different from labour income are denoted in bold. The range of labour income elasticity is 0.49 – 0.57 with respect to the first two approaches to income decomposition and 0.34 – 0.40 with respect to the third approach. Meanwhile, the financial net wealth effect clearly dominates that of non-financial assets in the long run. Overall, the elasticity for financial net wealth falls between 0.08 and 0.17, while it ranges between 0.01 and 0.04 in the case of non-financial assets. On the other hand, both non-labour income and non-financial assets also are important determinants of real private consumption as the parameters are always highly statistically significant.

As shown in **Table 3**, the average long-run coefficients for labour income, non-labour income, non-financial assets and net financial wealth are 0.54, 0.31, 0.12 and 0.03, respectively, based on the first two decompositions of income. With respect to the third split, the figures are 0.45, 0.22, 0.29, 0.09 and 0.02 for labour, property, transfer income, financial net worth and non-financial assets, respectively. Thus, the average elasticity of consumption with respect to non-labour income is at least half of that of with respect to labour income. With respect to both property and transfer income, the elasticity of consumption is also at least half of the elasticity with respect to labour income. The average elasticity to consume out of non-financial assets is typically about three times smaller as compared to financial net wealth. **Table 3** also reports long-run marginal propensities to consume (MPC) out different income and wealth components based on the average estimated long-run elasticities. Overall, we find that MPC for labour income is different from that for non-labour income (also property and transfer income). Labour income MPC also seems to depend on how income is split as the third approach yields a lower estimate.

[Insert Table 3 here]

In general, the findings with respect to wealth effects reported in **Table 3** are in line with the literature for the euro area. Sousa (2009) finds that long-run MPC to consume out of net financial wealth is between 1.75 and 1.93 cents per euro, while MPC to consume out of gross housing wealth is much smaller but still significant – between 0.21 and 0.32 cents per euro depending on the estimation method. The respective elasticities are also similar in magnitude to those reported here, i.e. 0.13-0.14 for net financial wealth and 0.05-0.08 for housing wealth. Similarly, Slacalek (2009) estimates long-run MPCs for the euro area and shows that financial wealth is associated with higher marginal propensity to consume as compared to non-financial wealth. He also finds that housing wealth has become more important since the late 1980s (and also significant in explaining consumption in the long run). The higher long-run impact of financial versus tangible assets may be explained by greater liquidity of the former or stronger bequest motives in the case of the latter (Altissimo et al., 2005). If one owns a house and lives there, there is probably less motive to sell it and consume out of gains when housing prices increase.

With respect to the short run, the evidence of the differential impact of income and wealth components is weaker, especially so with respect to disposable income. **Table 1** shows that in only 3 out of 12 specifications short-run coefficients on income components are significantly different. On the other hand, **Table 2** provide support that labour income is significantly more relevant in explaining consumption growth than property income but not so different from transfer income. In more than half of 16 equations the difference between the coefficient of non-financial assets and the one of financial net worth is statistically significant (in bold), signalling somewhat bigger role for non-financial assets in explaining consumption dynamics. Interestingly, the short-run impact of the former is greater compared to the long-

run effect and the opposite is true for the latter. Greater effects of non-financial wealth in the short-run may be explained by quite volatile financial asset prices in the short-run relative to house prices, thus, changes in financial wealth would be perceived as less permanent and this would result in lower MPC (Altissimo et al., 2005).

Regarding other short-run dynamics, higher 10-year yield on government debt and external finance premium as well as increasing ratio of household loans to GDP affect consumption growth negatively. The empirical evidence from several equations also confirms the presence of Ricardian effects. Consumption expenditures are dampened as a result of higher government leverage and budget deficit as well as increasing government consumption. Increasing inflation and oil prices as indicators of higher income uncertainty also have an adverse effect on consumption in the short-run. However, the impact of changes in inflation expectations on consumption growth depends on the type of survey used. An increase in the measure of two-year ahead annual inflation expectations from the Survey of Professional forecasters weighs down on consumption (**Table 1**, column 7), while the opposite is true for inflation expectations from the European Commission Consumer survey (**Table 2**, columns 2-4). Finally, we find that lagged consumption growth also often helps explain consumption dynamics. The findings reported here are broadly in line with those found in the related literature as discussed in Section 2.3.

Since the first-type income decomposition is the most prominent among selected equations, we focus on these 11 equations to analyse the determinants of consumption and their contributions to consumption growth in more detail. The long-run contributions of income and wealth to euro area private consumption growth shown in **Chart 2** are based on the average long-run coefficients across the 11 equations. While labour income often explains a larger share of consumption growth, non-labour income is also very important - non-labour income contributions are larger than those of labour income in 27 quarters out of 63. With respect to wealth, financial net worth is the main wealth component explaining consumption growth in the long run.

[Insert Chart 2 here]

Chart 3 plots the contributions of all explanatory variables to euro area private consumption growth based on the best performing equation from the set of 11. Two main observations emerge. First, non-labour income is almost as important a short-run driver of consumption as labour income. Second, non-financial assets appear to be more relevant than financial net wealth in explaining consumption growth. In the pre-crisis period, the biggest positive contributions come from the growth in non-financial wealth, labour and non-labour income. Meanwhile, changes in consumer leverage (loans to GDP ratio) acts as a drag on consumption. During the financial crisis important adverse effects materialise due to changes in the external finance premium, consumer leverage, financial net wealth and non-labour income. The decline in

consumption over the debt crisis period is mainly explained by decreases in non-financial wealth and labour income. Since the start of the recovery in 2013, net financial wealth, labour income, consumer leverage and, more recently, non-financial wealth (all positive contributions) play an important role for consumption recovery.

[Insert Chart 3 here]

Finally, we examine the (pseudo) out-of-sample forecasting abilities of 16 selected ECM equations. The models are estimated until 2015Q1 and then used to produce multi-step ahead forecasts over the period 2015Q2 - 2017Q2. **Charts 4** and **5** plot the generated forecasts, the mean forecast and actual real private consumption in level and growth rates, respectively.

[Insert Charts 4 and 5 here]

Overall, the mean forecast broadly tracks the actual data in terms of the level and quarter-on-quarter growth rates. In the first year, the level of actual consumption (red line) lies within the range of the generated forecasts (grey lines) and the mean forecast (solid black line) tracks it very closely. Over the remainder of the sample, the mean forecast is above the actual consumption although the gap between the two series is quite stable. As it can be seen in **Chart 5**, the mean forecast for consumption growth is typically very close to actual growth rates, especially so since the middle of 2016.

4. Conclusions

This study presents an analysis of real private consumption in the euro area on the basis of a thick modelling approach. It considers not only the standard short- and long-run macro determinants, i.e. disposable income and wealth, but also a rich set of additional explanatory variables in the short run: external finance premium, consumer leverage, government indebtedness and various income uncertainty measures. In addition, we split net wealth into financial and non-financial wealth and disposable income into labour and non-labour income. The latter – to the best of our knowledge – has not been analysed in the related literature. More importantly, we show that the impact of non-labour income on consumption is not negligible (up to half of that of labour income in the long run) and deserves a close look for forecasting private consumption.

Our results stress the importance to decompose disposable income and wealth. Against the background of recent attempts to link micro and macro data on household income and wealth (Fesseau et al., 2013;

Honkkila and Kavonius 2013), most promising for future work is to consider also distributive information on income and wealth for private consumption at the aggregated macro level.

References

Altissimo, F., Georgiou, E., Sastre, T., Valderrama, M.T., Sterne, G., Stocker, M., Weth, M., Whelan, K., and Willman, A., 2005. "Wealth and asset price effects on economic activity", *ECB Working Paper* No. 29.

Arioli, R., Bates, C., Dieden, H., Duca, I., Friz, R., Gayer, C., Kenny, G., Meyler, A., Pavlova, I. (2017) "EU consumers' quantitative inflation perceptions and expectations: an evaluation", *ECB Occasional Paper Series* No 186.

Bahmani-Oskooee, M., A.M. Kutan and D. Xi (2015) "Does exchange rate volatility hurt domestic consumption? Evidence from emerging economies" *International Economics* 144 (December), 53-65.

Bundesbank (2016) "The Phillips curve as an instrument for analysing prices and forecasting inflation in Germany" *Monthly Report* April, 31-45.

de Bondt, G.J. (1999) "Credit channels and consumption in Europe: Empirical evidence" *BIS Working Paper* No. 69.

de Bondt, G. (2011) "Equity wealth effects: fundamental or bubble driven?" *Applied Economics Letters* 18(7), 601-605.

Davis, M.A., and Palumbo, M.G., 2001. : A primer on the economics and time series econometrics of wealth effects", *Federal Reserve Board Finance and Economics discussion Series*, No. 2001-09.

Dees, S. and P. S. Brinca (2013), "Consumer confidence as a predictor of consumption spending: Evidence for the United States and the euro area" *International Economics* 134(August), 1-14.

Dynan, K. (2012) "Is a household debt overhang holding back consumption?" *Brookings Papers on Economic Activity*, Spring, 299-344.

ECB (2016) "Savings and investment behaviour in the euro area", *ECB Occasional Paper Series* No 167.
Estrada, A., D. Garrote, E. Valdeolivas and J. Vallés (2014) "Household debt and uncertainty: Private consumption after the Great Recession" *Bank of Spain Working Paper Series* No. 1415.

Fernandez-Corugedo, E., 2004. "Consumption theory", Centre for Central Banking Studies, *Handbooks in Central Banking, No 23.*

Fesseau, M., F. Wolff, M. L. Mattonetti (2013) "A cross-country comparison of household income, consumption and wealth between micro sources and National Accounts aggregates" *OECD Statistics Working Papers* No. 2013/03.

Geiger, F., J. Muellbauer and M. Rupprecht (2016) "The housing market, household portfolios and the German consumer." Revision of paper for Bundesbank, DFG and IMF conference, "Housing markets and the macroeconomy: Challenges for monetary policy and financial stability," Eltville, June 5–6, 2014.

Granger, C.W. and Y. Jeon (2004) "'Thick modeling'" *Economic Modelling* 21, 323-343.

Honkkila, J. and I.K. Kavonius (2013) "Micro and macro analysis on household income, wealth and saving in the euro area" *ECB Working Paper* No. 1619.

Hufner, F. and I. Koske (2010) "Explaining household saving rates in G7 countries: Implications for Germany" *OECD Economics Department Working Papers* No. 754.

Kerdrain, C. (2011) “How Important is wealth for explaining household consumption over the recent crisis?: An empirical study for the United States, Japan and the euro area” *OECD Economics Department Working Papers* No. 869.

Kim et al. (2015) “Aggregate consumption and debt accumulation: and empirical examination of US household behaviour”, Cambridge Journal of Economics 39, 93-112.

Kim, Y.K., M. Setterfield and Y. Mei (2014), “A theory of aggregate consumption”, Eur. J. Econ. Econ. Policies Interv., 11 (1), 31-49.

Kim, Y.K. and M. Setterfield (2016) “Debt servicing, aggregate consumption, and growth” Structural Change and Economic Dynamics 36(March), 22-33.

Slacalek, J., 2009. “What drives personal consumption? The role of housing and financial wealth”, *ECB Working Paper* No. 1117.

Sousa, R.M. (2009) “Wealth effects on consumption: evidence from the euro area”, *ECB Working Paper* No. 1050.

Table 1. ECM estimates based on the first and second types of income decomposition

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)	
Short run																									
ECM	C_{t-1}	0.340	(9.35)	0.268	(9.65)	0.245	(5.98)	0.228	(6.43)	0.300	(7.14)	0.234	(7.75)	0.286	(7.58)	0.239	(6.98)	0.275	(6.67)	0.208	(5.57)	0.252	(8.79)	0.321	(9.37)
Other	$\Delta(C)_{t-1}$	-	-	-0.184	(-2.59)	-0.217	(-4.09)	-	-	-0.187	(-2.87)	-0.273	(-4.48)	-	-	-	-	-0.169	(-2.78)	-0.227	(-3.91)	-	-	-0.155	(-2.51)
Consumer leverage	$\Delta(CD/GDP)_{t-1}$	-	-	-0.204	(-5.24)	-0.254	(-6.73)	-	-	-0.210	(-4.26)	-0.243	(-6.32)	-	-	-	-	-	-	-	-	-	-	-	-
	$\Delta(CD)_{t-1}$	-0.101	(-4.07)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Government leverage	$\Delta(GD/GDP)_{t-1}$	-0.070	(-2.16)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$\Delta GDEF_t$	-	-	-	-	-	-	-	-	-	-	-	-	-0.001	(-2.42)	-0.001	(-3.89)	-	-	-	-	-0.001	(-4.59)	-	-
	ΔGC_t	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.260	(-6.10)	-0.269	(-7.90)	-	-	-0.238	(-5.40)
Interest rates	$\Delta(MR_t - DR_t)$	-	-	-	-	-0.343	(-2.81)	-0.425	(-2.83)	-	-	-	-	-	-	-0.433	(-4.22)	-0.284	(-2.70)	-	-	-	-	-	-
	$\Delta(MR_t - SR_t)$	-	-	-	-	-	-	-	-	-0.254	(-4.03)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$\Delta(CLR_t - DR_t)$	-0.226	(-4.76)	-	-	-	-	-	-	-	-	-0.335	(-5.90)	-	-	-	-	-	-	-0.390	(-7.74)	-0.268	(-5.24)	-	-
	$\Delta(CLR_t - SR_t)$	-	-	-0.253	(-5.99)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.982	(-15.30)	-	-
	$\Delta(LR_t - SR_t)$	-	-	-	-	-	-	-	-	-	-	-	-	-0.222	(-7.10)	-	-	-	-	-	-	-	-	-0.081	(-2.36)
Uncertainty	$\Delta SPF2_t$	-	-	-	-	-	-	-	-	-	-	-	-	-0.583	(-4.76)	-	-	-	-	-	-	-	-	-	-
	$\Delta INFC_t$	-	-	-0.433	(-5.59)	-0.398	(-4.86)	-	-	-0.280	(-2.73)	-0.581	(-7.55)	-	-	-	-	-0.316	(-2.70)	-0.578	(-7.35)	-	-	-0.490	(-3.77)
	$\Delta OILP_t$	-	-	-	-	-	-	-0.005	(-3.81)	-	-	-	-	-	-	-0.005	(-4.92)	-	-	-	-	-0.002	(-2.22)	-	-
Income	ΔLY_t	0.185	(5.52)	**0.251**	(7.60)	*0.260*	(5.31)	0.178	(4.73)	0.211	(5.45)	**0.283**	(7.08)	0.131	(5.84)	0.180	(5.81)	0.196	(5.82)	**0.289**	(7.64)	0.172	(4.97)	*0.193*	(8.62)
	ΔNLY_t	0.174	(11.09)	**0.120**	(7.48)	*0.140*	(6.05)	0.139	(6.19)	0.131	(5.04)	**0.135**	(7.61)	0.185	(9.81)	0.165	(11.09)	0.152	(6.27)	**0.167**	(12.04)	0.163	(11.93)	*0.246*	(9.21)
Wealth	ΔFNW_{t-1}	0.050	(7.78)	**0.033**	(5.02)	**0.039**	(6.40)	0.062	(6.76)	**0.039**	(6.88)	**0.038**	(5.72)	0.042	(6.32)	0.055	(10.12)	**0.025**	(3.61)	**0.024**	(4.45)	0.046	(8.22)	0.024	(4.50)
	ΔNFA_{t-1}	0.064	(3.23)	**0.133**	(4.16)	**0.153**	(6.84)	0.067	(2.30)	**0.118**	(3.49)	**0.165**	(6.73)	0.057	(2.60)	0.055	(2.85)	**0.084**	(2.97)	**0.116**	(4.17)	0.045	(2.89)	0.065	(2.30)
Long run																									
Income	LY_{t-1}	**0.565**	-	**0.555**	-	**0.530**	-	**0.554**	-	**0.542**	-	**0.542**	-	**0.572**	-	**0.543**	-	**0.502**	-	**0.494**	-	**0.553**	-	**0.534**	-
	NLY_{t-1}	**0.318**	(25.00)	**0.308**	(31.51)	**0.316**	(31.86)	**0.294**	(17.66)	**0.318**	(34.31)	**0.307**	(21.84)	**0.283**	(18.52)	**0.303**	(23.90)	**0.322**	(24.89)	**0.313**	(17.11)	**0.302**	(27.47)	**0.307**	(40.35)
Wealth	FNW_{t-2}	**0.086**	(6.64)	**0.100**	(9.21)	**0.112**	(9.26)	**0.125**	(11.86)	**0.106**	(12.91)	**0.110**	(8.07)	**0.120**	(16.66)	**0.128**	(18.12)	**0.152**	(11.11)	**0.166**	(11.46)	**0.122**	(18.06)	**0.134**	(13.57)
	NFA_{t-2}	**0.031**	(7.11)	**0.037**	(6.72)	**0.042**	(6.68)	**0.027**	(3.24)	**0.034**	(5.88)	**0.041**	(6.17)	**0.025**	(5.71)	**0.026**	(5.42)	**0.024**	(5.81)	**0.027**	(3.97)	**0.023**	(4.95)	**0.025**	(5.74)
	R2	0.682		0.736		0.715		0.671		0.727		0.736		0.710		0.681		0.720		0.727		0.696		0.755	
	SE	0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002		0.002	
	J-stat	14.45		13.9		14.21		14.23		14.95		13.35		15.31		14.46		14.78		13.65		14.19		13.87	
	RMSE RW	0.273		0.220		0.248		0.276		0.133		0.324		0.193		0.287		0.148		0.275		0.262		0.273	
	RMSE AR(1)	0.302		0.243		0.274		0.304		0.147		0.357		0.213		0.317		0.163		0.304		0.289		0.302	

This table reports the GMM estimates for the selected consumption equations with the 1st (equations 1 to 11) and 2nd income decomposition (equation 12) together with *t*-statistics shown in brackets. The top two panels show short-run dynamics and long-run coefficients for wealth and income components, respectively. Entries in bold refer to significantly different coefficients for income and wealth components at 1% or 5%, entries in italics refer to significantly different coefficients at 10%. The bottom panel reports adjusted R-squared, standard error, J-statistics, relative RMSEs against Random Walk (RW) and AR(1) for each specification. Δ denotes the first (log) difference, other notations read as follows: CD - loans granted for households; GDP - gross domestic product; GD - government debt; GDEF - government deficit (Δ here indicates a quarterly growth rate); MR - mortgage rate for households; CLR - consumer loan rate; LR - 10-year government bond yield, SR - 3-m EURIBOR rate; DR - deposit rate for households; INFC - annual HICP core inflation; SPF2 - 2-year ahead annual inflation expectations from Survey of Professional forecasters; OILP - real oil prices; LY - labour income; NLY - non-labour income; FNW - financial net worth; NFA - non-financial assets; C - real private consumption; GC - real government consumption.

Table 2. ECM estimates based on the third type of income decomposition

		(1)		(2)		(3)		(4)	
Short run									
Consumption	C_{t-1}	0.271	(11.45)	0.299	(8.38)	0.380	(8.46)	0.305	(10.22)
Other	$\Delta(C)_{t-1}$	-0.211	(-5.66)	-0.255	(-4.79)	-	-	-0.186	(-3.84)
Consumer leverage	-	-							
Government leverage	$\Delta(GD/GDP)_{t-1}$	-	-	-0.115	(-3.45)	-	-	-0.107	(-2.99)
	$\Delta GDEF_t$	-	-	-	-	-0.001	(-2.89)	-	-
	ΔGC_t	-0.161	(-6.50)	-	-	-	-	-	-
Interest rates	ΔLR_t	-0.148	(-6.77)	-	-	-	-	-	-
	$\Delta(MR_t - DR_t)$	-	-	-0.224	(-2.58)	-0.278	(-3.38)	-	-
	$\Delta(MR_t - SR_t)$	-	-	-	-	-	-	-0.266	(-4.61)
Uncertainty	$CINFEXP_t$	-	-	-	-	0.008	(3.16)	-	-
	$\Delta CINFEXP_t$	-	-	0.012	(3.94)	-	-	0.012	(4.01)
	$\Delta OILP_t$	-0.004	(-5.62)	-	-	-	-	-	-
Income	ΔLY_t	**0.205**	(9.07)	**0.180**	(6.07)	**0.150**	(6.35)	**0.136**	(4.22)
	ΔPY_t	**0.078**	(5.10)	**0.035**	(2.40)	**0.085**	(7.65)	**0.047**	(3.71)
	ΔTY_t	**0.045**	(2.97)	**0.071**	(3.50)	0.112	(7.12)	0.111	(5.35)
Wealth	ΔFNW_{t-1}	**0.035**	(9.63)	**0.029**	(4.13)	**0.040**	(6.57)	**0.029**	(5.35)
	ΔNFA_{t-1}	**0.158**	(10.13)	**0.147**	(7.54)	**0.102**	(5.12)	**0.105**	(5.73)
Long run									
Income	LY_{t-1}	**0.388**	-	**0.338**	-	**0.399**	-	**0.392**	-
	PY_{t-1}	**0.206**	(9.99)	**0.254**	(18.01)	**0.196**	(20.49)	**0.214**	(11.97)
	TY_{t-1}	**0.261**	(22.48)	**0.315**	(28.18)	**0.294**	(37.47)	**0.293**	(26.31)
Wealth	FNW_{t-2}	**0.117**	(27.00)	**0.081**	(5.49)	**0.095**	(15.32)	**0.084**	(5.97)
	NFA_{t-2}	**0.028**	(4.75)	**0.012**	(2.65)	**0.016**	(4.50)	**0.017**	(3.66)
	R2	0.709		0.711		0.694		0.711	
	SE	0.002		0.002		0.002		0.002	
	J-stat	15.45		15.68		15.06		15.07	
	RMSE RW	0.198		0.320		0.195		0.316	
	RMSE AR(1)	0.219		0.354		0.216		0.349	

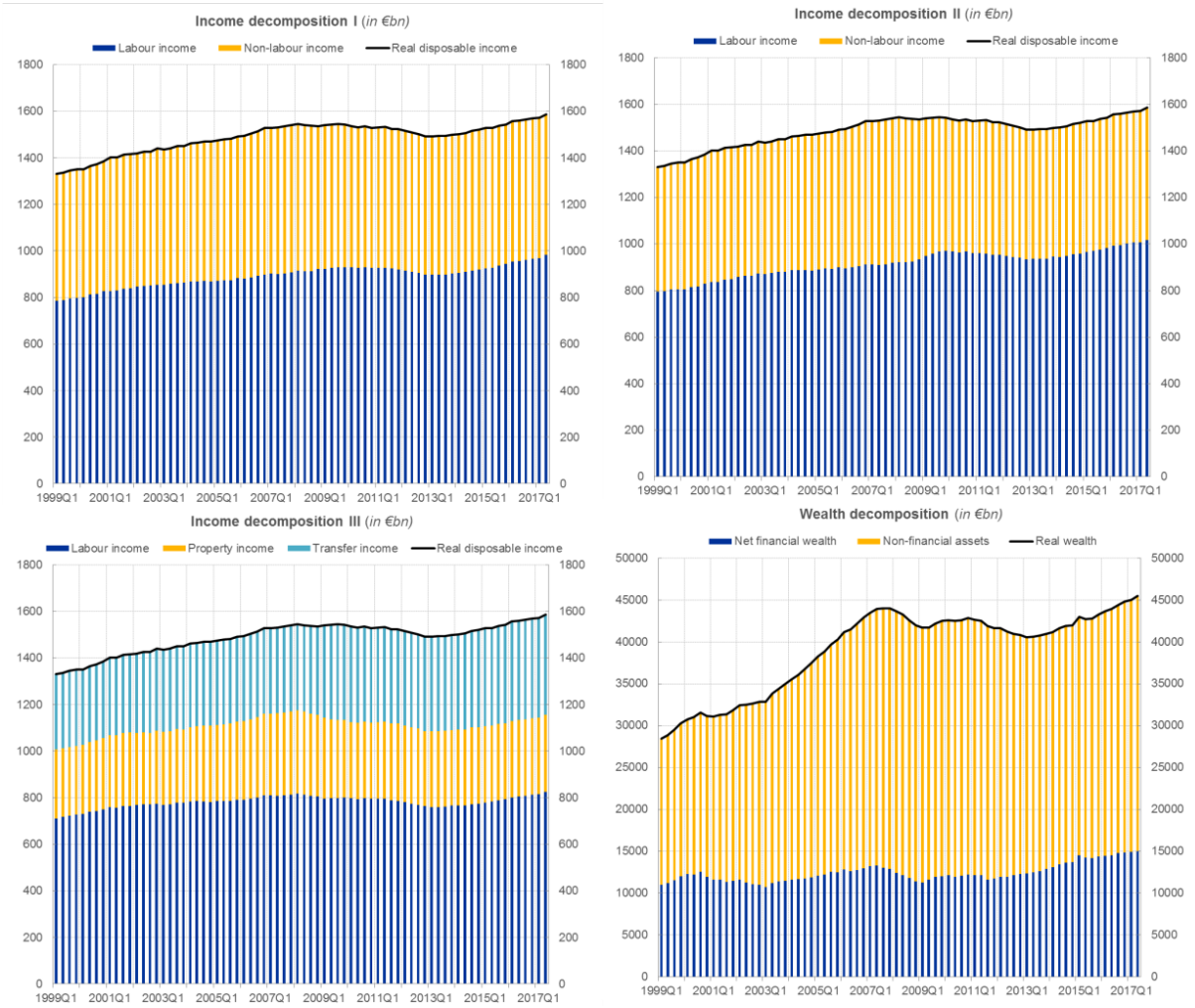
This table reports the GMM estimates for the selected consumption equations with the 3rd income decomposition together with *t*-statistics shown in brackets. The top two panels show short-run dynamics and long-run coefficients for wealth and income components, respectively. Entries in bold refer to significantly different coefficients for income and wealth components at 1% or 5%, entries in italics refer to significantly different coefficients at 10%. The bottom panel reports adjusted R-squared, standard error, J-statistics, relative RMSEs against Random Walk (RW) and AR(1) for each specification for each specification. Δ denotes the first (log) difference, other notations read as follows: GDP - gross domestic product; GD - government debt; GDEF - government deficit (Δ here indicates a quarterly growth rate); MR - mortgage rate for households; LR - 10-year government bond yield, SR - 3-m EURIBOR rate; DR - deposit rate for households; CINFEXP - inflation expectations from european Commision Consumer survey; OILP - real oil prices; LY - labour income; PY - property income; TY - transfer income; FNW - financial net worth; NFA - non-financial assets; C - real private consumption; GC - real government consumption.

Table 3. Average long-run elasticities and marginal propensities to consume

	Average elasticity	*MPC*
Income decomposition (I) and (II)		
LY	**0.54**	**78.99**
NLY	**0.31**	**66.87**
FNW	**0.12**	**1.27**
NFA	**0.03**	**0.15**
Income decomposition (III)		
LY	**0.38**	**63.21**
PY	**0.22**	**86.77**
TY	**0.29**	**99.52**
FNW	**0.09**	**0.99**
NFA	**0.02**	**0.09**

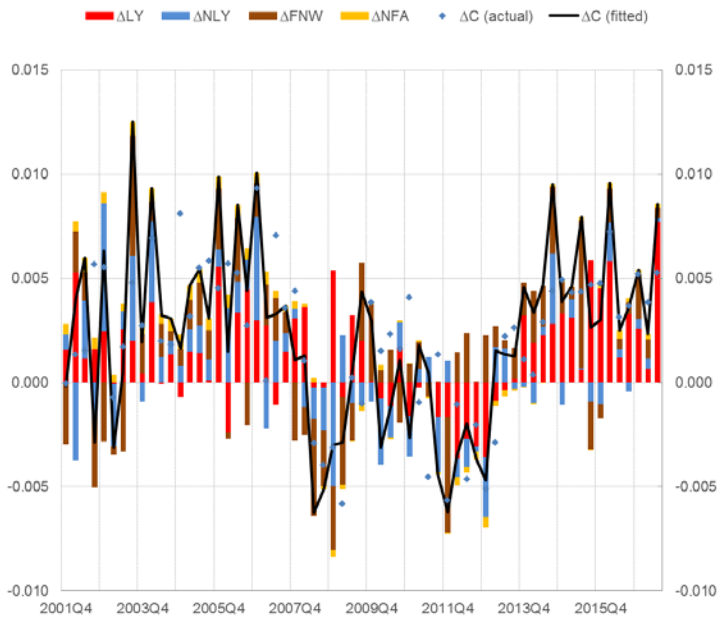
This table reports average long-run elasticities and marginal propensities to consume out of labour (LY), non-labour (NLY), property (PY), and transfer (TY) income, financial net wealth (FNW) and non-financial assets (NFA). The estimates based on equations with the 1st and 2nd income decomposition are shown in the top panel, while the bottom panel reports estimates based on equations with the 3rd income decomposition. MPC figures are reported in euro cents (100**elasticity**C/X, where C is the level of real consumption and X is a relevant income/wealth variable).

Chart 1. Income and wealth decompositions



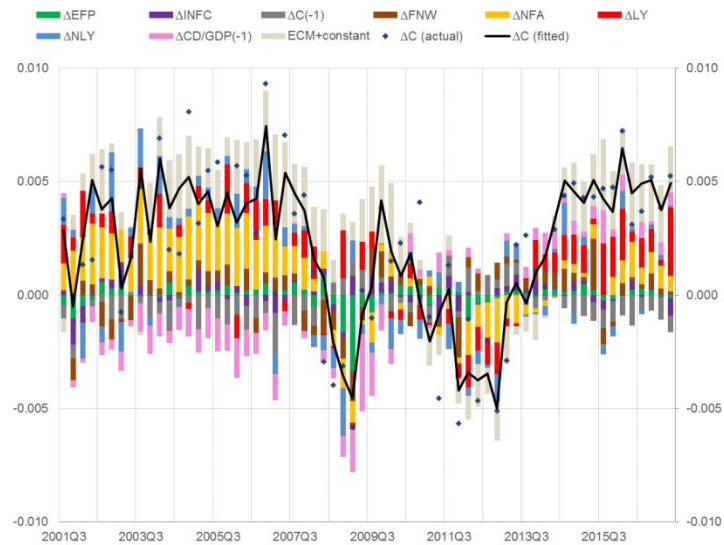
Notes: this chart plots total disposable income and contributions from its labour and non-labour components based on three decomposition approaches (top two panels and bottom left panel) as well as total wealth and contributions from its financial and non-financial wealth over the period 1999Q1 – 2017Q2 (all in €bn).

Chart 2. Contributions to consumption growth based on long-run elasticities



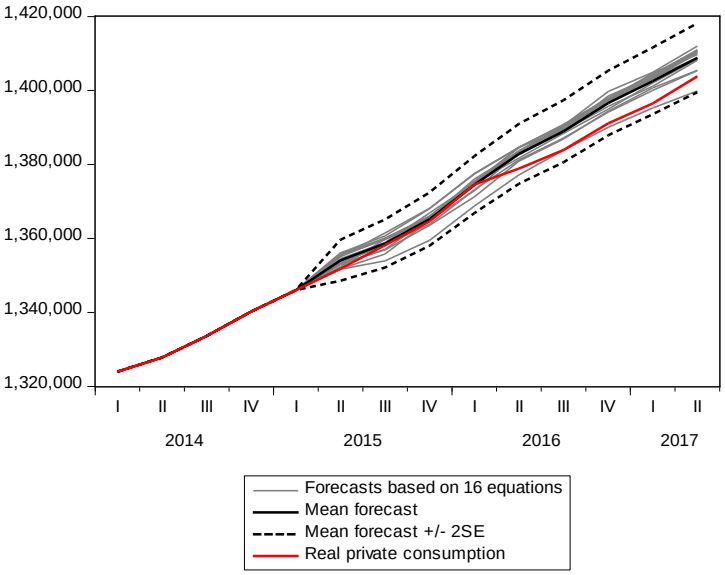
Notes: this chart plots actual and fitted quarterly growth rates of consumption together with contributions from labour (LY) and non-labour (NLY) income as well as from financial net wealth (FNW) and non-financial assets (NFA). The contributions are calculated based on average long-run elasticities from the estimated equations with income decomposition I and II (as reported in Table 3).

Chart 3. Contributions to consumption growth based on the full model



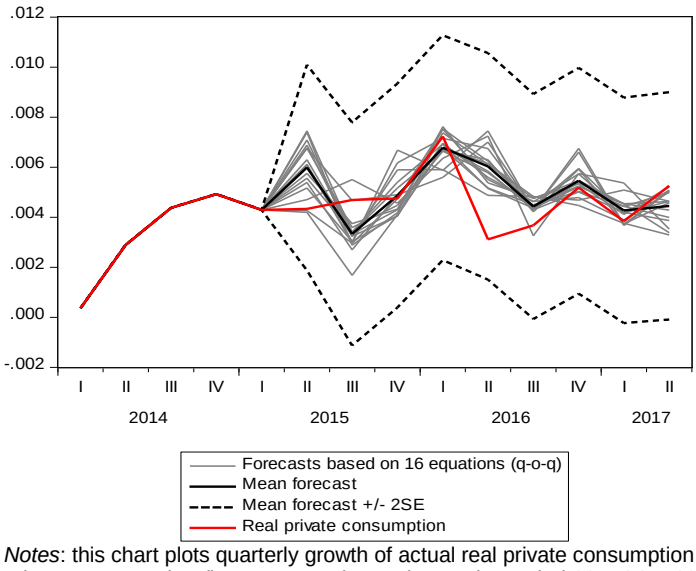
Notes: this chart plots actual and fitted quarterly growth rates of consumption (C) together with contributions from changes in: external finance premium measured as the difference between mortgage rate for households and 3-m EURIBOR rate (EFP), HICP inflation excluding energy and food (INFC), lagged (C), lagged consumer loans to GDP ratio (CD/GDP), labour (LY) and non-labour income (NLY), financial net wealth (FNW) and non-financial assets (NFA); as well as contributions from the ECM term and a constant. The contributions are calculated based on average long-run elasticities from the estimated equations with income decomposition I and II (as reported in Table 3).

Chart 4. Pseudo out-of-sample forecasts of euro area private consumption



Notes: this chart plots the level of actual real private consumption (in €m) together with the mean forecast and individual forecasts of private consumption (in levels) over the period 2015Q2 – 2017Q2 based on the 16 selected ECM equations estimated during 2001Q3 – 2015Q1.

Chart 5. Pseudo out-of-sample forecasts of euro area private consumption growth



Notes: this chart plots quarterly growth of actual real private consumption together with the mean forecast and individual forecasts of private consumption (in q-o-q growth rates) over the period 2015Q2 – 2017Q2 based on the 16 selected ECM equations estimated during 2001Q3 – 2015Q1.